J. Plant Production, Mansoura Univ., Vol. 3 (11): 2843 - 2856, 2012

EFFECT OF IRRIGATION TREATMENTS OF YIELD AND QUALITY ON SOYBEAN AND MAIZE GROWN UNDER DIFFERENT INTERCROPPING PATTERNS

Abou-Elela, A. M.
Crops Intensification Department, Agricultural Research Center, Giza, Egypt.

ABSTRACT

Two field trials were conducted in 2010 and 2011 to determine the effect of regimes irrigation on yield and its components for the maize-soybean intercropping patterns. The experimental was based on split plot in a randomized complete block design with three replications. The main plots consisted of three different irrigation regimes,(I_1)irrigation during all groth stage as control treatment,(I_2) withholding irrigation at the flowering stage and (I_3) withholding irrigation at the pod stage. The sub-plots included three intercropping patterns(T_1)=growing soybean on both sides of beds (140 cm) and planting one row of maize on the back of the bed (50cm between hills,1 plant) ,(T_2)=growing soybean on both sides of beds and planting one row of maize on the back of the bed and leave another bed (50cm between hills, 2 plants) and(T_3)= growing soybean on both sides of beds and planting one row of maize on back of the bed and leave another bed (25cm between hills, 2plants) Data showed that:

1- Whole irrigation gave the highest yield and yield components of maize/soybean intercropping. Whereas, withholding irrigation at the early flowering stage gave the lower yield and yield components.
2- Intercropping maize with soybean surpassed yield and yield components when used all beds, 50 cm between hills and left one plant /hill.
3- Interactions effect of irrigation x intercropping on maize indicated that, the treatments of I_1 X T_1 gave the highest values for all traits studied, whereas, the lowest value was recorded with I_2 x T_3.
4- Results showed that, Land Equivalent Ratio was the highest with the treatment of I_1 x T_1 (1.24, 1.16 and 1.20) in both seasons and the combined analysis, respectively, also, the same interaction recorded the highest net return (3303.07, 2750.35 and 3026.71) in both seasons and the combined analysis,respectively.

Keywords:Soybean,intercropping,maize ,irrigation regimes

INTRODUCTION

Soybean was the crop with multilateral application- for fodders, foods, industrials, medicines, and ecological purposes. According to Zolotitzkii (1962) not other plant in the world, that can produce during 100 - 120 days so many proteins and oil, so can give the soybean and not yet other plant that can compete with soybean about the numbers of the producing products.

Excluding economical factors, the drought is the most important factor, limiting grain production not only in our country, but in a world scale. A lot of studies were directed to evaluation the plants physiological adaptation to the water stress (Goranova and Todorova, 2005).

Soil water is the most crucial factor in arid and semi-arid regions and yield potential is directly a function of water available for plant growth.

Drought has been the major environmental constraint to plant survival and to crop productivity, Boyer (1983).

Soybean can be grown only under assured irrigation and it needs about 6-8 irrigations.. The soybean should be irrigated at the following critical growth stages such as flowering, pod initiation and seed filling period. It is observed that maximum reduction in yield, due to drought stress that occurred during the pod set and seed filling period (Desclaux, 2000; Ashley, and. Ethridge, 1978 and Abayomi, 2008) and water stress at flowering and/or pod development increased flower and pod abortion, Osborne *et al*., (2002)

The intercropped soybean yields were less for all intercropping arrangements than the monocropped soybean yield. (Neupane, R. K. 1983.) Intercrop systems may improve yield stability, allowing more consistent yields (Willey, 1980 and Fukai and Trenbath, 1993), and efficient use of the resources, allowing reductions in costly inputs (Morris and Garrity, 1993).

The objective of this investigation was to study the effect of irrigation regimes and intercropping patterns and their interactions on yield and its components as well as Land equivalent ratio .

MATERIALS AND METHODS

The present investigation was carried out at the farm of El-Gemmiza Agriculture Research Station, Agriculture Research Center, Egypt, during the two successive growing summer seasons 2010 and 2011 to study the effect of three irrigation regimes and three intercropping patterns on the productivity of maize (Three way Cross.310) and soybean (Giza 111).

The experiments were laid out in a split plot design with three replications, three irrigation practices (I) were randomly allocated in the main plots:

The main plots consisted of three different irrigation regimes(I) .

(I_1) : Irrigation during all growth stages as control treatment.

(I_2) : Withholding irrigation at the flowering stage.

(I_3) : Withholding irrigation at the beginning pod.

The sub-plots were randomly assigned by three Intercropping patterns (T):):

(T_1) = Growing soybean on both sides of beds (140cm and planting one row of maize on the back of the bed (50 cm between hills, 1 plant)

(T_2) = Growing soybean on both sides of beds and planting one row of maize on the back of the bed and leave another bed (50 cm between hills, 2 plants)

(T_3) = Growing soybean on both sides of beds and planting one row of maize on the back of the bed and leave another bed (25 cm between hills, 1 plant) (25 cm between hills and thinned to 1 plant/hill).

All the previous patterns resulted in 6000 of maize plants. Each sub-plot included of 4 beds, each plot was 3 m long and 5.6 m wide (16.8 m^2). The preceding winter crop was wheat in the two seasons. Soybean was planted on May 15th and 25 th May through 2010 and 2011 seasons, respectively. Maize was planted at the same date of planting soybean. Soybean was thinned to 2 plants/hills with distance of 10 cm between hill. All another cultural practices for both maize and soybean production were undertaken as recommended. Some mechanical and chemical properties of a representative soil sample used in the experimental soil were determined before preparation according *to Jackson* (1958) in 2010 and 2011 seasons, as shown as in Table (1).

Table (1): The mechanical and chemical analysis of experimental site in 2010 and 2011.

	Season 2010		Season 2011	
	Depth of soil sample (cm)			
Mechanical	**0-30**	**30-60**	**0-30**	**30-60**
Clay %	57.14	55.21	55.47	54.00
Silt %	22.29	21.94	23.68	22.80
Sand %	20.57	22.85	20.85	23.20
Texture	Clay			
Chemical analysis:				
Available N (ppm)	22.9	21.8	24.0	22.0
Available P_2O_5 (ppm)	9.0	8.5	11.0	10.0
Available K_2O (ppm)	550	535	500	480
Ec (mmhos/cm^3)	0.8	0.8	0.9	0.9
pH	7.40	7.3	7.3	7.2
$CaCo_3$ %	2.71	3.10	3.0	3.0
Organic matter %	1.0	1.1	1.2	1.2
Cations (meq/100 g.soil)				
Na^+	0.36	0.37	0.37	0.37
K^+	0.01	0.01	0.01	0.24
Ca^{++}	0.25	0.27	0.24	0.24
Mg^{++}	0.26	0.28	0.22	0.22
Anions (meq/100 g. soil)				
HCO^3	0.32	0.48	0.36	0.40
Cl^-	0.38	0.39	0.28	0.30
SO_4	0.20	0.06	0.22	0.12

At harvest time a random sample of ten plants from each sub-plot were taken in both seasons to determine the following characters:

A- Soybean yield and its components

1- Plant height (cm).
2- No.of pods/plant.
3- 100-seed weight (g).
4- Seed yield/plant (g)
5- Seed yield/fed (kg)

B-Maize yield and its components

1- Plant height (cm)
2- Ear length (cm).
3- 100- kernels weight (g)
4- Grain yield/plant (g)
5- Grain yield/fed. (ardab).

The competitive behavior of component crops in different soybean-maize association was determined in terms of Land Equivalent Ratio, relative crowding coefficient, aggerssivity and competitive ratio which were determined by using the following formulae.

Competitive functions. The following abbreviations were used to calculate different competitive functions.

Y_{aa} pure stand yield of crop "a".

Y_{ab} intercrop yield of crop "a".
Y_{bb} pure stand yield of crop "b".
Y_{ba} intercrop yield of crop "b".
Z_{ab} and Z_{ba} are sown proportions of crop "a" and "b" in an intercropping system.

Land Equivalent Ratio (LER). The ratio of area need under sole cropping to that of intercropping at the same management level to produce an equivalent yield, according to Mead and Willey (1980). It is calculated as follows:

$LER = LER_a + LER_b$

$LER_a = Y_{ab}/Y_{aa}$

$LER_b = Y_{ba}/Y_{bb}$

Relative crowding coefficient. Relative crowding coefficient was proposed by Dewit (1960), which was calculated by the following formula:

$K = (K_a \times K_b)$

$K_a = Y_{ab} \times Z_{ba} / (Y_{aa} - Y_{ab}) \times Z_{ab}$

$K_b = Y_{ba} \times Z_{ab} / (Y_{bb} - Y_{ba}) \times Z_{ba}$

Where,
K_a and K_b = Relative crowding coefficient for the component crop "a and b". All other abbreviations such as Y_{aa}, Y_{ab}, Z_{ab}, Z_{ba}, have been described above in this section.

Aggressivity value. Aggressivity value was calculated by the formula proposed by McGilchrist (1965).

$$A_{ab} = \frac{Y_{ab}}{Y_{aa} \times Z_{ab}} - \frac{Y_{ba}}{Y_{bb} \times Z_{ba}}$$

Where,
A_{ab} = Aggressivity value for the component crop "a".
All other abbreviations have been described above in this section.

Competitive ratio. Competitive ratio (CR) was calculated by the formula proposed by Willey *et al*. (1980).

$$CR_a = \frac{Y_{ab}}{Y_{aa} \times Z_{ab}} \div \frac{Y_{ba}}{Y_{bb} \times Z_{ba}}$$

Where,
CR_a = Competitive ratio for the component crop "a".
Farmer's benefit was calculated.
Total return-Price of maize yield+price of soybean yield(L.E.).

To calculate the total return, the average of the maize grain and soybean seeds prices presented by Agricultural Statisties(2010) ,Economic Affairs Sector.

Net return/faddan-total return-(fixed cost of soybean+ variable cost of both crops according to intercropping patterns)

Data statistically analyzed as the technique analysis of variance (ANOVA) of split- plot design as mentioned by Gomez and Gomez (1984). Treatment means were compared using the Least Significant Difference (LSD at 5%) test as outlined by Waller and Duncan (1969).

RESULTS AND DISCCUSSION

I-Effect of IRRIGATION regimes and intercropping patterns on Maize Yield:

Results in Table (2) showed that, significant effects due to irrigation treatments for plant height, ear length, 100-kernels weight, grain yield/ear and grain yield/fed. in both seasons and the combined analysis. Normal irrigation (I_1) recorded the highest values for all traits studied, followed by I_3, in both seasons and the combined data. While, the lowest values for all traits studied recorded with I_2 treatment in both seasons and the combined data. It may be due to the reduction at different irrigation cycles can be assigned to LAI reduction and decline of photosynthesis in order to filling of seeds that caused decreasing of seed weights,Nejad *et al*.,(2010).

Rafiee *et al*, (2007) stated that relative moisture content of leaf at time of flowering of corn plant have high correlation with seed function, negative correlation between drought tension with leaf surface index and potential of leaf water have provided reduction of leaf surface and reduction of photosynthesis at leaf water unit at level of sinking and result, reduction of supplying processed substances and negative effect of it on seed production in maize was led to the result of seed performance reduction.

Water stress decreased grain yield by decreasing stem height,number of grain per cob and 1000-grain weight,Khan *et al*.,(2001).

Concerning intercropping patterns,data revealed that , plant height recorded tha highest value with T_2,follwed by T_1,whereas the lost value was recorded with T_3.These results due to wide distance between maize plants and higher competition between two plants(T_2) compared to one plants(T_1) .Ear length,recorded the height value with T_2,followed by T_3,while the lowest value was recorded with T_1.On the other hand, 100-kernels weight,grain yield/ear and grain yield/fad., the highest value was recorded with T_1,followed by T_2 whereasT_3 recorded lowest value. .

The interaction between irrigation regimes x intercropping patterns on all studied traits had significant effects in both seasons and in the combined data. The maximum values of plant height and ear length were recorded by the interaction of I_1 xT_2 as shown as in Table 2. On the other hand, the interaction of I_1 x T_1 recorded the highest 100-kernels weight; grain yield/ear and grain yield/fed. in both seasons and in the combined data. However, the lowest values of grain yield/fed. were recorded from the interaction between I_2 and T_3.

II-Effect of Irrigation regimes and intercropping patterns on soybean Yield:

Results in Table (3) showed that, significant effects due to irrigation practices for no.of pods/plant, seed yield/plant and seed yield/fed. in both seasons and the combined analysis, while there were no significant differences between all irrigation regimes for plant height and 100-seed weight in both seasons and the combined analysis.

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Treatment (I_1) recorded the highest seed yield/fad. in the combined data (846.33 kg/fed.), followed by treatment (I_3) (783.67 kg/fed.), Sawian *et al*. (2002) showed that, the highest irrigation treatment increased number of plant height and no.of pods/plant. Similar results were obtained by Sangakkara *et al* (2001). While, the lowest yield found at treatment withholding irrigation at the flowering stage (739.39 kg/fed.).

Brevedan and Egli (2003) found that, drought stress at any stage of soybean development can reduce yield, but the extent and degree of damage, the capacity for recovery, and the impact on yield and yield components depend on the timing of a stress episode. Similar findings have also been reported by Boyer (1983) and Westgate and Peterson (1993). In present research, when the stress occurred at flowering stage, all yield and yield components were reduced,based on results soybean yield is more sensitive to drought stress during the early reproductive stage (flowering stage than other developmental stages. Similar results found by Zolotitzkii (1962),Boyer(1983 and eWestgat and Peterson(1993 .

Drought at later stages when pod filling had begum reduced seed size , according toMunier-Jolain *et al*,.(1998.Theindividual seed weight is a product of the rate and the duration of seed filling,it is generally determined during seed filling after the pod number had been fixed,Westgate and Peterson(1993 .

eed yield in soybean was not affected by the drought stress during the vegetative development stage, whereas single or multiple drought stress treatments applied during the reproductive development stages, pod elongation or seed enlargement resulted in significant reductions of seed yield by Demirtas *et al*.(2010.

The intercropping patterns effects were differed from season to another, this mean that there was no clear trend in this aspect on all studied traits, as the results of Table (3). The highest values of 100 seed weight and seed yield/plant were found with T_3 in both seasons and the combined data. While, the highest seed yield/fed was recorded with T_1 in both seasons and the combined data. On the other hand, there were no significant differences between T_1 and T_3 on seed yield/fed. in both seasons and the combined data. The interaction between irrigation regimes x intercropping patterns on all studied traits had significant effects in both seasons and in the combined data, except plant height. The interaction of I_1 xT_1 recorded the maximum values no. of pods/plant in the first seasons and the combined data, while the highest 100-seed weight and seed yield/fed were recorded with the interaction I_1 x T_3,as shown in Table (3). However, the lowest values of seed yield/fed. were recorded from the interaction between I_3 and T_2 in both seasons and the combined data.

III-Effect of Irrigation regimes and intercropping patterns on LER, RCC, Aggressivity and CR:

Effects of irrigation regimes, intercropping patterns and their interactions were recorded significant values of LER, RCC and Aggressivity in both seasons and their combined data, while, no significant differences between irrigation treatments on LER in the first season and combined data, respectively, Also, there were no significant difference between intercropping patterns on RCC in the second season as shown as in Table (4).

In the same table, yield advantage in terms of LER varied from 1.02 to 1.12 in the combined data. These results indicate that, 2 to 12 %, greater area would be required by a sole cropping system to recover the yield of intercropping system, similar results found by Miyda *et al*. (2005).

Normal irrigation (I_1) recorded the highest values of LER, RCC in both seasons and the combined data. Also, intercropping patterns (T_1) recorded the highest values of LER, RCC in both seasons and the combined data. While, the interactions between I_1 x T_1 were recorded the highest values of LER and RCC in both seasons and the combined data, as shown as in Table (4).

Data presented in Table (4) showed that, normal irrigation (I_1) recorded the highest values of CR in the second season and combined data. While, I_2 recorded the highest values of CR in the first season. Also, in the same table, the interactions between I_1 x T_3 were recorded the highest values of CR in the second season and the combined data.

Table (4) reveals that the value of aggressivity of soybean was positive for all combinations. Although the aggressivity index of maize was not shown, but maize was considered as the less-dominant crop in the system. Positive value of aggressivity indicates to soybean, as dominant crops in the present study. So in soybean/maize intercropping, maize growth associated with legume crops like soybean can be a dominated crop. .

The economic return of intercropped maize with soybean as compared with solid plantings has been calculated (Table 5). The prices of the products used were the farm gate prices of maize grains and soybean seeds at 2011 season. Variable costs and total costs were estimated according to Agricultural Statistics Book (2010).

Solid soybean recorded average seed yield/fed for both seasons of (978.28 kg/fed.) and net return (L.E) was 1713.12 L.E., it means that, intercropping maize/soybean under irrigation regimes increased the net return on the average by about 873.70 per feddan than solid soybean, while solid maize recorded average grain yield/fed (25.165 ardab/fed) and net return (L.E.) was 3236.3 L.E., it means that, intercropping maize/soybean under irrigation regimes decreased net return on the average by about 649.48 L.E. than solid maize.

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CONCLUSION

From this investigation it could be concluded that:

1-Whole irrigation gave the hightest yield and yield components of maize/soybean intercropping. Whereas, withholding irrigation at the flowering stage gave the lowest yield and yield components.

2-Intercropping maize with soybean surpassed yield and yield components when used all beds/ 50 cm between hills ,and left one plant hill

3- Interactions effect of irrigation x intercropping on maize indicated that, the treatments of I_1 X T_1 gave the highest values for all traits studied, whereas, the lowest value was recorded with I_2 x T_3 in both seasons and the combined data.

4- Results showed that, Land Equivalent Ratio was the highest with the treatment of I_1 x T_1 (1.24, 1.16 and 1.20) in both seasons and the combined analysis, respectively) and also, the same interaction recorded the highest net return (3303.07, 2750.35 and 3026.71) in both season and the combined analysis , respectively.

REFERENCES

Abayomi, Y. A .(2008). Comparative growth and grain yield responses of early and late maturity groups to induced soil moisture stress at different growth stages. . 4(1):

Agricultural Statistics (2010). Economic Affairs Sector, Ministry of Agriculture, Egypt, (in Arabic).

Ashley,D.A. and W. J. Ethridge (1978). Irrigation effects on vegetative and reproduction development of three soybean cultivars. 70: 467-471.

Boyer, J. S. (1983). Environmental stress and crop yields In Crop reactions to water and temperature stress in humid, temperate climates. Rapper, C.D. Jr., Kramer, P. J. (ed.) West view Press. Boulder,CO. pp 3–7.

Brevedan, R. E. and D. B. Egli (2003). Short periods of water stress during seed filling, leaf senescence, and yield of soybean. Crop sci., 43, 2083–2088

Demirtas, C.;S. Yazgan;B. N.Candogan;M. Sincik;H.Büyükcangaz and A.T.Göksoy (2010). Quality and yield response of soybean (*Glycine max* L. Merrill) to drought stress in sub–humid environment. African Journal of Biotechnology Vol. 9(41), pp. 6873-6881.

Desclaux D;T.T. Huynh ,and P. Roumet (2000) Identification of soybean plant characteristics that indicate the timing of drought stress. Crop Science 40, 716-722.

Dewit, C.T. (1960). On Competition. Versl. Land. bouwk, Onderzock, 68: 1–82.C.Fcomputer search

Fukai, S. and B.R., Trenbath (1993). Processes determining intercrop productivity and yields of component crops. Field Crops Res. 34, 247–271.

Gomez K.A. and A. Gomez (1984). Statistical procedures of Agricultural Research. John Wiley & Sons, New York, 2nd ed., 680p.

Goranova, K. and R. Todorova (2005). Past, present and future of the breeding of soybean, Scient. Reports Jubilee conf. "Breeding and technological aspects in processing of soybean and other legume crops", 08 September, Pavlikeni/in Bulg./, p.30- 41.

Jackson, M.L. (1958). Soil Chemical Analysis. Prentice-Hall Inc., Englewood.

Khan,M.B.;N.Hussain and M.Iqbal(2001.Effect of water stress on growth and yield components of maize variety YHS202.J. of Res..(Sci.,Bahauddin Zakariya University,Multan,Pakistan.Vol.12,No.1.pp.15-18

McGilchrist, I.A. (1965). Analysis of Competition Experiments. Biometrics, 21: 975–85.

Mead R, and R.W. Willey. (1980).The concept of a "Land equivalent ratio" and advantages in yields from intercropping. Exp. Agric. 16: 217-228.

Miyda, A.and K. Bhattacharjee, S. S. Ghose and P. Banik, (2005). Deferred seeding of blackgram (*Phaseolus mungo* L.) and rice (*Oryza sativa* L.) field on yield advantages and mothering of weeds. J. Agron. Crop Sci. 191, 195-201.

Morris, R.A. and D.P. Garrity, , (1993). Resource capture and utilization in intercropping: non-nitrogen nutrients. Field Crops. Res. 34, 319–334.

Neupane, R. K. (1983). Effects of Planting Arrangement on Maize and Soybean Intercropping J. Inst. Agric. Anim. Sci. 4:1-5.

Osborne. S. L.; J.Shepers ; D.D. Fransis and M. R. Schlemmer (2002). Use of spectral radiance to in season biomass and grain yield in nitrogen water- stressed corn. . 42:165-171.

Putnam D.H.; S.J. Herbert ,A. Vargas (1984). Intercropped corn soybean density studies. 1. Yield complementarily. Expl. Agric. 21: 41-51.

Sangakkara, U.R.; M. Frehner and J. Nosberger (2001). Influence of soil moisture and potassium fertilizer on vegetative growth of mung bean and cowpea. J.Agron. and Crop Sci., 186(2): 73 – 81.

Sawain, Omaima; M. U.A. El-Behary and A.F., Abo Hadid (2002). Effect of irrigation levels and N sources on green bean productivity. Egypt. Appl. Sci. 47(10): 326 – 347.

Waller R.A.,and D.B. Duncan (1969). A bays rule for the symmetric multiple comparison problem. Am. Stat. Assoc. J., 1485-1504.

Westgate,M. E. and C.M. Peterson (1993). Flower and pod development in water–deficient soybean (*Glycine max* L.Merr.) J. Exp. Bot ,44, 109–117.

Willey, RW; M. Matarajan; M.S. Reddy; M.R. Rao; P.T.C. Nambiar; J. Kammainan,and V.S. Bhatanagar (1980). Intercropping, studies with annual crops .In "Better crops for food"J.C. Homeless (Ed) Ciba Foundation symp. Pp.83-97.

Zolotitzkii, V. (1962). Soybean in the Far East, Habarovsk, pp. 250. (in russ.)

تأثير معاملات الرى ونظم التحميل المختلفه على المحصول ومكوناته لفول الصويا والذرة المحملين

عبد العزيز محمود ابو العلا
قسم بحوث التكثيف المحصولى-معهد المحاصيل الحقلية-مركز البحوث الزراعية-الجيزة

أجريت تجربتان حقليتان فى موسمى ٢٠١٠، ٢٠١١ لتقدير تأثير نظم الرى على المحصول ومكوناته للذرة وفول الصويا المحملين. استخدم تصميم القطع المنشقة مرة واحدة فى قطاعات كاملة العشوائية فى ثلاث مكررات. استخدمت نظم الرى فى القطع الرئيسية بينما استخدمت القطع التحت شقية لنظم التحميل. نظم الرى التى استخدمت هى (١) الرى الكامل (٢) حرمان الرى اثناء فترة التزهير (٣) حرمان الري اثناء فترة تكوين القرون.

استخدمت ثلاث نظم لتحميل الذرة مع الصويا:-

١- زراعه فول الصويا على جانبى المصطبة (١٤٠سم) ١٠٠% وزراعة الذرة فى صف واحد على ظهركل المصطبة ٥٠ سم بين الجور والخف على نبات واحد بالجورة.
٢- زراعه فول الصويا على جانبى المصطبة (١٤٠سم) ١٠٠% وزراعة الذرة فى صف واحد على ظهرمصطبة وترك المصطبة ٥٠ سم بين الجور والخف على نباتين بالجورة.
٣- زراعه فول الصويا على جانبى المصطبة (١٤٠سم) ١٠٠% وزراعة الذرة فى صف واحد على ظهرمصطبة المصطبة ٢٥ سم بين الجور والخف على نبات واحد بالجورة.

أظهرت النتائج مايلى:-

١- أعطى الرى الكامل لكلا المحصولين اعلا انتاجية للمحصول ومكوناته بينما الحرمان من الرى اثناء فترة التزهير كان تأثيرها أكبر على نقص انتاجية المحصول ومكوناته.
٢- أظهرت نتائج التحميل تفوق التحميل على كل المصاطب وترك مسافة ٥٠ سم بين الجووترك نبات واحد بالجورة.
٣- اظهر التفاعل بين التحميل ونظم الرى أن الرى الكامل و التحميل على مصاطب وترك نبات واحد بالجورة اعلا انتاجية للمحصول.
٤- اظهرت النتائج أن اعلى كفاءة استخدام الارض LER كانت مع المعاملة للرى الكامل مع الزراعة على مصاطب ١٤٠سم على مسافة ٥٠سم وترك نبات واحد بالجورة (١,٢٤ ، ١,١٦ و١,٢٠) فى كلا الموسمين والتحليل المشترك، على الترتيب و كان صافى الايراد لتلك المعاملة هو (٣٣٠٣,٠٧ ، ٢٧٥٠,٣٥ و ٣٠٢٦,٧١) فى كلا الموسمين والتحليل المشترك، على الترتيب.

بتحكيم البحث

أ.د / محمود سليمان سلطان	**كلية الزراعة – جامعة المنصورة**
أ.د / صلاح السيد عطيه	**مركز البحوث الزراعية**

Table (2): Effects of irrigations treatments, intercropping systems and their interactions on maize growth, and yield and its components in both seasons and their combined data.

Treatments	Plant height (cm)			Ear length (cm)			100-kernels weight			Grain yield/ear (g)			Grain yield/fed (ardab)		
	2010	**2011**	**Comb.**	**2010**	**2011**	**Comb.**	**2010**	**2011**	**Comb.**	**2010**	**2011**	**Comb.**	**2010**	**2011**	**Comb.**
Irrigation treatments															
I_1	283.11	282.48	282.79	20.11	19.76	19.93	38.37	38.98	38.68	157.13	150.57	153.85	8.13	8.03	8.08
I_2	274.42	276.41	275.42	17.29	17.23	17.26	33.46	35.55	34.51	140.81	134.88	137.84	7.01	6.99	7.00
I_3	277.34	277.74	277.54	18.63	18.71	18.67	36.10	37.31	36.70	150.51	141.49	146.00	7.37	7.41	7.39
LSD 0.05	**3.35**	**2.75**	**1.80**	**1.69**	**0.39**	**0.72**	**3.18**	**2.51**	**1.68**	**1.64**	**0.83**	**0.76**	**0.54**	**0.23**	**0.24**
Intercropping patterns															
T_1	278.83	279.99	279.41	17.63	18.28	17.96	36.79	38.41	37.60	151.98	145.22	148.60	7.65	7.94	7.80
T_2	280.43	280.98	280.71	19.74	19.70	19.72	36.02	37.46	36.74	150.01	142.21	146.11	7.51	7.50	7.51
T_3	275.61	275.67	275.64	18.66	17.72	18.19	35.11	35.97	35.54	146.46	139.50	142.98	7.35	6.98	7.16
LSD 0.05	**1.39**	**0.96**	**0.80**	**0.88**	**0.50**	**0.48**	**1.82**	**ns**	**1.14**	**1.23**	**0.74**	**0.68**	**0.12**	**0.23**	**0.12**
Interactions															
$I_1 \times T_1$	282.83	282.87	282.85	18.02	19.07	18.54	39.56	40.55	40.06	160.24	153.80	157.02	8.32	8.80	8.56
$I_1 \times T_2$	286.37	285.23	285.80	21.66	21.37	21.51	38.15	38.29	38.22	156.64	150.00	153.32	8.15	8.06	8.11
$I_1 \times T_3$	280.13	279.33	279.73	20.66	18.83	19.75	37.39	38.11	37.75	154.51	147.90	151.21	7.92	7.22	7.57
$I_2 \times T_1$	274.27	276.60	275.43	16.83	17.23	17.03	34.12	36.19	35.15	142.56	137.70	140.13	7.05	7.22	7.13
$I_2 \times T_2$	277.17	279.53	278.35	18.14	18.07	18.11	33.37	36.22	34.80	141.91	135.53	138.72	7.03	7.00	7.02
$I_2 \times T_3$	271.83	273.10	272.47	16.89	16.40	16.64	32.88	34.25	33.57	137.96	131.40	134.68	6.94	6.74	6.84
$I_3 \times T_1$	279.40	280.50	279.95	18.04	18.53	18.29	36.69	38.49	37.59	153.14	144.17	148.66	7.59	7.80	7.70
$I_3 \times T_2$	277.77	278.17	277.97	19.41	19.67	19.54	36.53	37.88	37.21	151.48	141.10	146.29	7.36	7.45	7.40
$I_3 \times T_3$	274.87	274.57	274.72	18.42	17.93	18.18	35.07	35.56	35.32	146.91	139.20	143.06	7.17	6.98	7.08
LSD 0.05	**2.41**	**1.66**	**1.39**	**1.52**	**0.87**	**0.83**	**3.16**	**2.71**	**1.97**	**2.14**	**1.29**	**1.18**	**0.20**	**0.41**	**0.21**

-ns, * and **: Non significant, significant at 5 and 1% levels of probability, respectively.

Table (3): Effects of irrigations treatments, intercropping systems and their interactions on soybean growth, and yield and its components in both seasons and their combined data.

Treatments	Plant height (cm)			No.of pods/plant			100-Seed weight (g)			Seed weight/plant (g)			Seed yield /fed (Kg)		
	2010	2011	Comb.	2010	2011	Comb.	2010	2011	Comb.	2010	2011	Comb.	2010	2011	Comb.
Irrigation treatments															
I_1	103.67	106.28	104.97	27.47	28.10	27.78	20.17	13.56	16.87	7.19	8.36	7.78	913.05	779.61	846.33
I_2	104.96	105.73	105.34	20.93	24.70	22.82	19.83	11.09	15.46	5.77	9.40	7.58	858.82	619.95	739.39
I_3	107.00	106.60	106.80	26.93	27.03	26.98	18.95	11.12	15.04	6.58	10.24	8.41	861.50	705.85	783.67
LSD 0.05	**ns**	**ns**	**ns**	**4.61**	**3.19**	**2.33**	**ns**	**ns**	**ns**	**0.50**	**1.53**	**0.67**	**13.26**	**38.59**	**16.95**
Intercropping patterns															
T_1	107.80	104.73	106.27	27.63	25.84	26.74	19.29	12.26	15.78	6.52	8.20	7.36	894.76	708.46	801.61
T_2	103.32	105.31	104.32	24.80	25.61	25.21	19.30	10.63	14.96	6.67	9.44	8.06	857.23	701.10	779.17
T_3	104.50	108.57	106.53	22.90	28.38	25.64	20.37	12.88	16.62	6.34	10.36	8.35	881.38	695.85	788.62
LSD 0.05	**3.52**	**4.10**	**ns**	**2.02**	**1.48**	**1.18**	**0.60**	**ns**	**1.34**	**ns**	**1.17**	**0.58**	**14.63**	**ns**	**13.36**
Interactions															
I_1 x T_1	105.70	105.43	105.57	31.20	27.50	29.35	19.73	13.69	16.71	7.75	7.80	7.78	923.17	758.59	840.88
I_1 x T_2	101.00	104.48	102.74	27.40	26.89	27.15	19.98	11.07	15.52	7.31	8.50	7.91	899.64	785.11	842.38
I_1 x T_3	104.30	108.93	106.62	23.80	29.91	26.85	20.82	15.93	18.37	6.50	8.79	7.65	916.33	795.14	855.74
I_2 x T_1	107.70	104.43	106.07	22.00	23.23	22.62	19.48	11.68	15.58	5.50	8.10	6.80	877.30	648.69	762.99
I_2 x T_2	103.27	105.37	104.32	20.80	24.11	22.46	19.36	10.49	14.93	5.90	9.50	7.70	831.41	614.45	722.93
I_2 x T_3	103.90	107.40	105.65	20.00	26.77	23.39	20.65	11.09	15.87	5.90	10.60	8.25	867.77	596.71	732.24
I_3 x T_1	110.00	104.33	107.17	29.70	26.78	28.24	18.67	11.41	15.04	6.31	8.70	7.51	883.81	718.09	800.95
I_3 x T_2	105.70	106.09	105.90	26.20	25.83	26.02	18.56	10.32	14.44	6.81	10.31	8.56	840.63	703.75	772.19
I_3 x T_3	105.30	109.37	107.33	24.90	28.47	26.69	19.64	11.62	15.63	6.63	11.70	9.17	860.04	695.70	777.87
LSD 0.05	**ns**	**ns**	**ns**	**3.50**	**2.55**	**2.05**	**1.04**	**4.78**	**2.31**	**0.64**	**2.02**	**1.00**	**25.33**	**41.80**	**23.15**

-ns, * and **: Non significant, significant at 5 and 1% levels of probability, respectively.

Table (4): Effects of irrigations treatments, intercropping systems and their interactions on LER, RCC, Aggresivity and CR in both seasons and their combined data.

Treatments	LER/soybean			LER/maize			LER			R.C.C			Aab			CR		
	2010	2011	Comb.	2010	2011	Comb.	2010	2011	Comb.	2010	2011	Comb.	2010	2011	Comb.	2010	2011	Comb.
Irrigation treatments																		
I_1	0.91	0.82	0.86	0.31	0.33	0.32	1.22	1.15	1.19	4.56	2.37	3.47	0.664	0.589	0.626	0.73	0.62	0.68
I_2	0.85	0.65	0.75	0.27	0.29	0.28	1.12	0.94	1.03	2.22	0.77	1.49	0.629	0.463	0.546	0.80	0.56	0.68
I_3	0.86	0.74	0.80	0.28	0.31	0.29	1.14	1.05	1.09	2.64	1.28	1.96	0.629	0.532	0.580	0.76	0.61	0.68
LSD 0.05	**0.013**	**0.041**	**0.018**	**0.013**	**0.013**	**0.008**	**ns**	**0.041**	**0.018**	**0.615**	**0.640**	**0.369**	**0.013**	**0.013**	**0.013**	**0.059**	**0.013**	**ns**
Intercropping patterns																		
T_1	0.89	0.74	0.82	0.29	0.33	0.31	1.18	1.07	1.13	3.61	1.55	2.58	0.653	0.530	0.591	0.76	0.57	0.67
T_2	0.85	0.74	0.79	0.29	0.31	0.30	1.14	1.05	1.09	2.56	1.46	2.01	0.624	0.527	0.5765	0.74	0.59	0.67
T_3	0.88	0.73	0.80	0.28	0.29	0.28	1.16	1.02	1.09	3.25	1.41	2.33	0.645	0.527	0.586	0.78	0.63	0.71
LSD 0.05	**0.010**	**ns**	**0.016**	**0.01**	**0.010**	**ns**	**0.010**	**0.010**	**0.007**	**0.601**	**ns**	**0.357**	**0.010**	**0.010**	**0.01**	**0.010**	**0.032**	**0.016**
Interactions																		
I_1 x T_1	0.92	0.80	0.86	0.32	0.36	0.34	1.24	1.16	1.20	5.29	2.27	3.78	0.671	0.565	0.618	0.72	0.55	0.64
I_1 x T_2	0.90	0.83	0.86	0.31	0.33	0.32	1.21	1.16	1.18	3.89	2.37	3.13	0.653	0.593	0.623	0.72	0.62	0.67
I_1 x T_3	0.91	0.84	0.87	0.30	0.30	0.30	1.22	1.13	1.17	4.51	2.48	3.49	0.668	0.609	0.638	0.75	0.70	0.73
I_2 x T_1	0.87	0.68	0.78	0.27	0.30	0.28	1.14	0.98	1.06	2.54	0.92	1.73	0.644	0.486	0.565	0.81	0.57	0.69
I_2 x T_2	0.83	0.65	0.74	0.27	0.29	0.28	1.10	0.93	1.02	1.77	0.74	1.26	0.607	0.459	0.533	0.77	0.56	0.66
I_2 x T_3	0.86	0.63	0.75	0.27	0.28	0.27	1.13	0.91	1.02	2.34	0.65	1.49	0.637	0.446	0.542	0.81	0.56	0.69
I_3 x T_1	0.88	0.75	0.82	0.29	0.32	0.31	1.17	1.08	1.12	2.99	1.46	2.23	0.645	0.539	0.592	0.76	0.59	0.67
I_3 x T_2	0.84	0.74	0.79	0.28	0.31	0.29	1.12	1.05	1.08	2.03	1.26	1.65	0.613	0.530	0.571	0.74	0.60	0.67
I_3 x T_3	0.86	0.73	0.79	0.27	0.29	0.28	1.13	1.02	1.07	2.91	1.10	2.01	0.629	0.527	0.578	0.78	0.63	0.71
LSD 0.05	**0.018**	**0.056**	**0.028**	**0.018**	**0.018**	**0.012**	**0.018**	**0.018**	**0.012**	**1.040**	**0.786**	**0.617**	**0.018**	**0.018**	**0.018**	**0.018**	**0.056**	**0.028**

-ns, * and **: Non significant, significant at 5 and 1% levels of probability, respectively.

Table (5): Effects of irrigations treatments, intercropping systems and their interactions on total return and net return (L.E.fed)

Treatments	Total return/fed. (L.E)			Net return/fed. (L.E)		
	2010	2011	Comb.	2010	2011	Comb.
Irrigation treatments						
I_1	5440.79	4884.81	5162.80	3220.79	2664.81	2942.80
I_2	4977.01	4016.87	4496.94	2757.01	1796.87	2276.94
I_3	5067.62	4453.82	4760.72	2847.63	2233.83	2540.73
Intercropping patterns						
T_1	5262.52	4580.63	4921.57	3042.52	2360.63	2701.57
T_2	5081.36	4455.38	4768.37	2861.36	2235.38	2548.37
T_3	5141.54	4319.49	4730.52	2921.55	2099.49	2510.52
Interactions						
$I_1 \times T_1$	5523.07	4970.35	5246.71	3303.07	2750.35	3026.71
$I_1 \times T_2$	5390.84	4914.37	5152.61	3170.84	2694.37	2932.61
$I_1 \times T_3$	5408.46	4769.70	5089.08	3188.47	2549.71	2869.09
$I_2 \times T_1$	5060.19	4182.43	4621.3	2840.19	1962.43	2401.31
$I_2 \times T_2$	4872.24	3997.79	4435.01	2652.24	1777.79	2215.01
$I_2 \times T_3$	4998.60	3870.38	4434.49	2778.60	1650.39	2214.49
$I_3 \times T_1$	5204.31	4589.1	4896.71	2984.31	2369.11	2676.71
$I_3 \times T_2$	4981.00	4453.99	4717.49	2761.00	2233.99	2497.49
$I_3 \times T_3$	5017.57	4318.39	4667.98	2797.57	2098.39	2447.98

Solid Maize 26.11 ardab/fed (2010) and 24.22 ardab/fed (2011)
Solid Soybean 1005.17 kg/fed (2010) and 951.39 kg/fed (2011)
Farm gate price: 1- Maize, L.E 220/ ardab 2- Soybean, L.E 4000/ton
Total cost : 1- Solid Soybean: L.E 2200 2- Solid Maize: L.E. 2300