



## EFFECT OF FYM AND N FERTILIZER ON PHOTOSYNTHETIC PARTITIONING PARAMETERS, YIELD AND YIELD ATTRIBUTES OF MAIZE-SOYBEAN INTERCROPPING

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### ABSTRACT

Two field experiments were carried out at Menia Al-Kamh district- Sharkia province during two summer successive growing seasons i.e. 2009 and 2010 to study the effect of FYM (Without, 20 and 40 m<sup>3</sup>/fad) and nitrogen fertilizer levels (Without, 45, 90 and 135 kg N/fad) on photosynthetic partitioning parameters, yield and yield attributes of maize (*Zea mays* L.) – soybean (*Glycine max* (L.) Merr.) intercrops. Soybean variety Giza-22 was sown at 93,333 plants/fad in pure stand and intercropping whereas, maize variety TWC 324 was sown at 23,333 plants/fad as pure stand and intercropping (3:3) system. Maize was planted in intercropping culture on one side and two plants / hill (46,666 plants/fad) instead of one plant/hill in solid plots (23,333 plants/fad), simultaneously, soybean was always sown and thinned as two plants/hill, 10 cm apart on the two sides of the ridge in intercropping culture (186.666 plants/fad) instead of one side of the ridge in the solid plots. Intercropping system significantly reduced Photosynthetic partitioning parameters (such as, relative photosynthetic potential for grain yield/plant (RPP<sub>grains</sub>), for biological yield/plant (RPP<sub>bio</sub>) and migration coefficient (MC), but doubling LAI for maize and soybean components. Also, intercropping significantly reduced each of number of ears/plant, ear weight/plant, grain weight/plant, grain and biological yields (ton/fad) as well as HI and number of branches and pods/plant, seed weight/plant, pod yield (kg/fad), seed index as well as seed and biological yields (kg/fad.) of maize and soybean components compared to the pure stand, (combined analysis). FYM application up to 40 m<sup>3</sup> followed by increasing Photosynthetic partitioning parameters of maize and soybean components except LA, LAI and MC which responded to FYM up to 20 m<sup>3</sup>/fad for soybean component. Also, addition of FYM up to 40 m<sup>3</sup>/fad., significantly increased all yield and yield attributes of both components. Otherwise, seed index and HI of maize and biological yield of soybean were significantly increased due to applying FYM up to 20 m<sup>3</sup>/fad. While, HI of soybean was significantly decreased due to increment of FYM (combined analysis). Applying of N up to 135 kg N/fad significantly increased all aforementioned traits of maize and soybean components except HI of soybean which was decreased due to increments of N level (combined analysis).

**Keywords:** Soybean-maize intercropping, FYM, LAI, HI, migration coefficient, (RPP<sub>grains</sub>).

### INTRODUCTION

Intercropping is a way to increase the productivity/land unit area. The situation becomes clearer in the developing nations. Where to day, Egypt suffers from acute shortage in vegetable oils. Panhwar *et al.* (2004) revealed that intercropping of soybean in maize rows did not show any adverse effect on maize plant height,

1000-grain weight as well as grain yield of maize. However, maize under monoculture recorded greater grain yield/ha. Soybean planted alone gave better performance in respect of seed yield/ha and yield contributing parameters. While, seed and other yield contributing parameters of soybean were significantly affected in intercrop treatments due to competition with main crop. Solank *et al.* (2011) recorded that maize +

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soybean intercropping accumulated higher dry matter at each stage which than solid cropping system. Grain yield of maize was significantly reduced by 17.3 and 12.6% during 2007 and 2008 seasons, respectively as compared with that of solid maize. Undie *et al.* (2012) reported that intercropping maize with soybean reduced maize LAI below its sole crop values. Similarly, soybean number of branches/plant and seed yield reduced below their sole crop values when intercropped with maize.

Adu- Gyanfi *et al.* (2007) stated that, when N fertilizer was added to the field of intercrops, legumes use the inorganic N instead of fixing N from the air and thus compete with maize for N. However, when nitrogen fertilizer is not applied, intercropped legumes will fix most of their N from the atmosphere and not compete with maize for N. Khan *et al.* (1999) found that, various organic and inorganic nitrogen treatments, significantly affected all parameters except no. of grains / cob. Farmyard manure application at 20 ton/ha combined with 60 kg N/ha /formed better than all other treatments and resulted taller plants, heavier 1000-grain weight, greater leaf area index, grain and biological yields. Shanwad *et al.* (2010) found that, applications of FYM at (75 T/ha + 100% recommended dose of fertilizers NPK) recorded significantly higher maize yield (6348 kg/ha).

Watson (1952) stated that, N had far more potent influence on the total photosynthesis of plants through its effect on the leaf area and all these might have cumulatively produced higher grain yield under the highest level of N. Tijani *et al.* (2000) showed that, plant height and leaf area indices were significantly increased for both maize and soybean from 6 weeks after sowing by the application of N fertilizer. Also, fertilizer increased dry matter by 17% at 50% flowering in soybean and by 11% at 50% silking in maize. Grain yield was increased by 32% due to the application of 30 kg N/ha in soybean. They added that, highest grain yield of maize (3.25 t/ha) was obtained from 60 kg N dose. Shivay and Singh (2003) found that, LAI of soybean was higher when N at 40 kg/ha, was applied compared with that of control. In general, the yield attributing parameters (plant height, branches/plant, pods/plant, seeds/pod, seed weight/plant, 1000-seed weight) and yield

increased with increasing N up to 40 kg/ha in soybean. The highest seed protein content was recorded with N at 80 kg/ha for soybean. Mbah *et al.* (2007) revealed that, applying fertilizer significantly increased the yield of the component crops than no fertilization. Undie *et al.* (2010) found that, application of 100 kg N/ha to maize, increased 100-grain weight, cob yield and grain yield by 46, 95, 35, 138 and 153%, in the same follow order in 2007 and by 15, 63, 48, 88 and 109%, respectively in 2008, over no nitrogen application. Similarly, application of 100 kg N/ha to soybean increased no. of pods/plant and 1000-seed weight by 53 and 16% respectively in 2007 and by 55 and 14%, respectively in 2008 over no nitrogen application. Undie *et al.* (2012) reported that, N application up to 100 kg/ha, increased number of branches in soybean and LAI in maize. Seed yield in soybean responded optimally at 50 kg N/ha. Thus, the objective of this investigation was to study the effect of FYM and N fertilizer levels on Photosynthetic partitioning parameters, yield and yield attributes of maize – soybean intercropping.

## MATERIALS AND METHODS

Two field experiments were conducted on administration field in Menia Al-Kamh district-Sharkia Governorate, during two successive summer seasons (2009 and 2010) to study the effect of FYM and N fertilizer levels on Photosynthetic partitioning, yield and yield attributes of maize (*Zea mays* L.) – soybean (*Glayscale max* (L.) Merr.). The soil was clay in texture and had an average of 125.5, 21.5 and 224.5 ppm for N, P and K during the two seasons. Farmyard manure had an average of 1.3 and 1.28 % for N and 26.3 and 25% for organic matter during the two seasons, respectively. In maize – soybean intercrop, each crop planted separately as a solid stand and in association by using 3:3 intercropping system i.e. growing three ridges of maize in alternation with three ridges of soybean. For those two planting patterns, ridge width was 90 cm. in solid plantings as well as intercropped patterns; the two crops were planted in one side of the ridge. Whereas, soybean was planted on both sides in intercropping pattern but on one side in solid planting. Here, the distances between and within ridges are the same in both sowings i.e. 20 x 90 cm

for maize and 10 x 90 cm for soybean. However, each hill contained two plants in all cases of the intercrops, except sole maize (one plant/hill). Thus, total population percentages reach 200% in 3:3 cropping system (100% component population of each crop). Seeds of soybean and maize were sown when soil moisture was adequate for germination i.e. (14 May and 6 June) and (10 and 30 May) in 2009 and 2010 seasons, for the two crops in sole planting and intercropping system, respectively. After three weeks from soybean sowing, maize grains were planted in solid as well as intercropping planting. The plants were thinned into one plant / hill after 21 days for maize and into two plants / hill for soybean after 30 days from planting.

A split-split plot design with three replications was used. Thirty six treatments were applied i.e. combination of three planting patterns, three farmyard manure rates and four nitrogen levels. Where, the planting patterns occupied the main plots for solid and intercropped plantings. The farmyard manure was arranged in 1<sup>st</sup> order sub-plots, the 2<sup>nd</sup> order sub plots were devoted to the four nitrogen fertilizer levels. Each sub-sub plot included six ridges, 3m long. Thus, the plot area was 16.2 m<sup>2</sup>.

The different treatments were: A- Three planting patterns 1-Pure stand of maize sown in hills, 20 cm apart (23,333 plants/fad) on one side of the ridge and one plant/hill (100% component population). 2- Pure stand of Soybean sown in hill, 10 cm apart (93,333 plants/fad) on one side of the ridge and two plants/hill. (100% component population). 3- Intercropping of three ridges of soybean in alternation with three ridges of maize (one side, two plants/hill). While, soybean present on both sides, two plants/hill. Thus, 3:3 cropping system gives 200% total population i.e. 100% from each component crop.

B- Three levels of farmyard manure (without addition, 20 m<sup>3</sup>/fad. and 40 m<sup>3</sup>/fad).

C- Four levels of mineral Nitrogen: (without addition, 45 kg / fad., 90 kg / fad. and 135 kg /fad.) were applied to sole and intercropped maize and soybean at form of urea (46.5% N) in three doses added at 20, 30, 40 days after planting.

In this cropping system, both Giza 22 soybean cultivar and TWC 324 maize cultivar

were used. Soybean seeds were inoculated with specific bacteria (*Bradyrhizobium japonicum* L.) at sowing time. The preceding crop was Egyptian clover (*Trifolium alexandrinum* L.) in the two seasons. A basal dose of P and K, corresponding to 30 kg P<sub>2</sub>O<sub>5</sub> as super phosphate (15.5% P<sub>2</sub>O<sub>5</sub>) and 24 kg K<sub>2</sub>O as potassium sulfate (50% K<sub>2</sub>O) were uniformly broadcasted at the time of seedbed preparation. Maize and soybean component crops were harvested at September 14<sup>th</sup> and 24<sup>th</sup> in the first season, and 10<sup>th</sup> and 17<sup>th</sup> in second one, respectively. Other agronomic practices were completed similar to that prevailing in the region.

### Photosynthetic Partitioning Parameters

Sample of 6 guarded plants was taken from each treatment at silking of maize (60 DAP) and at flowering of soybean (55 DAP) to estimate: 1- Leaf area / plant (dm<sup>2</sup>). In maize leaf area was determined using the formula according to Saxena and Singh (1965). In soybean leaf area / plant was determined with the help of dry weight of 50 disks (1cm diameter) taken from leaves, according to the total leaves dry weight and the dry weight of 50 leaf disks, leaf area / plant was calculated. 2- Leaf area index (LAI) was determined according to formula suggested by Watson (1952). 3- Relative photosynthetic potential for grain or seed yield / plant.  $RPP_{g-s} = \text{Grain or seed yield} / \text{plant (g)} / \text{LAI}$ . 4- Relative photosynthetic potential for biological yield / plant.  $RPP_{bio} = \text{biological yield} / \text{plant (g)} / \text{LAI}$ . 5- Relative photosynthetic potential for vegetative yield / plant.  $RPP_{veg} = RPP_{bio} - RPP_{g-s}$ . The values of RPP of seed, grain and biological yields / plant at harvest were calculated according to the procedure documented by Vidovic and Pokorny (1975). 6- Migration coefficient (MC) for maize = Ears dry weight / plant (g) / Biological yield / plant (g) at harvest. Migration coefficient (MC) for soybean = Pods dry weight / plant (g) / Biological yield / plant (g) at harvest. Such parameter was estimated as mentioned by McGraw (1977).

### Yield and Yield Attributes

At harvest, the central ridge of each component crop was used to determine the yield and its components. For solid and intercropped maize, components were number of ears / plant,

ear weight / plant, grain weight / plant, hundred grain weight (g), grain yield (ton / fad), biological yield (ton / fad) and harvest index (HI): (HI = Grain yield / fad. / Biological yield / fad.) HI was calculated according to Abdel-Gawad, *et al.* (1987). Grain yield was adjusted to a constant moisture content of 15%. Soybean components were: number of branches / plant, number of pods / plant, pod yield (kg / fad), seed weight / plant, seed index, seed yield (kg / fad), biological yield (kg / fad) and harvest index. The obtained data were statistically analyzed according to Steel *et al.* (1997). Least significant differences were used for the comparison between means. Means having the same letters are not significantly different. A combined analysis was made for the data of the two seasons. In interaction tables capital and small letters were used for comparisons among means of rows and columns, respectively.

## RESULTS AND DISCUSSION

### Photosynthetic Partitioning Parameters of Maize Component

Leaf area / plant ( $\text{dm}^2$ ), leaf area index, relative photosynthetic potential for grain yield/plant ( $\text{RPP}_g$ ), biological yield/plant ( $\text{RPP}_b$ ) and migration coefficient (MC) for maize as affected by intercropping, FYM and N-fertilization in both seasons and their combined analysis are presented in Tables 1 and 3. Data recorded in both seasons and their mean demonstrate that intercropping system had no significant effect on plant LA during both seasons and their combined analysis. Relative photosynthetic potential for grain yield/plant ( $\text{RPP}_{\text{grains}}$ ) and biological yield/plant ( $\text{RPP}_{\text{bio}}$ ) of maize component reduced by intercropping compared to the pure stand during both seasons and their combined analysis. Although, intercropping system had the same plant population density on half the area as compared with solid planting system and resulted in the same leaf area / plant. These results suggest that, the combined leaf canopy or root system may make greater and / or better use of light and N particularly under this system of intercropping, than when the same component crops are grown separately. But, the intercropping exerted no significant effect on LA / plant  $\text{dm}^2$  and migration coefficient (MC) during both seasons and their

combined. Results of combined analysis indicate that, plants fertilized with FYM up to  $40\text{m}^3$  / fad had higher values of leaf area / plant ( $\text{dm}^2$ ), leaf area index, relative photosynthetic potential for grain yield/plant ( $\text{RPP}_g$ ) and biological yield/plant ( $\text{RPP}_b$ ) as compared with the zero level of FYM. The differences among the three levels of FYM treatments did not reach the level of significance on migration coefficient (MC) during both seasons and their combined. Applying N- fertilizer up to  $135\text{ kg N}$  / fad caused significant increases in leaf area / plant ( $\text{dm}^2$ ), leaf area index, relative photosynthetic potential for grain yield ( $\text{RPP}_g$ ) and biological yield/plant ( $\text{RPP}_b$ ). Hence, the variation in photosynthetic partitioning parameters due to different levels of N was related to the differences in size of photosynthetic surface and to the relative efficiency of total sink activity. Similar results were reported by Patel *et al.* (2006); Undie *et al.* (2012). In meantime, Watson (1952) stated that, N had far more potent influence on the total photosynthesis of plants through its effect on the leaf area and all these might have cumulatively produced higher grain yield under the highest level of N.

As shown in the combined analysis, the interactions effects between planting patterns and N fertilizer levels on LAI,  $\text{RPP}_g$  and on migration coefficient (MC) of maize and planting patterns and FYM levels on  $\text{RPP}_g$  of maize and migration coefficient of soybean and the interaction effect between FYM and N fertilizer levels on MC of maize were significant. But, no additional information could be obtained other than the main effects. Therefore, interaction tables are not discussed.

### Photosynthetic Partitioning Parameters of Soybean Component

Leaf area / plant ( $\text{dm}^2$ ), leaf area index, relative photosynthetic potential for seed yield ( $\text{RPP}_s$ ) and biological yield/plant ( $\text{RPP}_b$ ), as well as, migration coefficient (MC) for soybean component as affected by intercropping, FYM and N- fertilization are presented in Tables 2 and 3. Total leaf area of soybean plant reduced by about 13.46% under intercropping culture than solid planting (100%); this may be due to doubling plant density under intercropping than that of solid pattern. But, the converse was true with LAI (see Table 2).

**Table 1. Leaf area / plant (dm<sup>2</sup>), leaf area index (LAI), relative photosynthetic potential for grain (RPP<sub>grains</sub>) and biological yield/plant (RPP<sub>bio</sub>) of maize as affected by planting patterns, FYM and N- fertilization in both seasons and their combined analysis.**

Main effects and interactions	Leaf area/plant dm <sup>2</sup>			LAI			RPP <sub>grains</sub>			RPP <sub>bio</sub>		
	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.
<b>Planting Patterns (P):</b>												
Solid planting	68.26	75.83	72.05	3.79	4.22	4.00	80.52	70.89	75.70	258.79	226.88	242.83
Intercropping	68.08	73.79	70.94	7.53	8.19	7.87	36.79	31.87	34.83	123.46	109.77	116.62
F-test	N.S.	N.S.	N.S.	**	**	**	**	**	**	**	**	**
<b>FYM levels (F): (m<sup>3</sup>/fad.)</b>												
Without	66.54 b	72.92 c	69.73 c	5.56 b	6.05 c	5.80 c	57.23	48.54 b	53.63 b	188.51 b	165.17 c	176.84 b
20	67.49 b	74.93 b	71.21 b	5.61 ab	6.22 b	5.92 b	59.20	41.73 c	55.47 ab	189.21 b	167.68 b	178.44 b
40	70.49 a	76.59 a	73.54 a	5.82 a	6.35 a	6.09 a	59.53	53.88 a	56.70 a	195.66 a	172.13 a	183.89 a
F-test	*	**	**	*	**	**	N.S.	**	**	**	*	**
<b>N-fertilization N: (kg N/fad.)</b>												
Without	64.55 c	68.42 d	66.48 d	5.38 c	5.68 d	5.53 d	56.06 d	50.23	53.15 c	183.71 c	168.58	176.14 c
45	66.71 c	73.10 c	69.91 c	5.55 bc	6.08 c	5.81 c	58.84 c	52.29	55.57 b	190.47 b	167.72	179.09 b
90	68.99 b	77.00 b	72.99 b	5.75 ab	6.39 b	6.07 b	59.35 b	52.09	55.72 ab	193.44 ab	167.16	180.30 b
135	72.44 a	80.73 a	76.59 a	5.98 a	6.68 a	6.33 a	60.36 a	50.92	56.64 a	196.89 a	169.85	183.37 a
F-test	**	**	**	*	**	**	**	N.S.	**	**	N.S.	**
<b>Interactions:</b>												
P x F	N.S.	N.S.	N.S.	N.S.	**	N.S.	N.S.	N.S.	**	**	N.S.	N.S.
P x N	N.S.	N.S.	N.S.	N.S.	**	**	*	N.S.	**	**	N.S.	N.S.
F x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	N.S.	N.S.

N.S., \* and \*\*, not significant, significant at 0.05 and 0.01 levels, respectively. FYM: farmyard manure, Faddan= 4200 m<sup>2</sup>.

**Table 2. Leaf area / plant (dm<sup>2</sup>), leaf area index (LAI), relative photosynthetic potential for seed (RPP<sub>seeds</sub>) and biological yield/plant (RPP<sub>bio</sub>) of soybean as affected by planting patterns, FYM and N- fertilization in both seasons and their combined analysis.**

Main effects and interactions	Leaf area/plant dm <sup>2</sup>			LAI			RPP <sub>seeds</sub>			RPP <sub>bio</sub>		
	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.
<b><u>Planting Patterns (P):</u></b>												
Solid planting	15.87	16.50	16.18	1.76	1.83	1.79	15.80	15.00	15.47	52.81	55.89	54.35
Intercropping	14.04	14.46	14.25	3.12	3.23	3.18	7.32	7.35	7.34	22.68	22.72	22.69
F-test	*	*	**	**	**	**	**	**	**	**	**	**
<b><u>FYM levels (F): (m<sup>3</sup>/fad.)</u></b>												
Without	14.25 b	14.18 c	14.22 b	2.36 b	2.33 c	2.34 b	10.84 b	11.54	11.29 b	40.18	39.98	40.08
20	15.71 a	15.46 b	15.58 a	2.55 a	2.52 b	2.53 a	10.88 b	11.11	10.99 b	34.86	39.96	37.41
40	14.91 b	16.82 a	15.86 a	2.42 b	2.74 a	2.58 a	12.96 a	10.89	11.93 a	38.20	37.96	38.08
F-test	**	**	**	*	**	**	**	N.S.	**	N.S.	N.S.	N.S.
<b><u>N-fertilization N: (kg N/fad.)</u></b>												
Without	12.68 d	12.76 d	12.72 d	2.04 d	2.06 d	2.05 d	11.23 c	10.15 d	10.82 b	34.65 c	34.81 b	34.73 c
45	14.34 c	14.71 c	14.53 c	2.34 c	2.39 c	2.37 c	10.86 d	10.52 cd	10.69 b	35.01 c	37.48 b	36.24 c
90	15.63 b	16.37 b	16.01 b	2.57 b	2.71 b	2.64 b	12.69 a	11.18 bc	11.94 a	38.43 b	41.33 a	39.88 b
135	17.16 a	18.09 a	17.63 a	2.82 a	2.96 a	2.89 a	11.46 bc	12.87 a	12.17 a	42.89 a	43.59 a	43.24 a
F-test	**	**	**	**	**	**	**	**	**	**	**	**
<b><u>Interactions:</u></b>												
P x F	*	*	**	N.S.	N.S.	N.S.	N.S.	N.S.	**	**	*	**
P x N	**	N.S.	N.S.	**	**	N.S.	N.S.	**	**	**	*	**
F x N	**	N.S.	*	N.S.	N.S.	N.S.	N.S.	N.S.	**	**	N.S.	N.S.

N.S., \* and \*\*, not significant, significant at 0.05 and 0.01 levels, respectively. FYM: farmyard manure, Faddan= 4200 m<sup>2</sup>.

**Table 3. Migration coefficient (MC) for maize and soybean as affected by planting patterns, FYM and N- fertilization in both seasons and their combined analysis.**

Main effects and interactions	Maize			Soybean		
	2009	2010	Comb.	2009	2010	Comb.
<b>Planting Patterns (P):</b>						
Solid planting	0.341	0.341	0.341	0.629	0.595	0.612
Intercropping	0.347	0.345	0.346	0.567	0.582	0.575
F-test	N.S.	N.S.	N.S.	N.S.	N.S.	*
<b>FYM levels (F): (m<sup>3</sup>/fad.)</b>						
Without	0.341	0.346	0.344	0.560 b	0.575	0.567 b
20	0.348	0.344	0.346	0.606 a	0.590	0.598 ab
40	0.343	0.338	0.341	0.628 a	0.602	0.615 a
F-test	N.S.	N.S.	N.S.	*	N.S.	*
<b>N-fertilization N: (kg N/fad.)</b>						
Without	0.344 b	0.339 c	0.341 b	0.589	0.600	0.595
45	0.347 a	0.346ab	0.346 a	0.598	0.582	0.590
90	0.344 b	0.348 a	0.346 a	0.599	0.566	0.582
135	0.341 b	0.340bc	0.341 b	0.606	0.607	0.606
F-test	**	**	**	N.S.	N.S.	N.S.
<b>Interactions:</b>						
P x F	N.S.	N.S.	N.S.	N.S.	N.S.	*
P x N	**	**	**	N.S.	N.S.	N.S.
F x N	**	N.S.	**	N.S.	N.S.	N.S.

N.S., \* and \*\*, not significant, significant at 0.05 and 0.01 levels, respectively. FYM: farmyard manure, Faddan= 4200 m<sup>2</sup>

Solid planting surpassed intercropping in relative photosynthetic potential for seed yield/plant (RPP<sub>s</sub>) and biological yield/plant (RPP<sub>b</sub>) during both seasons and their combined analysis; this may be due to higher values of LAI of intercropping pattern. With respect to FYM effect: it would appear that, Leaf area / plant (dm<sup>2</sup>), leaf area index and migration coefficient of soybean component tended to increase with adding FYM up to 20 m<sup>3</sup>/fad; but relative photosynthetic potential for seed yield/plant (RPP<sub>s</sub>) significantly increased when 40 m<sup>3</sup>/fad; FYM were applied. Regarding N fertilization effect it was found that, applying N up to 135kg/fad followed by a significant increase in Leaf area / plant (dm<sup>2</sup>), leaf area index, relative photosynthetic potential for seed yield/plant (RPP<sub>s</sub>) and for biological yield/plant (RPP<sub>b</sub>) as compared with the control treatment during two seasons and combined mean. N levels had no significant effect on migration coefficient (MC) during both seasons and their

combined analysis. It was observed that, N application significantly influenced relative photosynthetic potential for seed yield/plant (RPP<sub>s</sub>), biological yield/plant (RPP<sub>b</sub>), chiefly by increasing leaf area / plant (dm<sup>2</sup>) and leaf area index. Hence, the variation in photosynthetic partitioning parameters due to different levels of N was related to the differences in size of photosynthetic surface and to the relative efficiency of total sink activity. The obtained results were in accordance with those reported by Patel *et al.* (2006); Undie *et al.* (2012).

As shown in the combined analysis, the interactions effects between planting patterns and FYM levels on leaf area/plant, RPPs and RPP<sub>bio</sub>, planting patterns and N fertilizer levels on RPPs and RPP<sub>bio</sub> and FYM levels and N fertilizer levels on RPPs of soybean were significant. But, no additional information could be obtained other than the main effects. Therefore, interaction tables are not discussed.

### Yield and Yield Attributes of Maize Component

Number of ears/plant, ear weight/plant, grain weight/plant, seed index, grain and biological yields (ton/fad) and HI of maize component as affected by intercropping, FYM and N-fertilization in both seasons and their interactions are presented in Tables 4 and 5. It is obvious that, number of ears/plant, ear weight/plant, grain weight/plant and harvest index, as well as, grain and biological yields (ton / fad) were greater for solid planting than those of intercropping system, because plants were grown under competition of doubling densities under intercropping as compared with solid in general. Furthermore, these results suggested that, the leaf canopy and root system may make greater and/or better to use light and N particularly under this system of intercropping, than when the same component crops are grown separately. The results are in a good connection with those reported by Ghosh *et al.* (2004); Metwally *et al.* (2009) and Solank *et al.* (2011). Data obtained show that, application of FYM up to 40 m<sup>3</sup>/fad significantly increased aforementioned traits except grain and harvest indices which responded to FYM up to 20 m<sup>3</sup>/fad during both seasons and their combined. This favorable effect of FYM may be attributed to improving soil physical, chemical and biological properties to better aforementioned traits, besides providing essential nutrients to the crop. These results are in accordance with those obtained by Badr and Othman (2006). Khan *et al.* (1999) found that, FYM application up to 20 ton/ha combined with 60 kg N/ha formed better than all other treatments and resulted higher 1000-grain weight and greater grain and biological yields. Regarding N fertilization effect, adding N up to the highest level (135 kg N/fad), significantly increased all aforementioned traits during two seasons and their combined analysis. These results are in agreement with those obtained by Tijani *et al.* (2000); Morgado and Willey (2003); Shivay and Singh (2003); Panhwar *et al.* (2004); Ayoola and Adeniyani (2006); Patel *et al.* (2006); Mbah *et al.* (2007) and Meena *et al.* (2007). Meantime, Undie *et al.* (2010), they found that application of 100 kg N/ha to maize increased No. of ears/plant, cob length, 100-grain weight, cob and grain yields over no nitrogen application.

In the same mention, Ayoola and Makinde (2007) reported that, maize performed best in terms of growth and yield with complementary application of inorganic and organic fertilizers.

As shown in the combined analysis, the interactions effects between planting patterns and FYM levels on grain weight/plant and harvest index, planting patterns and N fertilizer levels on number of ears/plant, grain weight/plant and 100 grain weight and FYM levels and N fertilizer levels on ear weight/plant and grain weight/plant were significant. But, no additional information could be obtained other than the main effects. Therefore, interaction tables are not discussed.

### Yield and Yield Attributes of Soybean Component

Number of branches and pods / plant, seed yield/plant, pod yield (kg/fad.), seed index, seed and biological yields (kg/fad.) and harvest index of soybean component as affected by intercropping, FYM and N- fertilization in both seasons and their combined analysis are presented in Tables 6 and 7. It is obvious that, all aforementioned traits were greater in solid planting than in intercropping system.

These results are similar to those obtained by Panhwar *et al.* (2004); Mbah *et al.* (2007); Meena *et al.* (2007) and Metwally *et al.* (2009). Data obtained (Tables 6 and 7) show that, application of FYM up to 40 m<sup>3</sup>/fad caused significant increases in each of number of branches, pods/plant, pod yield (kg / fad), seed yield/plant and seed yield (kg/fad) during the two seasons and pooled data, except seed index in 2<sup>nd</sup> season only, and up to 20 m<sup>3</sup> for biological yield (kg/fad). But harvest index significantly reduced with increment of FYM up to 40 m<sup>3</sup>/fad during both seasons and their combined. These results are similar to those obtained by Ayoola and Adeniyani (2006); Badr and Othman (2006) and Khan *et al.* (1999). Regarding N fertilization effect, adding N up to the highest level (135kg N/fad) significantly increased all aforementioned traits during the two seasons and their combined analysis. Except HI trait which significantly reduced due to applying N up to 135 kg N/fad. Increase in various plant growth characters such as leaf area, LAI, total

**Table 4. Number of ears / plant, ear weight / plant (g) and grain weight / plant (g) of maize as affected by planting patterns, FYM and N-fertilization in both seasons and their combined analysis.**

Main effects and interactions	Number of ears / plant			Ear weight/plant (g)			Grain weight/plant (g)		
	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.
<b><u>Planting Patterns (P):</u></b>									
Solid planting	1.35	1.32	1.34	334.82	326.14	330.40	305.64	298.17	301.90
Intercropping	1.31	1.07	1.19	321.56	310.86	316.21	276.39	269.58	272.99
F-test	N.S.	**	**	N.S.	*	**	N.S.	**	**
<b><u>FYM levels (F): (m<sup>3</sup>/fad.)</u></b>									
Without	1.25 b	1.13 c	1.19 b	313.92 c	306.79 c	310.23 c	278.39 c	269.67 c	274.17 c
20	1.37 a	1.19 b	1.28 a	325.13 b	317.88 b	321.50 b	288.75 b	281.33 b	285.04 b
40	1.38 a	1.27 a	1.32 a	345.54 a	330.83 a	338.19 a	305.63 a	300.63 a	303.13 a
F-test	*	**	**	**	**	**	**	**	**
<b><u>N-fertilization N: (kg N/fad.)</u></b>									
Without	1.10 d	1.04 c	1.07 d	298.78 d	287.39 d	292.92 d	262.44 d	251.83 d	257.14 d
45	1.28 c	1.19 b	1.23 c	324.06 c	311.94 c	318.00 c	286.06 c	278.67 c	282.36 c
90	1.40 b	1.22 b	1.31 b	336.89 b	330.11 b	333.50 b	299.44 b	293.50 b	296.47 b
135	1.54 a	1.34 a	1.44 a	353.06 a	344.56 a	348.81 a	316.11 a	311.50 a	313.81 a
F-test	**	**	**	**	**	**	**	**	**
<b><u>Interactions:</u></b>									
P x F	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	**	**
P x N	**	**	**	N.S.	**	N.S.	N.S.	N.S.	*
F x N	N.S.	N.S.	N.S.	N.S.	*	**	N.S.	*	**

N.S., \* and \*\*, not significant, significant at 0.05 and 0.01 levels, respectively. FYM: farmyard manure, Faddan= 4200 m<sup>2</sup>.

**Table 5. Seed index, grain and biological yields (ton / fad) and harvest index of maize as affected by planting patterns, FYM and N-fertilization in both seasons and their combined analysis.**

Main effects and interactions	Seed index			Grain yield (ton / fad.)			Biological yield (ton / fad.)			Harvest index		
	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.
<b>Planting Patterns (P):</b>												
Solid planting	37.33	36.86	37.09	3.67	3.69	3.68	9.16	8.75	8.95	39.86	42.15	41.11
Intercropping	34.88	36.17	35.53	2.97	3.06	3.02	7.91	7.59	7.75	37.63	39.65	38.96
F-test	N.S.	N.S.	*	*	*	**	**	N.S.	**	N.S.	N.S.	N.S.
<b>FYM levels (F): (m<sup>3</sup>/fad.)</b>												
Without	35.08	35.20 c	35.14 b	2.96 c	2.95 c	2.95 c	7.47 b	7.27 c	7.37 c	39.73	40.53	40.13
20	36.38	36.55 b	36.46 a	3.42 b	3.44 b	3.43 b	8.91 a	8.16 b	8.66 b	38.22	41.06	40.20
40	36.85	37.80 a	37.33 a	3.58 a	3.74 a	3.66 a	9.23 a	9.07 a	9.15 a	38.29	41.12	40.00
F-test	N.S.	**	**	**	**	**	**	**	**	N.S.	N.S.	N.S.
<b>N-fertilization(N): (kg N/fad.)</b>												
Without	33.16 d	33.29 d	33.22 d	2.67 d	2.68 d	2.67 d	6.74 d	6.58 d	6.66 d	38.66	40.79	40.16
45	35.27 c	35.83 c	35.55 c	3.09 c	3.18 c	3.13 c	7.99 c	7.26 c	7.63 c	38.79	41.78	41.02
90	36.99 b	37.22 b	37.11 b	3.59 b	3.57 b	3.58 b	9.28 b	8.81 b	9.05 b	38.84	40.55	39.55
135	39.00 a	39.72 a	39.36 a	3.92 a	4.07 a	3.99 a	10.12 a	10.03 a	10.07 a	38.69	40.49	39.67
F-test	**	**	**	**	**	**	**	**	**	N.S.	N.S.	N.S.
<b>Interactions:</b>												
P x F	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*
P x N	N.S.	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
F x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N.S., \* and \*\*, not significant, significant at 0.05 and 0.01 levels, respectively. FYM: farmyard manure, Faddan= 4200 m<sup>2</sup>.

**Table 6. Number of branches and pods / plant, seed weight / plant and pod yield (kg / fad.) of soybean as affected by cropping system, FYM and N- fertilization in both seasons and their interactions**

Main effects and interactions	Number of branches/plant			Number of pods/plant			Seed weight/plant (g)			Pod yield (kg / fad.)		
	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.
<b><u>Planting Patterns (P):</u></b>												
Solid planting	5.34	5.61	5.47	64.56	65.56	65.06	27.79	27.72	27.75	1166.5	1106.4	1164.2
Intercropping	4.63	4.80	4.71	54.33	54.99	54.66	22.90	23.74	23.32	1040.4	1055.8	1048.1
F-test	**	**	**	*	*	**	**	*	**	*	N.S.	**
<b><u>FYM levels (F): (m<sup>3</sup>/fad.)</u></b>												
Without	4.27 b	4.44 c	4.35 c	50.56 b	50.88 b	50.72 b	22.81 c	24.09 c	23.45 c	1045.0 b	951.8	1040.1 b
20	5.16 a	5.37 b	5.26 b	64.28 a	63.83 a	64.05 a	25.42 b	25.66 b	25.54 b	1196.3 a	1097.2	1146.7 a
40	5.53 a	5.80 a	5.67 a	63.51 a	66.13 a	64.82 a	27.80 a	27.44 a	27.62 a	1069.1 b	1194.3	1131.7 a
F-test	**	**	**	**	**	**	**	**	**	**	N.S.	**
<b><u>N-fertilization N: (kgN/fad.)</u></b>												
Without	3.96 d	4.08 d	4.02 d	38.71 d	41.57 d	40.14 d	21.04 d	19.48 d	20.26 d	925.5 d	948.5 d	937.0 d
45	4.60 c	4.83 c	4.72 c	51.03 c	51.28 c	51.16 c	22.66 c	22.82 c	22.74 c	1077.0 c	1082.3 c	1079.7 c
90	5.33 b	5.54 b	5.44 b	67.88 b	67.75 b	67.81 b	27.94 b	26.47 b	27.20 b	1177.6 b	1123.9 b	1178.6 b
135	6.04 a	6.37 a	6.21 a	80.17 a	80.52 a	80.34 a	29.74 a	34.16 a	31.95 a	1233.7 a	1169.5 a	1229.5 a
F-test	**	**	**	**	**	**	**	**	**	**	**	**
<b><u>Interactions:</u></b>												
P x F	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	N.S.	**	N.S.	N.S.	N.S.
P x N	N.S.	N.S.	N.S.	*	*	*	**	**	**	N.S.	N.S.	**
F x N	N.S.	N.S.	**	N.S.	N.S.	**	**	N.S.	**	N.S.	N.S.	N.S.

N.S., \* and \*\*, not significant, significant at 0.05 and 0.01 levels, respectively. FYM: farmyard manure, Faddan= 4200 m<sup>2</sup>.

**Table 7. Seed index, grain and biological yields (kg / fad.) and harvest index of soybean as affected by cropping system, FYM and N-fertilization in both seasons and their interactions**

Main effects and interactions	Seed index			Seed yield (kg / fad.)			Biological yield (kg / fad.)			Harvest index		
	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.	2009	2010	Comb.
<b>Planting Patterns (P):</b>												
Solid planting	19.79	18.65	19.22	820.35	835.85	828.35	2033.4	2028.2	2030.8	40.34	41.21	40.75
Intercropping	18.25	18.42	18.33	710.37	714.04	712.20	1963.1	1960.5	1961.8	36.18	36.42	36.30
F-test	*	N.S.	**	*	*	**	N.S.	*	**	*	*	**
<b>FYM levels (F): (m<sup>3</sup>/fad.)</b>												
Without	19.02	18.20 b	18.61	737.54	737.26 c	737.77 c	1815.4 b	1804.9 b	1810.2 b	40.87 a	41.38 a	41.12 a
20	19.12	18.42 b	18.77	756.81	765.97 b	761.39 b	2120.1 a	2055.3 a	2087.7 a	36.03 b	37.50 b	36.76 b
40	18.92	18.98 a	18.95	801.73	821.61 a	811.67 a	2059.4 a	2122.8 a	2091.1 a	39.88 a	39.05 b	39.46 a
F-test	N.S.	**	N.S.	N.S.	**	**	**	**	**	*	*	**
<b>N-fertilization N:(kgN/fad.)</b>												
Without	17.55 d	16.91 d	17.23 d	682.58 d	671.66 d	677.12 d	1655.8 d	1652.5 d	1654.2 d	42.29 a	40.85 a	41.57 a
45	18.49 c	18.25 c	18.37 c	741.97 c	745.79 c	743.88 c	1879.1 c	1869.0 c	1874.1 c	39.61 bc	40.11 a	39.86 b
90	19.60 b	19.04 b	19.32 b	807.88 b	826.62 b	817.75 b	2122.7 b	2110.1 b	2116.4 b	38.19 c	39.71 a	38.95 b
135	20.42 a	19.93 a	20.18 a	829.01 a	855.70 a	842.35 a	2335.4 a	2345.8 a	2340.6 a	35.61 d	36.87 b	36.08 c
F-test	**	**	**	**	**	**	**	**	**	**	**	**
<b>Interactions:</b>												
P x F	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 N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.
F x N	*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N.S., \* and \*\*, not significant, significant at 0.05 and 0.01 levels, respectively. FYM: farmyard manure, Faddan= 4200 m<sup>2</sup>.

dry matter, number of branches and pods / plant, pod yield (kg / fad), seed yield / plant and seed index ultimately results into increase seed yield. This might be reasons responsible for spectacular increase in overall seed yield of soybean. The results of Tijani *et al.* (2000); Morgado and Willey (2003); Shivay and Singh (2003); Panhwar *et al.* (2004); Ayoola and Adeniyani (2006); Mbah *et al.* (2007); Meena *et al.* (2007); Undie *et al.* (2010) and Undie *et al.* (2012) reported that, number of branches and seed yield of soybean responded optimally at 50 kg N/ha.

Data given in Table (6-a) show the effect of interaction between planting patterns with N fertilizer levels on number of pods/plant of soybean. Since, as in the combined analysis, under solid planting and intercropping, any increase in N level up to the level 135 kg N/fad, was followed by a respective significant increase in number of pods/plant of soybean. For all N levels, intercropping depressed number of pods/plant of soybean compared to the solid planting.

Data given in Table (6-b) show the effect of interaction between FYM and N fertilizer levels on number of pods/plant of soybean. It was clear that, number of pods/plant of soybean was affected by addition of FYM up to 20 m<sup>3</sup>/fad. Since, as in the combined analysis, any increase in N level up to the level 135 kg N/fad was followed by a respective significant increase in number of pods/plant of soybean.

As shown from data in Table (6-c) that, seed weight/plant of soybean as affected by interaction of planting patterns and FYM levels (combined analysis). It was clear that, seed weight of soybean plant was affected by addition of FYM up to 20 m<sup>3</sup>/fad under intercropping. While, in solid planting, that seed weight was significantly higher due to adding the highest level of FYM (40 m<sup>3</sup>/fad) compared to the seed yield of soybean plant achieved in no FYM treatment. For all FYM levels, intercropping depressed seed weight of soybean plant compared to the pure stand.

Data given in Table (6-d) show the effect of interaction between planting pattern with N fertilizer levels on seed weight (g) of soybean plant. Since, as in the combined analysis, under solid planting any increase in N level up to 90

kg N/fad was followed by a respective significant increase in seed weight (g) of soybean plant. For all N levels, intercropping depressed seed weight (g) of soybean plant compared to the solid planting.

Seed weight/plant of soybean as affected by interaction of FYM and N fertilizer levels (combined analysis) is given in Table (6-e). It was clear that seed weight (g) of soybean plant was not affected by addition of FYM up to 40 m<sup>3</sup>/fad. Since, as in the combined analysis, any increase in N level up to the rate 135 kg N/fad was followed by a respective significant increase in seed weight (g) of soybean plant.

## Conclusion

Intercropping system did not reduce relative photosynthetic potential for grain yield/plant (RPP<sub>grains</sub>) and biological yield/plant (RPP<sub>bio</sub>) whereas migration coefficient (MC) and total LA / plant did not affect by intercropping for both crops, but increased LAI for maize and soybean. Also, yield and yield attributes of maize and soybean compared to the pure stand were reduced relatively. FYM application up to 40 m<sup>3</sup>, followed by increasing growth parameters of maize and soybean components except LA, LAI and MC which responded to FYM up to 20 m<sup>3</sup> / fad for soybean component. Also, addition of FYM up to 40 m<sup>3</sup>/fad significantly increased all yield and yield attributes of both components except seed index and HI. Applying of N up to 135 kg N/fad., significantly increased all aforementioned traits of maize and soybean except HI of soybean.

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**Table 6-a. No. of pods/plant of soybean as affected by interaction of planting patterns with N-fertilization**

Planting Patterns	N-fertilization			
	0	45	90	135
Solid	D	C	B	A
	43.94 a	56.97 a	72.42 a	86.92 a
Intercropping	D	C	B	A
	36.33 b	45.34 b	63.21 b	73.77 b

**Table 6-b. No. of pods/plant of soybean as affected by interaction of FYM levels and N-fertilization**

FYM levels	N-fertilization			
	0	45	90	135
0	D	C	B	A
	31.18 b	44.18 b	59.28 b	68.22 c
20	D	C	B	A
	46.07 a	55.23 a	70.93 a	83.98 b
40	C	C	B	A
	43.17 a	54.05 a	73.23 a	88.83 a

**Table 6-c. Seed weight/plant (g) of soybean as affected by interaction of planting patterns with FYM levels**

Planting Patterns	FYM levels		
	0	20	40
Solid	C	B	A
	24.79 a	27.39 a	31.09 a
Intercropping	B	A	A
	22.11 b	23.69 b	24.16 b

**Table 6-d. Seed weight/plant (g) of soybean as affected by interaction of planting patterns with N-fertilization**

Planting Patterns	N-fertilization			
	0	45	90	135
Solid	C	B	A	A
	21.14 a	24.98 a	32.15 a	32.76 a
Intercropping	C	C	B	A
	19.39 b	20.49 b	22.26 b	31.14 b

**Table 6-e. Seed weight/plant (g) of soybean as affected by interaction of FYM levels and N-fertilization**

FYM levels	N-fertilization			
	0	45	90	135
0	D	C	B	A
	17.33 c	20.75 b	24.48 c	31.25 a
20	D	C	B	A
	19.75 b	23.22 a	27.04 b	32.17 a
40	C	C	B	A
	23.71 a	24.25 a	30.09 a	32.44 a

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### تأثير إضافة السماد البلدي والسماد النيتروجيني على مقاييس توزيع التمثيل الضوئي والمحصول ومساهماته تحت نظام تحميل الذرة الشامية وفول الصويا

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أقيمت تجربتان حقليتان خلال موسمي ٢٠٠٩ و ٢٠١٠ بحقل إرشادي - منيا القمح - محافظة الشرقية تحت إشراف قسم المحاصيل - كلية الزراعة - جامعة الزقازيق. لدراسة تأثير ثلاث مستويات للسماد البلدي (بدون إضافة - إضافة بمعدل ٢٠ م<sup>٣</sup> - إضافة بمعدل ٤٠ م<sup>٣</sup> للفدان) وأربع مستويات للسماد النيتروجيني (بدون إضافة - ٤٥ - ٩٠ و ١٣٥ كجم ن للفدان) لثلاثة نظم: الزراعة المنفردة للذرة الشامية صنف هجين ثلاثي ٣٢٤ (٢٣,٣٣٣ نبات للفدان) - الزراعة المنفردة لفول الصويا صنف جيزة ٢٢ (٩٣,٣٣٣ نبات للفدان) - الزراعة (أي زراعة الذرة الشامية على ثلاثة خطوط على مسافة ٩٠ × ٢٠ سم ونباتين في الجورة بدلا من نبات واحد في حالة الزراعة المنفردة متبادلة مع ثلاثة خطوط من فول الصويا على أبعاد ٩٠ × ١٠ سم على جانبي الخط ونباتين بالجورة بدلا من جانب واحد من الخط في حالة الزراعة المنفردة) على صفات النمو والمحصول ومساهماته لكلا المكونين. ويمكن تلخيص أهم النتائج التي تم التوصل إليها على النحو التالي: أدى التحميل إلى حدوث نقصا معنويا في صفات النمو (الجهد النسبي للتمثيل الضوئي لمحصول الحبوب وللمحصول البيولوجي للنبات و معامل الهجرة إلا أن دليل مساحة الورقة قد زاد لكلا المكونين). أيضا حدث نقصا معنويا لكل من عدد كيزان النبات - وزن الكوز للنبات ووزن الحبوب للنبات - محصول الحبوب والمحصول البيولوجي للفدان ووزن ١٠٠ حبة بالنسبة للذرة الشامية. وعدد الفروع وعدد بذور القرن ووزن البذور للنبات ومحصول البذور والقرون والمحصول البيولوجي بالكجم للفدان ودليل البذرة ودليل الحصاد لفول الصويا بالمقارنة بالزراعة المنفردة. أدى إضافة السماد البلدي حتى أعلى مستوى (٤٠ م<sup>٣</sup> للفدان) إلى حدوث زيادة معنوية لصفات النمو لكلا المكونين، فيما عدا صفات مساحة الورقة ودليل مساحة الأوراق ومعامل الهجرة والتي استجابت للسماد حتى ٢٠ م<sup>٣</sup> للفدان لمكون فول الصويا. أيضا زادت جميع صفات المحصول ومساهماته لكلا المكونين. باستثناء دليل البذرة والحصاد للذرة الشامية وللمحصول البيولوجي لفول الصويا قد زادوا معنويا بالإضافة حتى ٢٠ م<sup>٣</sup>. أما دليل الحصاد لفول الصويا فقد انخفض معنويا بإضافة السماد البلدي. أدى إضافة السماد النيتروجيني حتى أعلى مستوى (١٣٥ كجم ن للفدان) إلى حدوث زيادة معنوية لجميع صفات النمو والمحصول ومساهماته لكلا المكونين باستثناء دليل الحصاد لفول الصويا الذي انخفض بإضافة السماد النيتروجيني. ويمكن التوصية بزراعة فول الصويا محملا على الذرة الشامية بإضافة ٤٠ م<sup>٣</sup> سماد بلدي و ١٣٥ كجم ن للفدان تحت ظروف التجربة.