COMPARATIVE STUDY AMONG IRRIGATION SYSTEMS FOR COWPEA YIELD IN SANDY SOIL

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ABSTRACT

A field study was conducted at the experimental Farm of the Faculty of Agriculture, Zagazig Univeristy, Sharkia Governorate, during the summer season 2009 to determine comparative study between irrigation systems (traditional, sprinkler, drip and subsurface) for irrigation efficincy, water saving, cowpea yield, yield components, water use efficincy and net profit in sandy soil conditions.

The experimental results reveal that:

- *The application efficiency; distribution uniformity and irrigation efficiency for subsurface irrigation increased by 4.2, 13.5 and 60.1%; 4.57, 15.97 and 29.06% and 8.99, 31.70 and 109.75% compared with drip, sprinkler and traditional systems.*
- $Kc_{calculated}$ *and* Kc_{FAO} *values were 0.40 and 0.41; 0.82 and 1.05 and 0.55 and 0.60 at the different stage of cowpea.*
- *Drip system increased the pod yield and WUE by 14.98 and 9.47%, 40.42 and 57.58% and 61.76 and 188.89% compared with subsurface, sprinkler and traditional systems.*
- *The highest water saving was obtained of 1780, 1675 and 1420* m^3*/fed under subsurface, drip and sprinkler compared with traditional systems.*
- *The highest net profit was obtained of 3276, 2680, 1823 and 1602 LE/fed under drip, subsurface, traditional and sprinkler irrigation systems.*

Keywords: irrigation systems, water saving, efficiency, net profit, cowpea.

INTRODUCTION

Irrigation systems is considered one of the important limiting factors affecting the agricultural production. Sandy soils are generally characterized as very poor for moisture holding capacity and scarcity of organic matter. Cowpea is a summer vegetable legume crop and considered as one of the main legumes grown in Egypt. It considered as a good source of protein carbohydrate and other nutrients.

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Mbagwu and Osuigwe (1985) found that the highest cowpea yield was obtained when irrigation with water equivalent to 100% field capacity every 2 days compared with 4 days. **Arnaout (1995)** showed that the average the irrigation efficiency, distribution uniformity, water saving and lima beans yield of the drip system increased by 15.87 and 38.37%, 8.87 and 11.37%, 3.13 and 96.99% and 27.49 and 12.95% compared with sprinkler and furrow systems, respectively. **Shehata and Bakeer (1995)** found that the drip irrigation system saving water applied by 48.25 and 96.78% compared with sprinkler and furrow systems respectively, and showed that potatoes yield, water use efficiency and water benefit under drip, sprinkler and furrow systems were 9.43, 7.30 and 5.30 ton/fed, 2.07, 1.20 and 0.76 kg/m^3 and 1.033, 0.601 and 0.379 LE/m^3 respectively. **Shahien et al. (1996)** found that increasing the irrigation number from 4 to 8, the green cowpea yield, dry yield, pod length, pod weight, seed number per pod and 100-seed weight were increased from 3.13 to 3.53 ton/fed, 0.89 to 1.01 ton/fed, 12.57 to 13.34 cm, 3.45 to 4.6 g, 8.77 to 9.76 and 14.37 to 17.35 g respectively. **Arnaout (1997)** reported that the drip system saved about 13.05 and 26.61% of irrigation water requirements compared with sprinkler and furrow systems respectively and found that the highest pea yield values of 2.625, 2.35, 2.4 ton/fed were obtained under drip, sprinkler and furrow systems respectively. **Arnaout (1999)** found that the surface drip system increase the lima beans by 5.6 and 8.77% and decrease the cost of production unit by 6.8 and 10.2% than subsurface drip and sprinkler systems. **Shawky et al. (2001)** found that the application efficiencies were 92.9, 92.56, 81.48 and 65.7% for subsurface drip, surface drip, sprinkler and furrow systems, respectively. They also found that the surface and subsurface drip systems saved 22.2 and 21.7% of the irrigation water requirements comparing to sprinkler system and saved 51.55 and 50.90% when compared with furrow irrigation system, and the total green bean yield and water use efficiency for subsurface drip system increased by 29.44 and 27.64%; 57.87 and 222.30% and 40.23 and 77.78% compared with surface drip, furrow and sprinkler systems. **El-Gindy and Abdel-Aziz (2003)** found that the drip irrigation system saved of water requirement, total maize yield and water use efficiency about 20.3, 20.76 and 40% compared with sprinkler irrigation system. They also found that lowest cost of maize production unit was 64.6 LE/Mg under drip irrigation system when 100% of ETc daily was applied. **Gencoglan et al. (2005)** found that the averages of total applied water and the highest mean potential dry yield under basin, sprinkler and drip irrigation were 937.7 and 1.13, 913.4 and 1.36 and 886.5 mm and 1.58 t/ha, respectively.Thus, the mean seasonal water use by pepper varied from 1020.7 to 1109.7 mm. **Hassanli et al. (2009)** indicated that the maximum and minimum water saving, corn yield and WUE of 2471 and 1845.4 m^3/fed, 5.07 and 4.08 ton/fed and 2.12 and 1.43 kg/m^3 were obtained with subsurface drip and furrow method.

The objectives of this work were to determine the effect of irrigation systems on application efficiency, distribution uniformty, irrigation efficiency, cowpea yield, yield components, water use efficincy, water saving, cost per unit production and net profit in sandy soil conditions.

MATERIALS AND METHODS

The field experiments were carried out at El-Khattara experimental Farm, Faculty of Agriculture, Zagazig University, Sharkia Governorate during summer season 2009. The experimental was conducted to study the effect of irrigation systems on application efficiency, distribution uniformty, irrigation efficiency, cowpea yield, yield components, water use efficincy, water saving, cost per unit production and net profit in sandy soil conditions. Conventional analysis of the soil samples and irrigation water used were preformed and the results are tabulated in Tables (1 and 2).

Table (1): Some physical and chemical properties of the experimental site.

Soil depth (cm)	Particle size distribution (%)			$Caco_3$ (%)	Bulk density (g/cm^3)	p^H	EC (ds/m^{-1})	O.M (%)	F.C* (%)	W.p* (%)	A.W (%)
	Sand	Silt	Clay								
0-20	88.0	9.7	2.3	2.4	1.35	8.2	1.3	0.4	11.0	5.0	6.0
20-40	89.1	9.0	1.9	2.6	1.24	8.5	1.2	0.3	10.7	5.1	5.6
40-60	88.5	8.5	3.0	2.7	1.30	8.7	1.5	0.25	10.5	5.0	5.5

- **Field capacity (F.C) and wilting point (A.W.) by weight**

Table (2):Chemical analysis of irrigation water used.

p^H	EC (dSm^{-1})	Cations (meq/L)				Anions (meq/L)				SAR	ESP	Water Class
		Na^+	Ca^{++}	Mg^{++}	K^+	Cl^-	HCO_3^-	CO_3^{--}	SO_4^{--}			
7.5	1.76	10.2	6.4	4.6	0.8	9.7	6.4	-	6.3	4.35	4.88	C_2S_1

Irrigation systems:

The used irrigation systems one the following:

- Sprinkler irrigation system consist of the following components: A control head (pumping station delivered flow rate of 120 m^3/h under operating pressure of 5.0 bar, pressure manometers, regulate pressure, main pipe lines with PVC diameter of 12.5 cm buried at depth of 1.20 m under the ground, lateral pipe lines with 75 mm diameter of PVC, riser of 80 cm height, sprinkler nozzles with 3.6 and 2.4 mm diameter and the distance between sprinklers were 12 x 12 m.
- Drip and subsurface irrigation systems consists of the following components: Control head (centerifugal pump, valves, manometer, pressure control valves, regulate pressure, screen filters with 200 mesh, fertilizer tank, main line pipe PVC underground with diameter of 75 mm, submain lines flexible PVC pipes laid underground with 50 mm diameter, lateral line: surface lateral emitter lines polyethylene pipes have small diameter of 16 mm and subsurface lateral emitter lines (GR) polyethylene pipes have small diameter of 16 mm laid on the ground parallel to each other at 75 cm and dripper, fastened to the emitter liner with equal distances of 30 cm and flow rate of 4 lph. The lateral line each with 24 m length.
- Surface irrigation system consists of main and submain canals. The plots were irrigated by means of concrete pipe to deliver a given quantity of irrigation water through a gat valve constructed on the pipe to regulate the amount of water required to each plot.

All experimental unit received equal amounts of farmyard manure at rate of 20 m^3/fed. Nitrogen fertilizer in form of ammonium sulphate (20.5% N) was added at rate of 100 kg/fed before sowing irrigation. Phosphorus fertilizer in form of calcium superphosphate (15.5% P_2O_5) was applied during seeding preparation at rate of 200 kg/fed. Potassium fertilizer in from of potassium sulphate (48% K_2O) at rate of 50 kg/fed. The seed planting cowpea (Kream–7cvs) was done in the row in 1th May 2009 at 30 cm apart. The first harvesting was carried at 11th August 2009. The total net area of the experiment was 1512 m^2. Sprinkler irrigation system had (864 m^2), and the three other systems had (648 m) divided into three equal plots of (216 m^2) for drip, subsurface and surface irrigation systems.

Measurements and calculations:

1. **Irrigation system Efficiencies:**

   a. **Application efficiency (AE):** Was calculated from the following equation according to **Wu and Gitilin (1975)**

$$AE = \frac{W_{DZ}}{D_T} \times 100 \qquad \text{.. (1)}$$

Where:

W_{DZ} : depth of water stored in the root zone, cm.

D_T : gross depth of applied water.

   b. **Water distribution uniformity (DU):** Was calculated from the following equation according to **Merriam and Karmeli (1979)**

$$DU = \frac{DLq}{Dav} \qquad \text{.. (2)}$$

Where:

DLq: the depth infiltrated on the quarter of the area, which received the lowest amount of the irrigation water.

Dav: the average depth of infiltrated water.

   c. **Irrigation system efficiency (E_s):** Was calculated from the flowing formula according to **Wu and Gitilin (1975).**

$$E_s = AE \times DU \qquad \text{.. (3)}$$

2. **Irrigation water**

   a. **Amount of water added :** Was calculated according to the following equation as sited from **(Aboamera 2010)**:

$$\mathbf{IRa = (F.C - M.B) \times \rho \times Z \times A / E_s} \quad \text{.................... (4)}$$

Where:

IRa : Volume of water at each irrigation event, (cm^3)

F.C : Soil moisture content at field capacity, (%)

M.B : measured soil moisture content before irrigation, (%)

ρ : soil bulk density (g/cm^3), **Z** : depth of root zone (cm),

A : irrigated area (cm^2), and **E_s** : irrigation system efficiency (%).

b. Calculated irrigation water requirements and crop coefficient:

The amount of calculated irrigation water requirements was determined by using Blany and Kriddle method, according to the following equation ***(Vermeiren and Jobling, 1980)***

$$IRc = \frac{\lfloor (ET_0 \times Kc) \times Dd \rfloor + Lf}{Es} \quad \text{......... (5)}$$

$$Kc_{FAO} = \frac{(Es \times IRc) - Lf}{ET_0 \times Dd}$$

Where:

IRc: calculated irrigation water requirements, mm/intervals.

ET_o: evapotranspiration, mm/day.

kc : crop coefficient for (***Doorenbos and Kassam,1979***) .

Dd: time intervals. Es : system efficiency, %.

$$Kc_{\text{ calculated}} = \frac{(Es \times IRa) - Lf}{ET_0 \times Dd} \quad \text{......... (6)}$$

c. **Potential evapotranspiration (ETo):** Was calculated according to CROPWAT program. Agro-meteorological data were measured during the running of the experiment (Table 3).

Table (3): Average Agro-meteorological data in month at EL-Khtara.

Month	Max Temp. (c°)	Min Temp. (c°)	Relative Humidity (%)	Wind speed (m/sec)	Sunshine (h)	ET_o
May	28.7	18.2	55.7	1.55	10.2	5
June	35.7	22.1	58.7	1.47	11.8	5.6
July	36.2	21.4	60.8	1.34	12.1	6.2
August	36.0	19.8	45.7	1.36	11.5	5.7

3. **Total yield and its component:** At harvesting time five plants from each treatment were randomly taken to determine pod length, dry pod mass, number of pods/plant, number of seeds/pod, seeds mass/pod, pod diameter, mass of 100 seeds, and total yield (pod and seed).

4. **Water use efficiency:** Was calculated according to **Jensen (1983)** as follows:

$$WUE = \frac{\text{Total fresh yield (kg/fed)}}{\text{Actual applied irrigation water } (m^3/\text{fed})}, \text{ kg/m}^3 \quad \ldots.(7)$$

5. **Water saving:** Was calculated by the follows formula:

$$\text{Water saving } (m^3/\text{fed}) = MIRa - \text{IRa T} \quad \ldots\ldots\ldots. (8)$$

Where:

$MIRa$: maximum actual irrigation water requirement at treatment, (cm^3)

$IRa\ T$: actual irrigation water requirement at treatment, (cm^3)

6. **Cost analysis**

Cost analysis was carried out by using the current dealer prices for equipment and installation according to 2012 price level and cowpea production cost.

Total cost:

a- Irrigation system costs: Capital irrigation system cost was calculated using the current dealer prices for equipment and installation according to

2012 price level. The following cost analysis evaluation has been carried out according to **Worth and Xin (1983).**

1) Fixed costs: The annual fixed cost of capital investment in the irrigation system was calculated using the following equation:

$$\mathbf{F.C = D + I + T} \quad \text{... (9)}$$

Where:

F.C : annual fixed cost (LE/year), **D** : depreciation (LE/year),

I : interest (LE/year) and **T** : taxes and overhead ratio (LE/year).

Depreciation: Depreciation of the components of an irrigation system is based on the expected life of each element. The expected life of a number of irrigation system components has been prepared from numerous sources as guidelines and saved for estimating depreciation. Depreciation was calculated according to **(Jensen 1981)** using the following equation:

$$\mathbf{D = \frac{0.90 \times I.C}{E.L}} \quad \text{..................................... (10)}$$

Where:

I.C : is the element initial cost of irrigation system (LE) and

E.L: the element expected life (year).

Capital interest: was calculated using the following equation:

$$\mathbf{I = \frac{I.C \times 1.10}{2} \times I.R} \quad \text{.................................. (11)}$$

Where**:**

I.R : is the interest rate/year.

Taxes and overheads ratio: The annual cost of taxes can be obtained from the taxing entity in the particular location where the irrigation development is occurring. Insurance costs obtained similarly from insurance companies. The combined cost for taxes and insurance normally runs in the range of 1.5 to 2.5% of the initial investment value of the irrigation facilities **(Jensen 1981).** Taxes and insurance were considered to be 2.0% from initial cost.

2) Running cost: The annual running cost of capital investment in the irrigation system was calculated using the following equation:

$$RC = E.C + (R \& M) + L.C \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

Where:

RC: annual running costs (LE/year), **L.C**: labor costs (LE/year),

E.C: energy costs (LE/year) and

(R&M): repairs and maintenance costs (LE/year).

Labor cost: Labor to operate the system cost and to check the system components depends on irrigation operating time. This time would change from system to another according to irrigation water application rate. Labor cost was estimated as follows:

$$L.C = T \times N \times p \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

Where:

L.C: annual labor cost (LE/year), **T** : annual irrigation time (T/year),

N : labor number/feddan and **P** : labor cost (LE/h).

Energy cost: The energy cost for electrical type source was calculated using the following formula:

$$E.C = Bp \times T \times pr \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

Where:

E.C : energy costs for electricity (LE/year),

Bp : the brake power (kW), **T** : the annual operating time (h) and

Pr :cost of electrical power (LE/kW.h).

The brake horse power required (**Bp**) in kW for water pumping was calculated by using the following equation **(Longenbaugh and Duke,1981):**

$$B_p = \frac{Q \times T_{DH}}{C \times E_{overall}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)$$

Where:

Q : total discharge rate (l/s), **T_{DH}** : total dynamic head (m),

C: conversion coefficient to energy unit, 102 according to **Jensen 1981**,

$E_{overall}$: overall efficiency (67.5% for pump derived by electric motor)

Repairs and maintenance costs: The annual cost of repairs and maintenance of irrigation system were taken as 2-3% of the initial cost.

Total annual irrigation costs = fixed costs + running costs

b- Fertilization cost: Were calculated as following:

$$\mathbf{Fr = (Wf \times pr) + Ac} \qquad \text{.. (16)}$$

Where:

Fr : fertilization costs (LE/fed), **Wf** : amount of fertilizers (kg/fed),

Pr: fertilizer price (LE/kg) and **Ac**: application fertilizer costs (LE/fed).

c- Weed control costs: Was carried out manually by using labors and weed control cost was calculated as following:

$$\mathbf{Wc = N \times L \times T} \qquad \text{....................................... (17)}$$

Where:

Wc : weed control costs (LE/fed), **N** : labors number/feddan,

L : labor cost (LE/h) and **T** : time used (h/fed).

d- Pest control cost: Was carried out by using the sprayer and pest control costs was calculated as following:

$$\mathbf{Pc = (Wp \times p) + Ac} \qquad \text{.. (18)}$$

Where:

Pc : pest control costs, LE/fed **Wp** : amount pesticide used, kg/fed,

P : pesticide price, LE/kg and

Ac : application pesticide costs LE/fed (sprayer rent and labor cost).

7. **Cost per unit production: W**as calculated by using the following formula:

$$\text{Cost per unit production} = \frac{\text{Total production costs (LE/fed)}}{\text{Total fresh yield (Mg/fed)}} \quad \text{LE/Mg.. (19)}$$

8. Net profit: The economical net profit of cowpea yield was calculated by using the following formula (***Younis et al.,1991***):

$$\mathbf{P = (Yt \times d) - Ct} \quad \text{.................................. (20)}$$

Where:

P : net profit, LE/fed; **Yt** : total yield, ton/fed;

D : yield price, LE/ton, and, **Ct** : total production costs, LE/fed.

RESULTS AND DISCUSSION

1. Irrigation systems Efficiency.

The data presented in Fig. (1) shows that for subsurface irrigation, the application efficiency; distribution uniformity and total irrigation efficiency increased by 4.2, 13.5 and 60.1%; 4.57, 15.97 and 29.06% and 8.99, 31.70 and 106.75% compared with drip, sprinkler and traditional irrigation systems. Generally, the values of application efficiency, distribution uniformity and irrigation efficiency obtained by both the subsurface and drip irrigation systems were much higher than sprinkler and traditional systems.

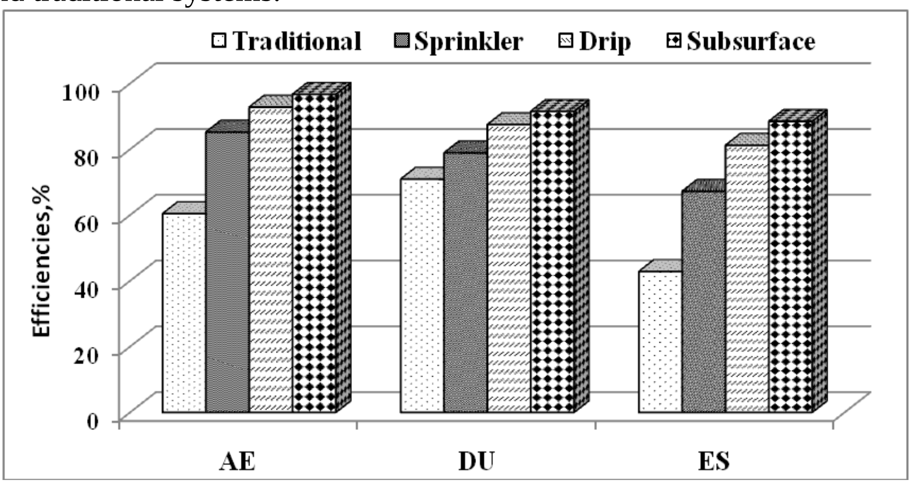


Fig. (1): Application efficiency, distribution uniformity and irrigation system efficiency under different irrigation systems.

2. Irrigation water

a. Actual irrigation water applied.

The actual irrigation water applied for cowpea throughout growing season under traditional, sprinkler, drip and subsurface irrigation systems is given in Fig. (2). The obtained data revealed that the higher actual irrigation of water applied were found under traditional and sprinkler irrigation systems, while the lowest values was found under subsurface and drip irrigation systems, because the subsurface and drip irrigation systems have higher application efficiency compared with traditional and sprinkler systems. The actual irrigation of water applied were 3750, 2930, 2075 and 1970 m^3/fed with using traditional, sprinkler, drip and subsurface irrigation systems, respectively.

b. Calculated amount of irrigation water.

The calculated irrigation water applied for cowpea throughout growing season under traditional, sprinkler, drip and subsurface irrigation systems are given in Fig. (2). The calculated amount of irrigation water with subsurface irrigation system was 2520 m^3/fed, but under traditional, sprinkler and drip were 4800, 2980 and 2653 m^3/fed.

The actual irrigation requirements lower than the calculated irrigation requirements, because we used the Kc from FAO under different conditions of climate and soil.

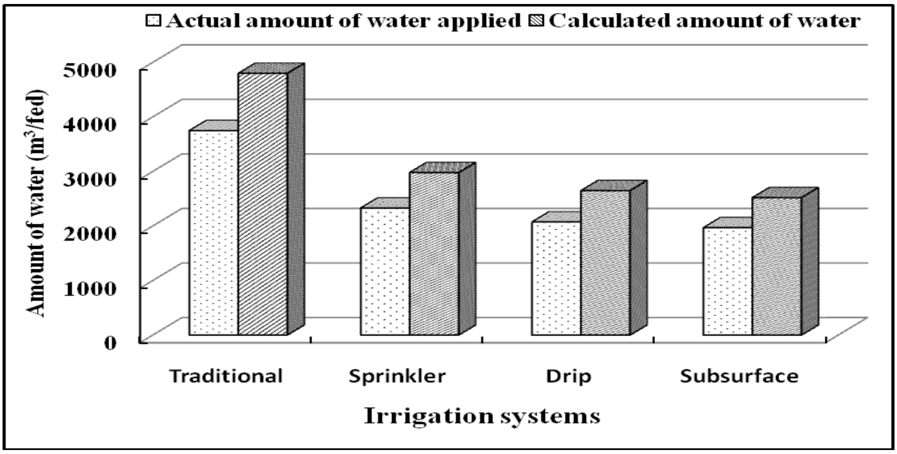


Fig. (2): Actual applied and calculated amount of irrigation water under different irrigation systems.

c. Kc calculated.

The crop coefficient reflects the crop cover percentage and soil conditions on the ETo values. The Kc values were estimated from the delaying IRa rates and the delaying ETo rates. The results reveal that the Kc values, as a function of the interaction between IRa and ETo (as overall mean) were low during initial stage, then increased during development stage and reached its maximum values during Mid-season stage, thereafter, the Kc values redecreased again during late stage. Fig. (3) showed that crop coefficient values were 0.40, 0.82, 0.82 and 0.55 ($Kc_{calculated}$) and 0.41, 1.05. 1.05 and 0.60 (Kc_{FAO}) at the different stage of cowpea under irrigation systems.

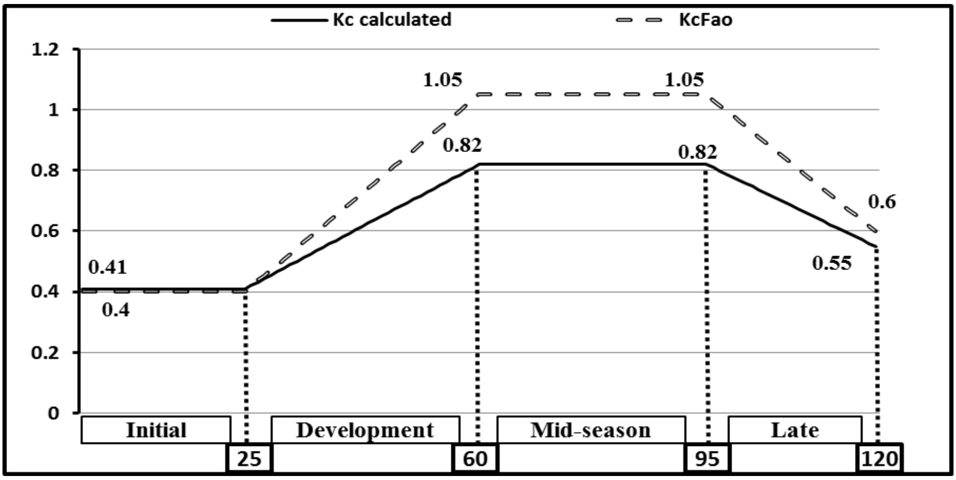
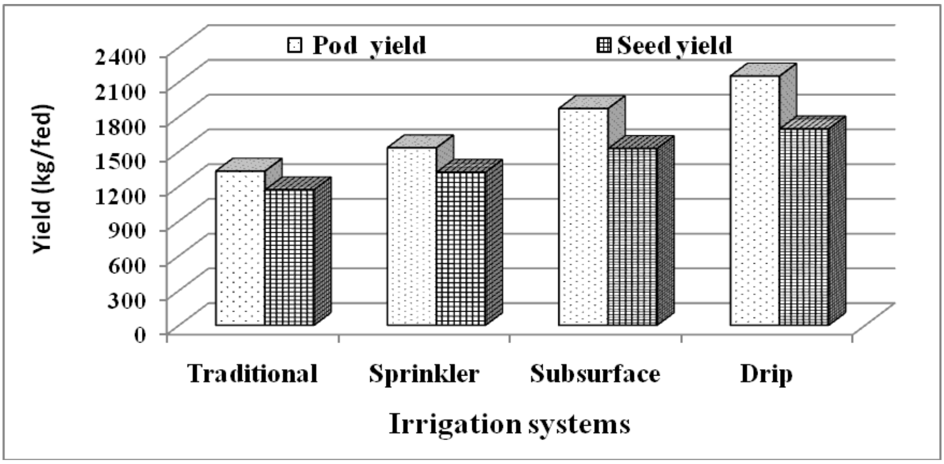


Fig. (3): The crop coefficient values of cowpea.

4. Crop yield

The data presented in Fig. (4) shows that for drip irrigation system increased the pod length, seed number per pod, pod number per plant, pod yield and seed yield by 10.27, 12.51 and 18.76%, 6.75, 11.57 and 14.61%, 19.21, 41.17 and 52.41%, 14.98, 40.42 and 61.76% and 6.91, 28.34 and 45.0% compared with subsurface, sprinkler and traditional irrigation systems respectively. Generally, the results show that the highest yield and yield components were found by using drip irrigation compared with different irrigation systems.



(4): The cowpea yield (pod and seed) under different irrigation systems.

5. Water use efficiency (WUE)

The data presented in Fig. (5) shows that the values of WUE for pod yield were 1.04, 0.95, 0.66 and 0.36 kg/m^3 under drip, subsurface, sprinkler and traditional irrigation systems respectively. The data presented in Fig. (5) shows that the WUE values of pod and seed yield for drip irrigation was higher than both systems of subsurface (9.47 and 2.5%), sprinkler (57.58 and 43.86%) and traditional (188.89 and 164.52%). This is attributed to the few water losses during the irrigation operating.

Finally, the obtained results revealed that, the highest value of WUE for pod and seed yield and minimum irrigation water applied was found by using subsurface irrigation and drip irrigation system.

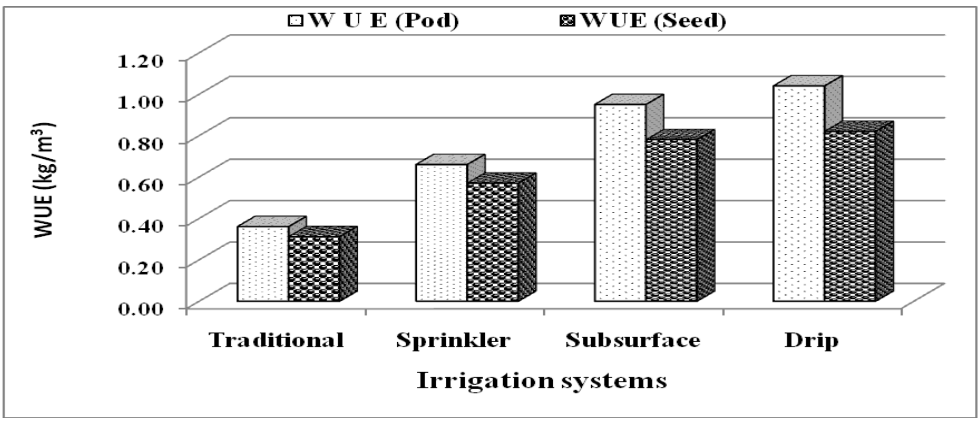


Fig. (5): Water use efficiency under different irrigation systems.

6. Water saving

The water saving for cowpea throughout the growing season under different irrigation systems for the investigated is given in Fig. (6). The data showed that the water saving under the different treatments compared with the actual irrigation water requirements 3750 m^3/fed (Traditional). Results show that the highest value of water saving was obtained under subsurface (1780 m^3/fed), drip (1675 m^3/fed) and sprinkler (1420 m^3/fed) compared with traditional irrigation system. Generally, the results show that, the highest water saving was found with using subsurface and drip irrigation systems.

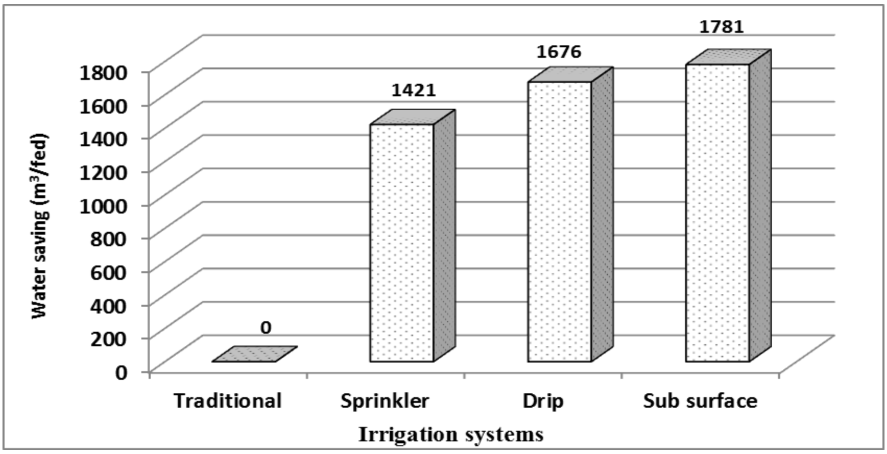


Fig. (6): Water saving of cowpea under different irrigation systems.

7. Cost calculation.

The results showed that the lowest cost per unit production (pod and seed) and highest net profit was found with using subsurface irrigation system.

The results in Fig. (7) showed that the total cost of sprinkler irrigation (2225 LE/fed) higher than subsurface (2098 LE/fed), drip (1995 LE/fed) and traditional irrigation systems (1500 LE/fed). The cost per unit production (pod and seed) was 1128 and 1284, 1453 and 1686, 1122 and 1324 and 928 and 1178 LE/Mg under traditional, sprinkler, subsurface and drip irrigation systems. It could be concluded that the higher net profit was 3276 LE/fed with drip irrigation system, 2680 LE/fed with subsurface, 1823 LE/fed with traditional and 1602 LE/fed with sprinkler irrigation systems.

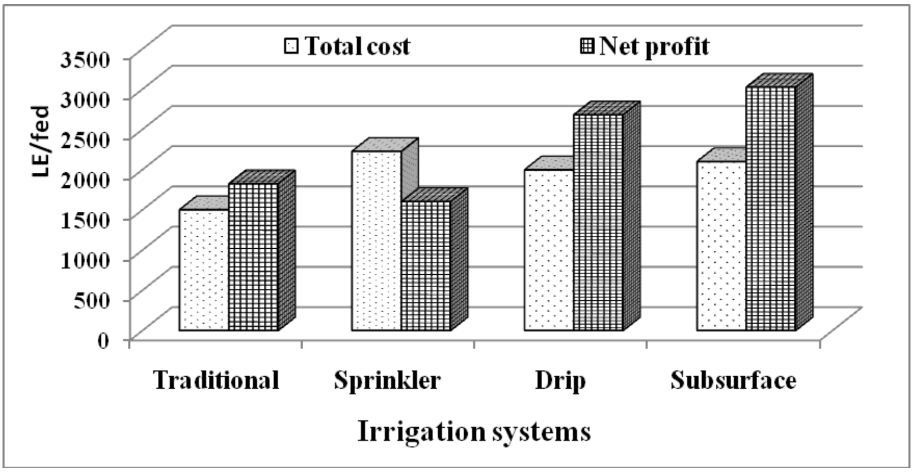


Fig. (7): Total cost, cost per unit production and net profit under different irrigation systems.

CONCLUSIONS

The obtained results can be summarized as follows:

1. The values of application efficiency, distribution uniformity and irrigation efficiency obtained by both the subsurface and drip irrigation systems were much higher than sprinkler and traditional irrigations.
2. The Kc values as a function of the interaction between IRa and ETo (as overall mean) were low during initial stage, then increased during development stage and reached its maximum values during Mid-season stage, thereafter, the Kc values redecreased again during late stage.
3. The highest yield and yield components were found by using drip compared with different irrigation systems.
4. The highest value of WUE for pod and seed yield was found by using drip and subsurface irrigation systems.

5. The highest water saving was found with using subsurface and drip irrigation systems.
6. The lowest cost per unit production (pod and seed) and highest net profit was found with using drip irrigation system.

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الملخص العربي

دراسة مقارنة لنظم الري لمحصول اللوبيا في الاراضي الرملية

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نظرا لمحدودية الموارد المائية والاستخدام الجائر للمياه في الاراضي الجديدة وقلة احتفاظها بها وزيادة عدد السكان، والذي أدى الى تناقص نصيب الفرد من المياه، لذا كان من الضروري العمل علي ترشيد المياه المتاحه والمحافظة عليها وزيادة المساحه المرويه. ويعتبر تطبيق تقنيات الري الحديث أحد السبل الهامة في هذا المجال. وتقوم الفكرة الأساسية في هذا البحث على دراسة مقارنة لنظم الري المختلفة (الري السطحي والري بالرش والري بالتنقيط والري تحت السطحي) علي انتظامية توزيع المياه وكفاءة النظام وترشيد المياه المستخدمة وانتاجية المحصول اللوبيا ومكوناته وكفاءة استخدام المياه والتكاليف الكلية وتكاليف انتاجية الميجاجرام من المحصول (القرون والبذور) وصافي الربح لمحصول اللوبيا في الاراضي الجديدة بمنطقة الخطارة محافظة الشرقية.

وكانت أهم النتائج المتحصل عليها هي:

- زيادة كفاءة الاضافة وانتظامية التوزيع وكفاءة الري تحت نظام الري تحت السطحي بالمقارنة بنظم الري الأخري (التنقيط - الرش - التقليدي).

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- زيادة انتاجية محصول اللوبيا (قرون) تحت نظام الري بالتنقيط بنسبة ١٤.٩٨، ٤٠.٤٢، ٦١.٧٦% بالمقارنة بنظام الري تحت السطحي والرش والتقليدي.

- زيادة ترشيد المياه تحت نظام الري تحت السطحي (١٧٨٠ م^{٣}/فدان) والري بالتنقيط (١٦٧٥ م^{٣}/فدان) والري بالرش (١٤٢٠ م^{٣}/فدان) بالمقارنة بنظام الري التقليدي.

- حقق الري بالتنقيط أقل تكاليف للميجاجرام من محصول اللوبيا قرون وبذور (٩٢٨، ١١٧٨ جنية) بالمقارنة بالري تحت السطحي (١١٢٢، ١٣٢٤ جنية) والرش (١٤٥٣، ١٦٨٥ جنية) والتقليدي (١١٢٧، ١٢٨٤ جنية).

- زيادة العائد الاقتصادي لمحصول الفدان من اللوبيا تحت نظام الري بالتنقيط (٣٢٧٦ جنية/فدان) بالمقارنة بنظام الري تحت السطحي (٢٦٨٠ جنية/فدان) والري التقليدي (١٨٢٣ جنية/فدان) والري الرش (١٦٠٢ جنية/فدان).

لذلك توصي الدراسة عند زراعة اللوبيا في الاراضي الجديدة يفضل استخدام نظام الري بالتنقيط أو الري تحت السطحي للحصول علي أعلي كفاءة وانتظاميه لتوزيع المياه وتوفيرها وكذلك أعلى انتاجية للمحصول (القرون والبذور) وأقل تكاليف لانتاج الوحدة من المحصول وأعلي صافي ربح في منطقة الدراسة.