*Zagazig J. Agric. Res., Vol. 35 No. (6) 2008* 1301-1314

# YIELD AND YIELD ATTRIBUTES OF SOYBEAN AND MAIZE AS AFFECTED BY THE INTERCROPPING WITH MAIZE

**Fathy, A.E., A.A. Ibrahim, A.A. G. Ali, and I.M. Abd El-Hameed**

**Agronomy Dept., Fac. of Agric., Zagazig Univ., Egypt.**

*Accepted 30/11/2008*

**ABSTRACT:Two field experiments were conducted on administration field in Diyarb Nigm District, Sharkia Governorate Egypt, during two successive seasons (2005 and 2006). Giza-35 and Giza-111 soybean cultivars were sown at 93,333 plant/fad.as pure stand and intercropping as well and maize variety Giza-351which was sown at 28,000 plant/fad.as pure stand and intercropping were used in this investigation.The experimental field soil was clay in texture. The experiment aimed to study the effect of intercropping soybean with maize included: Pure stand of maize variety Giza-351 (28,000 plant/faddan), Pure stand of soybean cultivar Giza-35 (93,333 plant/faddan), Pure stand of soybean cultivar Giza-111 (93,333 plant/faddan), soybean was sown on one side of the ridge and maize was on the other side concerning the influence of intercropping on yield and yield attributes ,as well as competition for both crops.**

**The results indicated that: Soybean Giza111 cultivar outyielded Giza 35 in solid plantings but when the later was intercropped with maize, Giza 351 cultivar performed better. Insignificant differences between solid and intercropping to either of Giza 35 or Giza 111cultivar of soybean in oil content. Pure stand of soybean Giza 35 or Giza 111cultivars appeared to produce heaviest weight of oil yield (340.95 and 336.47 kg/fad., respectively) as compared with intercropping patterns (149.45 and 132.37 kg/fad., respectively) Number of seeds/pod as well as 100 - seed weight were not affected significantly by intercropping. Number of rows/ear of maize Giza 351 cultivar and oil yield (kg/fad.) were adversely affected by**

**intercropping with maize. Yield reductions of soybean cultivars due to intercropping with maize were 60.7% and 52% for Giza 111 and Giza 35, respectively, meanwhile the reduction in grain yield of maize valued to 19% and 26.8% when intercropped with Giza 35 and Giza 111 soybean cultivars,respectively. Land equivalent ratio for yield and oil yield of maize + soybean Giza 35 cultivar were 1.24 and 1.37 while LER of maize + soybean Giza 111 cultivar were 1.12 and 1.12 ,respectively.**

**Key words: Soybean, maize intercropping, LER, monocrop, cultivar.**

## INTRODUCTION

Intercropping is defined as growing two or more crops in the same field at the same time. It can achieve more produce than the crop components if they are grown as monocrop. On the other hand, it is gain more efficiency in land use. The adventages of intercropping as a mean of cropping intencification were shown by many workers Willey *et al.*, 1983; Mohamed *et al.*, 1984; Awad *et al.*, 1988; Mohamed and Nigem, 1988 and Attia and El-Bially, 1990 all worked on intercropping maize and soybean. Verma and Dutta 1984 indicated that growing maize and soybean in alternate rows gave the highest maize grain yield (3.72 ton/ha 0 and LER, also soybean seed yield was highest in pure stands (1.02ton/ha) and decreased with intercropping.On the other hand, Carruthers *et al.*, 2000, working on soybean and many other crops with maize, they found that maize grain yield and harvest index were not affected by any intercropping ,however, soybean seed yield was decreased as compared with sole Agbaje *et al.*, 2002, obtained LER greater than one for intercropping maize with soybean in 1:1 patterns when compared with other systems ( MS 1:2 ;1:3 and 1:4). El-Katib and Sherief 2003, found that the pattern MS of 2:4 caused the highest LER.Kumar *et al.*, 2003, showed that the reduction in the grain yield of maize was of the value of 13 –35% and that for soybean was of 47 –55% with different intercropping patterns. Contrary to this, El-Sergany *et al.*, 1994 stated that maize + soybean intercrop was of disadvantage. Thus, the objectives of this study was to seek the possibility of intercropping soybean into maize

fields in order to have more efficiency of land use to how additional oil yield with minimum decrease in maize yield.

## MATERIALS AND METHODS

Two field experiments were conducted on administration field in Diyarb Nigm District, Sharkia Governorate, during two summer seasons (2005 and 2006). To study the effect of intercropping of soybean with maize on yield, yield attributes, oil percentage and oil yield of both crops.The soil was clay in texture. The maize variety was Giza-351 which was sown at 28,000 plant/fad.as population in both sole cropping and intercropping, likewise the two tested soybean cultivars were Giza-35 and Giza-111 sown at population of 93,333 plant/ fad .as pure stand and intercropping. Maize was sown on one side of the ridge and soybean on the other side. The different treatments were as follow: 1-pure stand of maize Giza-351 variety. 2-pure stand of soybean Giza-35, cultivare. 3-pure stand of soybean Giza-111 cultivare. 4-maize, Giza-351 variety + soybean Giza 35 cultivar in an intercrop system. 5- maize Giza – 351 variety+soybean Giza-111 cultivar in an intercrop system. These five treatments were arrenged in a randomized block design with four replications .Sowing dates were June, 15th and May 23rd in 2005 and 2006 seasons, respectively. Each plot was 6 ridges of four meter length and 60 cm apart. Sowing was done in hills 15 cm and 25 cm apart for soybean and maize, respectively; in both sowings then thinned to one plant/hill after 21 days for maize and to two plants/ hill for soybean after 30 days from planting. Other agronomic practices were completed similar to that prevailing in the region. Both crops were harvested after 120 days from planting. Preceeding crop was faba bean and wheat for two seasons, respectively. Phosphorous fertilizer in the form of calcium super phosphate (15.5% $P_2O_5$) was applied as soil incorporated during tillage operation at rate of 30kg $P_2O_5$/faddan. Nitrogen fertilizer (as ammonium nitrate 33.5% N) was applied at rate of 80 kg N/faddan, during the 1st three irrigations.

At harvest, one or two ridges of each crop were used to determine the yield and yield attriputs of maize and soybean. The following

traits were recorded: A-Soybean data: number of pods/plant, pod yield/plant(gm), number of seeds/ pod ,weight of 100-seed (gm), straw and seed yields/faddan (kg).B-Maize data: number of rows/ear, number of kernels/row, 100- kernel weight (gm), grain and straw yields (kg/faddan). Dried mature seeds were ground into very fine powder to determine oil% of both crops (using Soxhelt apparatus and diethyle ether according to A.O.A.C. (1980). Oil yield (kg/fad.) was calculated by multiplying seed yield (kg/fad.) by seed oil percentage of both crops.

In order to asses the nature and degree of competition between soybean and maize plants, the following parameter was determined. Land Equivalent Ratio (LER): it was culculated according to Willey and Osira (1972): LER = L soyabean + L maize. Where. L soyabean = intercropped yield of soybean/pure stand of soybean, L maize = intercropped yield of maize /pure stand of maize, A randomized complete block design with four replicates adopted in this investigation permitted. Statistical analysis of data by the usual technique of variance (ANOVA) as mentioned by Gomez and Gomez (1984) A combined analysis was made for the data of the two seasons.Significant differences between various means of different characters under study were compared with the help of Duncan' s multiple range test (1955).

## RESULTS AND DISCUSSION

As seen in Table 1. number of pods/plant was adversely affected when both cultivars of soybean were intercropped with maize Giza 351 variety. Giza 111 soybean cultivar had significantly higher pod numbers/plant than sole crop of Giza 35 cultivar. Giza 35 cultivar gave significantly lower pod yield/ plant than sole cropping of Giza 111 which was compared with the intercropping treatments. However, number of seeds/pod of soybean was not changing by the cultivar. However, when any of the two soybean cultivars were intercropped with maize, pod yield per plant was significantly decreased.The results are in a good connection with those reported by Abd El-Aal *et al.* (1993); Carruthers *et al.* (2000); Rahimy *et al.* (2002); Kumar *et al.* (2003) and Polthanee *et al.* (2003).

Hundred seed weight (gm) of soybean was not influenced by intercropping with maize as shown

**Table 1. Number of pods/plant, number of seeds/pod and pod yield (gm)/plant of soybean grown in both solid planting and in association with maize during two summer seasons 2005 and 2006 as well as combined**

| Planting patterns | Number of pods/plant | | | Number of seeds/pod | | | Pod yield (gm)/plant | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | Combined | 2005 | 2006 | Combined | 2005 | 2006 | Combined |
| Soybean Giza 35 cultivar | 64.85a | 70.65a | 67.65b | 2.43 | 2.28 | 2.36 | 31.92b | 37.50 | 34.71a |
| Soybean Giza 111 cultivar | 78.83a | 74.43a | 76.63a | 2.57 | 2.28 | 2.43 | 42.30a | 34.80 | 38.55a |
| Soybean Giza 35 cultivar + Maize Giza 351 cv. | 24.68b | 57.56ab | 41.12c | 2.43 | 2.21 | 2.32 | 12.22c | 32.40 | 22.31b |
| Soybean Giza 111 cultivar + Maize Giza 351 cv. | 32.15b | 53.04b | 42.60c | 2.50 | 1.93 | 2.22 | 15.52c | 34.00 | 24.76b |
| F- test | ** | * | ** | NS | N.S | N.S | ** | N.S | ** |

in Table 2. The seed yield (kg/fad) of soybean followed pod yield (kg)/plant in behavier. Since the superiority of Giza111 cultivar over Giza 35 one cultivar and over both intercropping treatments was observed .The other cultivar (Giza 35) gave better yield of seeds than the intercropping treatments. On the other hand, the reduction in seed yield/faddan of soybean (Giza 111 cultivar) when intercropped with maize (Gize 351 variety) was of the value of 61% while, the value for soybean (Giza 35 cultivar) was 56% indicating that Giza 35 soybean cultivar was more efficient than Giza 111 in intercropping system with maize.. On the other hand, straw yield (kg/fad) gave different picture. Giza 35 stood first followed by monocrop of Giza 111. The latter gave higher straw yield when intercropped with maize than did Giza 35. This reduction was a result of crowdness of plants of both components which created more compitition between plants. Giza 111 cultivar could resist such compitition than did Giza 35 soybean cultivar. These results are in agreement with those reported by Edje (1983); Abdel Aal *et al.* (1993); Rezende *et al.* (1997); Agbaje *et al.* (2002); Polthanee *et al.* (2003) and Gadallah *et al.* (2006).While, Carruthers *et al.* (2000) found that 100- seed weight of soybean was significantly reduced by intercropping.

Seed oil content and oil yield (kg/fad.) of soybean was significantly affected by intercropping with maize as shown in Table 3. The superiority of Giza 35 over Giza 111 in sole crops or in intercropping patterns. Oil yield (kg/fad.) was adversely affected when both cultivars of soybean were intercropped with maize Giza 351 variety. On the other hand, the reduction in oil yield of soybean (Giza 111 cultivar) when intercropped with maize (Gize 351 variety) was of the value of 60.65% while, the value for soybean (Giza 35 cultivar) was 56.16% indicating that Giza 35 soybean cultivar was more efficient than Giza 111 in. intercropping system with maize These results are in agreement with those reported by Abdel Aal *et al.* (1993).

Tables 4 and 5 shows the behavier of maize crop when intercropped with soybean cultivars. Number of kernels/row, 100 - kernel weight (gm), oil percentage and straw yield (kg/faddan) were not significantly affected by the intercropping. However, Number of rows/ear, grain and oil yields (kg/fad.) were significantly affected by the intercropping. Sole crop of maize

**Table 2. Hundred seed weight (gm), seed and straw yields (kg)/faddan of soybean grown in both solid planting and in association with maize during two summer seasons 2005 and 2006 as well as combined**

| Planting patterns | Hundred seed weight (gm) | | | Seed yield (kg)/fad. | | | Grain yield (kg)/fad. of maize (comb.) | | Straw yield (kg)/fad. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | Combined | 2005 | 2006 | Combined | | LER | 2005 | 2006 | Combined |
| Soybean Giza 35 cultivar | 14.5 | 19.5 | 17.0 | 1539.00a | 1166.0a | 1353.0a | 4151.2 | — | 1552.0a | 2192.0a | 1872.0a |
| Soybean Giza 111 cultivar | 15.5 | 17.5 | 16.5 | 1644.00a | 1114b | 1379.0a | —— | — | 1423.0a | 2338.0a | 1881.0a |
| Soybean Giza 35 cultivar + Maize Giza 351 cv. | 14.0 | 17.5 | 15.7 | 548.0b | 639.0c | 594.0b | —— | 1.24 | 236.0b | 825.0b | 531.0b |
| Soybean Giza 111 cultivar + Maize Giza 351 cv. | 15.0 | 18.5 | 16.7 | 431.0b | 637.0c | 534.0b | —— | 1.12 | 239.0b | 886.0c | 563.0b |
| F- test | NS | N.S | N.S | ** | ** | ** | —— | — | ** | ** | ** |

**Table 3. Seed oil percentage, oil yield (kg)/fad. and LER (in combined) of soybean grown in both solid planting and in association with maize during two summer seasons 2005 and 2006 as well as combined**

| Planting patterns | Seed oil percentage | | | Oil yield (kg)/fad | | | Oil yield (kg)/fad. For maize | LER |
|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | Combined | 2005 | 2006 | Combined | Combined | Combined |
| Soybean Giza 35 cultivar | 24.43b | 25.95a | 25.2a | 375.97b | 302.57a | 339.27a | 192.20 | ------ |
| Soybean Giza 111 cultivar | 24.33b | 24.47b | 24.4b | 399.98a | 272.59b | 336.47a | ---------- | ------- |
| Soybean Giza 35 cultivar + Maize Giza 351 cv. | 25.58a | 24.74b | 25.16a | 140.17c | 158.08c | 149.45b | ---------- | 1.37 |
| Soybean Giza 111 cultivar + Maize Giza 351 cv. | 24.44b | 25.15a | 24.79b | 105.33d | 160.20c | 132.37c | ---------- | 1.12 |
| F- test | * | * | * | ** | ** | ** | ---------- | ---------- |

**Table 4. Number of rows/ear, number of kernels/row and 100- kernel weight (gm) of maize grown in both solid planting and in association with soybean during two summer seasons 2005 and 2006 as well as combined**

| Planting patterns | Number of rows/ear | | | Number of kernels/row | | | 100-kernel weight(gm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | Combined | 2005 | 2006 | Combined | 2005 | 2006 | Combined |
| Maize Giza 351 cv. | 16.13a | 15.71 | 16.17a | 36.68 | 33.15 | 35.90 | 33.0 | 26.0 | 29.5 |
| Maize Giza 351 cv.+ Soybean Giza 35 cultivar | 16.50a | 14.73 | 15.50ab | 36.15 | 31.83 | 33.99 | 31.5 | 25.3 | 28.9 |
| Maize Giza 351 cv. +Soybean Giza 111 cultivar | 15.38b | 14.19 | 14.79b | 34.73 | 32.50 | 33.61 | 32.0 | 27.5 | 29.8 |
| F- test | ** | N.S | ** | N.S | N.S | N.S | N.S | N.S | N.S |

**Table 5. Grain yield (kg)/faddan, oil percentage, oil yield and straw yields (kg)/faddan of maize as affected by cropped soybean cultivar during two summer seasons 2005 and 2006 as well as combined**

| Planting patterns | Grain yield (kg)/fad. | | | Oil % | | | Oil yield (kg)/fad. | | | Straw yield (kg)/faddan | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | Comb. | 2005 | 2006 | Comb. | 2005 | 2006 | Comb. | 2005 | 2006 | Comb. |
| Maize Giza 351 cv. | 4946.7a | 3355.7a | 4151.2a | 4.70 | 4.56 | 4.63 | 232.49a | 153.01a | 192.20a | 7458a | 7131 | 7337 |
| Maize Giza 351 cv. + Soybean Giza 35 cultivar | 4229.3b | 2481.7b | 3355.5b | 4.57 | 4.63 | 4.59 | 193.27b | 114.90b | 154.01b | 7593a | 7221 | 7407 |
| Maize Giza 351 cv. + Soybean Giza 111 cultivar | 3690.7c | 2389.3b | 3040.0c | 4.64 | 4.66 | 4.65 | 171.24c | 111.34c | 141.36b | 6879b | 7076 | 6978 |
| F- test | ** | ** | ** | N.S | N.S | N.S | ** | ** | * | * | N.S | N.S |

gave higher values of number of rows/ear grain and oil yields than when intercropped wih either of soybean cultivars in the combined analysis. The reduction in grain and oil yields was of the magnitude of 19.16% and 19.87% with Giza 35 while, this value was 26.76% and 26.45% when the soybean cultivar changed to Giza 111, indicating that Giza 35 cultivar was better variety for intercropping with maize. Its reduction in seed yield was less than Giza 111 and maize grain yield was more when intercropped with Giza 35 soybean cultivar, respectively. These results are in agreement with those reported by Abdel Aal *et al.* (1993).

This may be attributed to the increase in the availability of light to maize plants which increased the production of photosynthates and their reflection on the plant yield, beside the direct transefer of fixed $N_2$ from soybean to maize plants (Abdur-Rashid *et al.*, 2006). Also, Natarajan and willey (1980) reported that the most commonly suggested reason for utilize growth resources rather differently, so that when grown together they complement each other and make better overall use of resources than when grown separately.

Land equivalent ratio (LERs), of the two soybean cultivars when intercropped with maize in Tables 2 and 3(Giza 351 variety) were of the value of 1.24 and 1.37 for Giza 35 and 1.12 and 1.12 for Giza 111 soybean cultivars, respectively. This means that both intercropping patterns showed advantages. LER results revealed highly significant differences, since Giza 35cultivar recorded higher LER, when both cultivars were intercropped with maize indicating the superiority of Giza 35 cultivar and its higher efficiency under intercropping system compared with Giza 111 cultivar. Several investigators came to the similar results (Agbaje *et al.*, 2002 and El-Katib and Sherief 2003).

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# تأثير تحميل فول الصويا مع الذرة الشامية على المحصول ومساهماته لكليهما

أحمد السيد فتحي – عطية عبد المنعم إبراهيم–
أحمد عبد الغنى على– إسماعيل محمد عبد الحميد

قسم المحاصيل– كلية الزراعة– جامعة الزقازيق– مصر

أقيمت تجربتان حقليتان خلال موسمي ٢٠٠٥ و ٢٠٠٦ بحقل إرشادي –ديرب نجم – محافظة الشرقية. لدراسة تأثير التحميل لفول الصويا مع الذرة الشامية : الزراعة المنفردة للذرة الشامية صنف جيزة ٣٥١ (٢٨,٠٠٠ نبات للفدان) – الزراعة المنفردة لصنفي فول الصويا جيزة ٣٥ و جيزة ١١١ (٩٣,٣٣٣ نبات للفدان)– الزراعة المحملة لصنفي فول الصويا مع الذرة الشامية بنظام ١ : ١ (أي زراعة الذرة الشامية على جانب واحد من الخط بينما الأصناف على الجانب الآخر بنفس كثافة الزراعة المنفردة) على صفات المحصول ومساهماته لصنفي فول الصويا.

ويمكن تلخيص أهم النتائج التي تم التوصل إليهاعلى النحو التالي: أدى استخدام فول الصويا صنف جيزة ١١١ في نظام الزراعة المنفردة إلى حدوث زيادة معنوية في المحصول بالمقارنة بالصنف الآخر (جيزة ٣٥)، ولكن عند زراعتهما محملين على الذرة الشامية صنف جيزة ٣٥١ كان الصنف جيزة ٣٥ قد أعطى أعلى قيمة للمحصول مقارنة بالصنف الآخر، تفوق الصنف جيزة ٣٥ في نسبة الزيت سواء منفردا أو محملا بالمقارنة بالصنف الآخر، وان محصول الزيت انخفض بالتحميل، على حين أن صفة وزن المائة بذرة لم تتأثر بالتحميل.عدد السطور/الكوز في الذرة الشامية ومحصول الزيت تأثرا عكسيا بالتحميل مع فول الصويا. أدى التحميل إلى حدوث نسبة انخفاض ٦١% و ٥٦ % في محصول صنفي فول الصويا جيزة ١١١ و جيزة ٣٥ على التوالي . على حين كانت نسبة الانخفاض ١٩% و ٢٦,٨% لمحصول الذرة الشامية عند التحميل مع صنفي فول الصويا جيزة ١١١ وجيزة ٣٥ على التوالي . أدى تحميل فول الصويا على الذرة الشامية إلى زيادة محصوليه تفوق الواحد الصحيح مقارنة بزراعة كل محصول على حدة. نسبة المكافئ الأرضي لنظام التحميل ذرة شامية + فول الصويا صنف جيزة ٣٥ كانت تساوى ١,٢٤و ١,٣٧ بينما كانت ١,١٢و١,١٢ لنظام التحميل ذرة شامية + فول الصويا صنف جيزة ١١١.