EFFECT OF IRRIGATION REGIME, PHOSPHORUS LEVEL AND TWO VICIA FABA VARIETIES ON: III – IRRIGATION WATER PRICE.

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ABSTRACT

Field experiments were carried in clay loam soil during two successive growing seasons (2009-2010) to study the effect of watering regimes, phosphorous levels and Vica faba varieties on irrigation water pricing.

Treatments used were:

Watering regime:

IR_1= irrigations at 100% of Et_c throughout the irrigation season.

IR_2= irrigations at 100% of Et_c and skipped two irrigations at floral initiation stage,

IR_3= irrigations at 100% of Et_c and skipping two irrigations at flowering stage and,

IR_4= irrigations at 100% of Et_c and skipping two irrigations at podding stage.

Phosphorous levels:

P_1=20Kg P_2O_5 fed.$^{-1}$, P_2=15Kg P_2O_5 fed.$^{-1}$ and P_3=10Kg P_2O_5 fed.$^{-1}$

Faba bean varieties:

Giza Blanka(GB) and Giza 461(G461) varieties were used.

Data obtained revealed that water price of GB ranged from threefold to fourfold of that of G461. Also, increasing P_2O_5 added increased water price regardless of watering regime and faba bean variety. Faba bean must not be stressed in flowering stage (IR_3).The maximum water price were 13.2 and 3.5 EL m^{-3} of irrigation water under watering regime IR_2, whereas the minimum ones were 11.6 and 2.5 EL m^{-3} under IR_3 for GB and G461, respectively . It is obvious that water is the most limited and priceless factor over the globe. Therefore, it must not be given free to any production activity including the agricultural one for the benefit of our generations. In the same time, the nation has to compensate farmers i. e.

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giving them some production factors as seeds, fertilizers, herbicides, insecticides which can be controlled completed or partially free. Farmers can be compensated also, through doing some agricultural operation free and dropping land taxes.

Keywords: watering regime, P_2O_5 level, faba bean variety, water price.

INTRODUCTION

The agricultural production in Egypt on one hand, is constrained by limited and fixed water resources, soil salinity /sodicity, water logging and lower irrigation efficiency problems, and ,on the other hand, a fast growing population (3%) . Water is the most priceless and limiting natural resources for agricultural production in arid and semi-arid regions.

Nowadays, the total annual water resources of Egypt are about 67.27 billon m^3 (Abo,Zied, 2000) . Agricultural sector has the 1st call on water. It consumes almost 80-90% of the total water allocated to Egypt.

Many authors studied the effects of irrigation methods , irrigation levels, fertilizer level, and plant species on the net income i.c Younis (1986), Zhang and Oweis (1999), Metwally (2001),Cetin et al (2004), Maisiri et al (2005) , Tayel et al (2006), El- Shawadfy (2008), Tayel et al (2008), Sabreen(2009), Dagdelen et al (2009), Tayel et al (2010) and Tayel and sabreen (2011). The senior author does belief that the net income has been overestimated in some of the previous studies. The reasons for this are: missing one or more of the fixed costs (i. e. interest on the capital costs, land rent and water is offered free to the farmers.

The present experiment was conducted to study the effect of both irrigation and phosphorus levels and Vicia Faba varieties on irrigation water price.

MATERIALS AND METHODS

1. Field experiments:

Field experiments were conducted in two successive growing seasons 2010-2011 to study the effect of irrigation regimes and phosphorus fertilization level on cost analysis of two varieties of Faba bean production grown in clay loam soil (Table 1).

Table (1): Some soil physical properties of the experiment at site.

Sample depth, cm	Particle Size Distribution, %				θ_w (w/w)		*	B.D. (g/cm³)	Texture class
	Coarse Sand	Fine Sand	Silt	Clay	F.C.	W.P.	A. W.		
0-15	5.2	9.20	27.3	58.3	34.84	19.59	15.25	1.19	C.L
15-30	2.1	9.2	28.2	60.5	34.57	19.87	14.70	1.12	C.L
30-45	3.0	2.05	28.85	66.10	33.6	19.0	14.6	1.08	C.L

F. C : Field capacity W. P : Wilting point A.W : Available water

B.D : Bulk density C. L : Clay loam

2. Experiment layout:

The experiments were carried out in split-split plot design with three replicates. The main, sub main and sub-sub main plots were devoted for faba bean varieties, phosphorous treatments and irrigation regimes, respectively.

3. Fertilization treatments

Phosphorus and N fertilizers were applied at the rate recommended by Ministry of Agriculture and Land Reclamation i.e. 20, 15 and 10 kg of P_2O_5 /fed. in the form of super phosphate (p_1, p_2 and p_3) and 35 kg N /fed. as ammonium nitrate 33.5% . Both P_2O_5 and N were broadcasted during seed bed preparation. The two faba bean varieties were sown in rows 60 cm apart and hills were spaced 10-15 cm apart.

4. Method of irrigation and it's component:

Surface drip irrigation method was used. The irrigation system components include the following:

4.1. Control head:

It was located at the water source supply. It consists of centrifugal pump (Its discharge 300 m3/h at 2 bar pressure and 5/4 inch diameter. The pump was operated at 40 horse power and the discharge line was connected with a relief valve to control the operating pressure. A screen (120 meshes) was fitted on the inlet pump delivery pipe to complete the adequate filtration process required for water entering the system.

4.2. Main lines:

They are made of P V C pipe 63 mm in φ to convey irrigation water to the laterals.

4.3. Lateral lines:

They are made of PE tubes 16 mm in φ. The lateral length and space in between were 50 and 0.8 m, respectively

4.4. Dripper:

Standard drippers were spaced 0.5 m apart along the lateral this. The dripper discharge is 4 Lh^{-1} at an operating pressure of 1 bar.

5. Crop used:

Two varieties of faba bean Giza blanka (GB) and Giza461 (G461) were used. Plant seeds of the two varieties were sown in rows 60 cm apart in hills spaced 10-15 cm. At the end of germination stage, seedlings were thinned to secure two plant /hill.

b. Irrigation regimes:

Plants were irrigated using the four following irrigation regimes:

IR_1 =100% of Et_c throughout the irrigation season,

IR_2 =100% of Et_c and skipped two irrigations at the floral initiation stage,

IR_3=100% of Et_c and skipped two irrigations at flowering stage,

IR_4 =100% of Et_c and skipped two irrigations at podding stage,

The plants were harvested at the last week of March next year i.e. grown season lasted 120 days.

7. Cost Analysis

Irrigation costs

Capital cost for different irrigation system components was calculated using current dealer prices for equipment and installation according to 2011 price level (ASAE Standard 1997).

7.1. Fixed costs :

The annual fixed costs of capital invested in the irrigation systems were calculated using the following equation:

$$F.C. = D + I + T \qquad (1)$$

where:

F.C.	= The annual fixed cost,	(LE/year)
D	= The depreciation,	(LE/year)
I	= The interest, and	(LE/year)
T	= Taxes and overheads ratio.	(LE/year)

7.2. Depreciation was calculated using the following equation:

$$D = (I.C) / (E.L) \quad (2)$$

where:

I.C = The initial cost of irrigation system, components (LE)
E.L = The expected life of the component (years)

7.3. Interest on capital was calculated using the following equation:

$$I = (I.C / 2) \times I.R \quad (3)$$

where:

I = The interest, (taken 14%) (rate/year)

7.4. Taxes and overheads ratio, taken 2.0% from initial cost. (Tayel, 2010)

7.5. Capital Recovery factor (CRF) = depreciation + interest on investment:

$$CRF = i\,(1+i)^n / (1+i)^n \; -1 \quad (4)$$

where:

I = The interest rate decimal
n = The period of analysis

$$\text{Equipment costs per year} = CRF \times \text{initial cost} \quad (5)$$

8. Running Costs:

8.1. The annual running cost was calculated using the following equation:

$$R.C = L + E + (R\&M) \quad (6)$$

where:

R.C.	= annual running cost,	(LE/year)
L	= labor cost,	(LE/year)
E	= energy cost, and	(LE/year)
(R&M)	= repairs and maintenance costs.	(LE/year)

8.2. Labor cost " one labors for drip irrigation (20 feddans), and 20 LE/day for one labor."

8.3. Power cost, was calculated using the following equation

$$Bp = (Q \times Tdh) / K \times E \quad (7)$$

Where:

Bp	= break horse power,	(kW)
Q	= discharge rate,	(m^3/h)
Tdh	= total dynamic head,	(m)
K	= coefficient to convert to energy unit, 102 (according to Jansen, 1981), and	
E	= the overall efficiency, 45% for pump driven by internal combustion engine	

The power cost of diesel type engine was calculated using the following formula:

$$E.C = 1.2\ Bp \times H \times S \times F \qquad (8)$$

Where:

E.C	= energy cost of diesel,	(LE/ kW)
H	= annual operating hours,	(h)
S	= specific fuel consumption,	(l/kW/h)
F	= fuel price, and	(LE/l)
1.2	= factor accounting for lubrication.	

9. Repair and maintenance costs:

Pumps and emitters, 3-7% and 5-8 % of initial cost, respectively. (Jansen, 1981)

Electric motor and pipes, 1.5-2.5% and 0.5 % of initial cost, respectively. (Tayel, 2010)

10. The Total Cost = Fixed cost + Running cost, LE/fed/year

Faba bean Giza blanka seeds buy and sale 9000 and 7000 LE $fed.^{-1}$

Faba bean Giza 461 seeds buy and sale 6000 and 5000 LE $fed.^{-1}$

Add 4000 LE $fed.^{-1}$ $year^{-1}$ for rent.

RESULTS AND DISCUTION

Cost analysis: The cost analysis of drip irrigation system is presented in table (2).

Table (2): The annual cost for drip irrigation system and injection devices.

Irrigation system components		pump	E.M.	M.L.	emitters
Fixed Costs	CRF(Ismail,2009)	0.1315	0.1102	0.1023	0.1874
	Equipment cost/year	2542.97	1395.35	1125.3	1499.2
	Taxes &Overheads	386.76	253.24	220	160
	Total	2929.73	1648.6	1345.3	1659.2
Variable Costs	Labor	-	-	-	14400
	Power	-	5929.42	-	-
	Repair &maintenance	1160.28	253.24	55	520
	Total	1160.28	6182.66	55	14920
Total Cost for farm LE/Year		29900.737			
Total Cost LE/fed/Year		622.93			
Total Cost LE/fed/season		311.466			

where:

E.M. = electric motor,

M.L. = main line , and

CRF =capital Recovery factor.

Data on cost analysis are given in Tables (2, 3, 4; 5). It is obvious that while the fixed cost (depreciation + interest + taxes and overheads) of the drip irrigation system, pump, E.M., M.L. and emitters were 2929.73, 1648.6, 1345.3 and 1659.2 LE/ year respectively i. e. 25.4% of the total cost, the variable costs (labor, power and repair; maintenance) were 1160.28, 6182.66, 55 and 14920 LE/ year in the same sequence i. e. =74.6% of the total cost.

GB net profit highly exceeds that of G461. Increasing P_2O_5 applied increased the net profit of the two varieties. This is due to the following factors:

(1)Egyptian soils are poor in soluble phosphorus due to the alkalinity and $CaCo_3$,

(2)Phosphorus is an essential element for plants especially legumes,

(3)Phosphorus is needed for nodules formation and subsequently for symbiotic
nitrogen fixation and the higher number of branches plant^{-1} GB variety relative to G461 one (Tayel and sabreen,2011) .

The effect of watering regime on the net profit depends on stage of growth in which irrigation was skipped. Data on hand indicated that faba bean must not be water stressed in flowering stage (IR3). Since, all production factors have been taken into consideration in cost analysis except irrigation water, the net profit is the income from using irrigation water i. e. it price.

Data of table (6) and Fig. (1,2;3) show that water price varied from 10.7 to 13.2 LE m^{-3} and from 2.5 to 3.3 EL m^{-3} in the case of growing GB and G461, respectively . Since water is the most limited and priceless factor on the globe, it must not be given free for any production activities including the agricultural one. But the nation have to compensate farmers i. e. giving them other production factors which are under control as fertilizers, seeds, herbicides and insecticides completely or partially free. Also, doing some agricultural process as: soil plowing, crop harvesting ....ext free and dropping the agricultural land taxes are other means for farmers compensation.

Table (3): Cost of faba bean production, and its sale price under different irrigation and phosphorous treatments (LE/fed.)

Varity	Irr.	P_2O_5	Irr. Cost	Fer.	seeds	Planting	Weed control	Harvest	Total cost	Total yield ton/fed.	Production sale price LE/fed.
G461		P_1		170	360	140	333	260	3968.75	1.65	8250
	IR_1	P_2	311.466	165	360	140	333	260	3963.75	1.61	8050
		P_3		160	360	140	333	260	3958.75	1.6	8000
		P_1		170	360	140	333	260	3910.9	1.64	8200
	IR_2	P_2	276.05	165	360	140	333	260	3905.9	1.6	8000
		P_3		160	360	140	333	260	3900.9	1.51	7550
		P_1		170	360	140	333	260	3939.46	1.62	8100
	IR_3	P_2	293.53	165	360	140	333	260	3934.46	1.57	7850
		P_3		160	360	140	333	260	3929.46	1.44	7200
		P_1		170	360	140	333	260	3945.02	1.63	8150
	IR_4	P_2	296.94	165	360	140	333	260	3940.02	1.59	7950
		P_3		160	360	140	333	260	3935.02	1.5	7500
GB		P_1		170	540	140	333	260	4148.75	2.9	20300
	IR_1	P_2	311.466	165	540	140	333	260	4143.75	2.87	20090
		P_3		160	540	140	333	260	4138.75	2.81	19670
		P_1		170	540	140	333	260	4090.9	2.88	20160
	IR_2	P_2	276.05	165	540	140	333	260	4085.9	2.84	19880
		P_3		160	540	140	333	260	4080.9	2.63	18410
		P_1		170	540	140	333	260	4119.46	2.81	19670
	IR_3	P_2	293.53	165	540	140	333	260	4114.46	2.71	18970
		P_3		160	540	140	333	260	4109.46	2.54	17780
		P_1		170	540	140	333	260	4125.02	2.83	19810
	IR_4	P_2	296.94	165	540	140	333	260	4120.02	2.79	19530
		P_3		160	540	140	333	260	4115.02	2.58	18060

Add 2000 LE/fed. /season as rent

Table (4): Net profit of faba bean and water price under different irrigation and phosphorous treatments (LE/fed.)

Variety	Irrigation treatments	P_2O_5 kg /fed.	Net profit (LE/fed.)	Irr. Water price
G461	IR_1	20	4281.25	3.12
		15	4086.25	2.98
		10	4041.25	2.95
	IR_2	20	4289.1	3.53
		15	4094.1	3.37
		10	3649.1	3.00
	IR_3	20	4160.5	3.22
		15	3915.54	3.03
		10	3270.54	2.53
	IR_4	20	4204.98	3.22
		15	4009.98	3.07
		10	3564.98	2.73
GB	IR_1	20	16151.25	11.77
		15	15946.25	11.62
		10	15531.25	11.32
	IR_2	20	16069.1	13.21
		15	15794.1	12.99
		10	14329.1	11.78
	IR_3	20	15550.54	12.03
		15	14850.54	11.49
		10	13670.54	10.57
	IR_4	20	15684.98	11.99
		15	15409.98	11.78
		10	13944.98	10.66

Where:

IR_1= irrigations at 100% of Et_c throughout the irrigation season.

IR_2= irrigations at 100% of Et_c and skipped two irrigations at floral initiation stage,

IR_3= irrigations at 100% of Et_c and skipping two irrigations at flowering stage and,

IR_4= irrigations at 100% of Et_c and skipping two irrigations at podding stage.

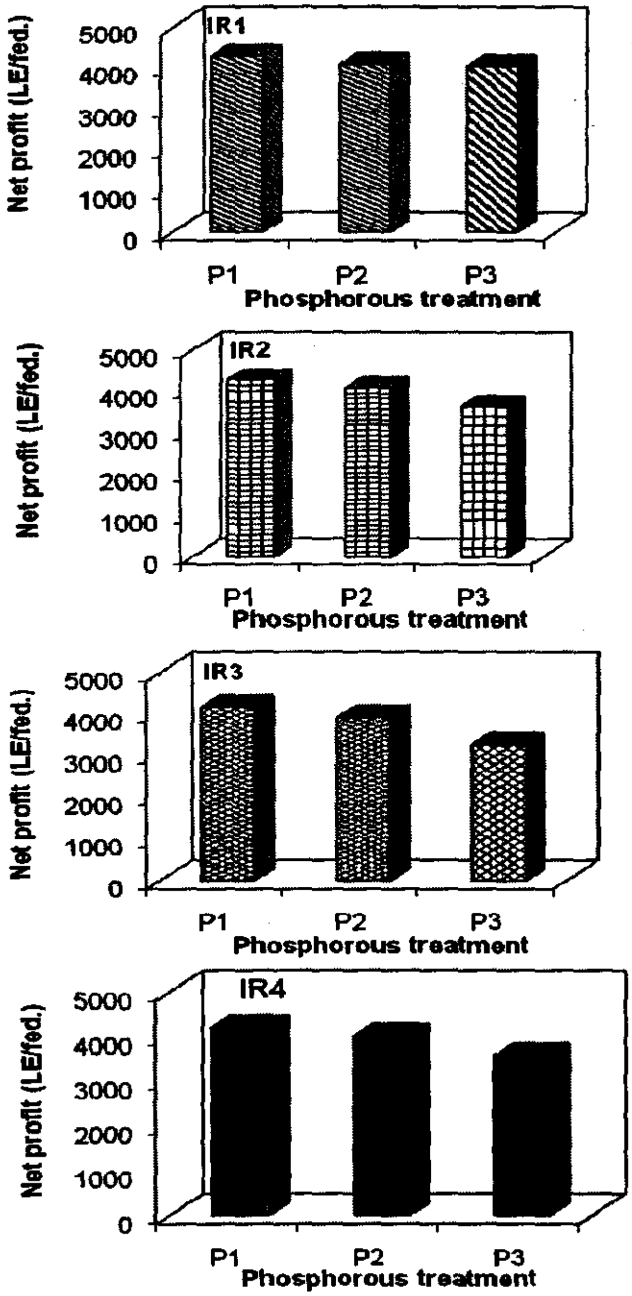

Fig .(1): Net profit of faba bean production at different irrigation and phosphorous treatments (G461).

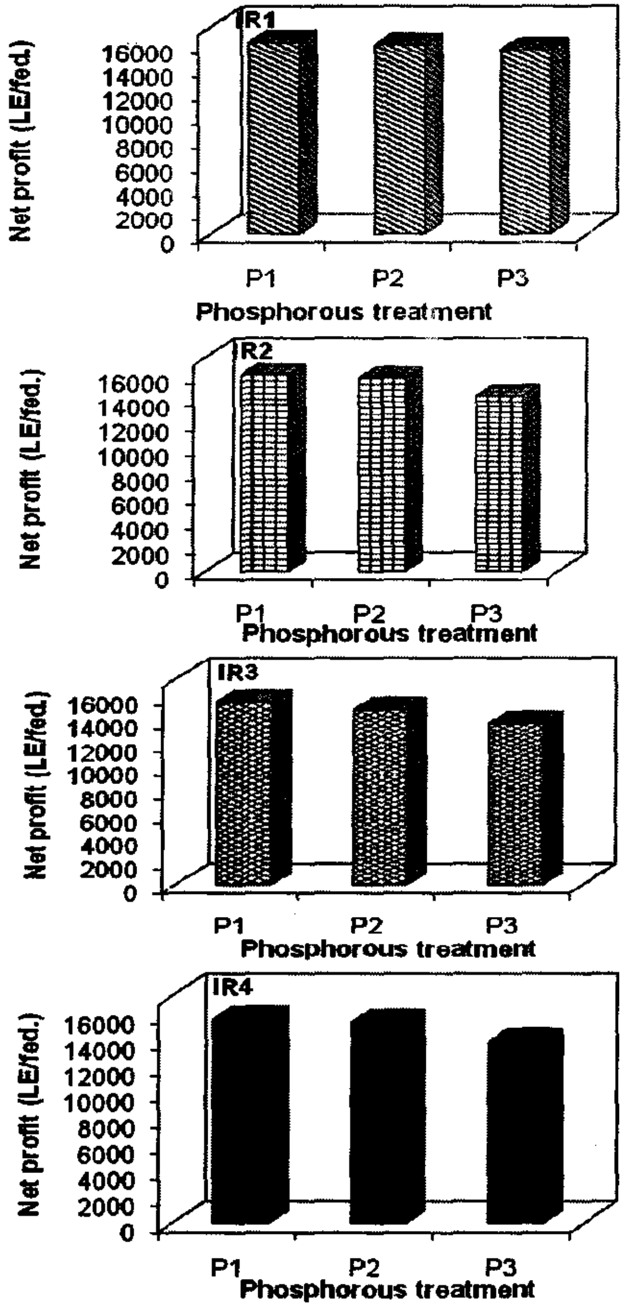

Fig.(2) : Net profit of faba bean production at different irrigation and phosphorous treatments (GB).

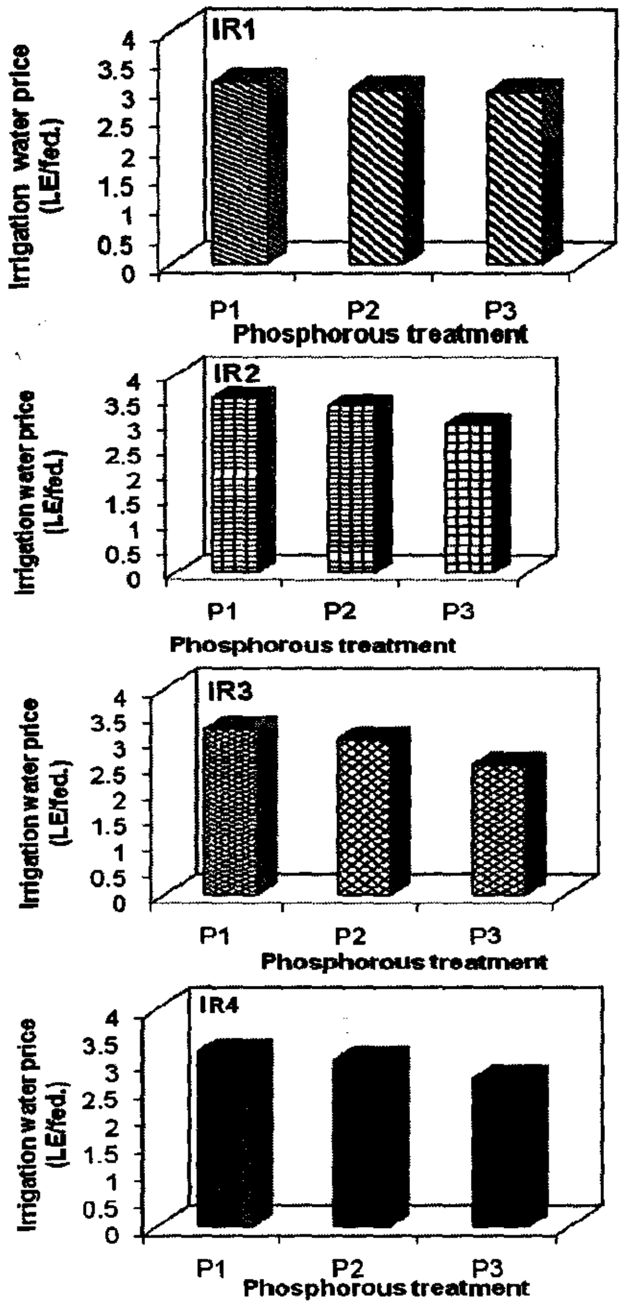

Fig.(3) : Irrigation water price of faba bean production at different irrigation and phosphorous treatments (G461).

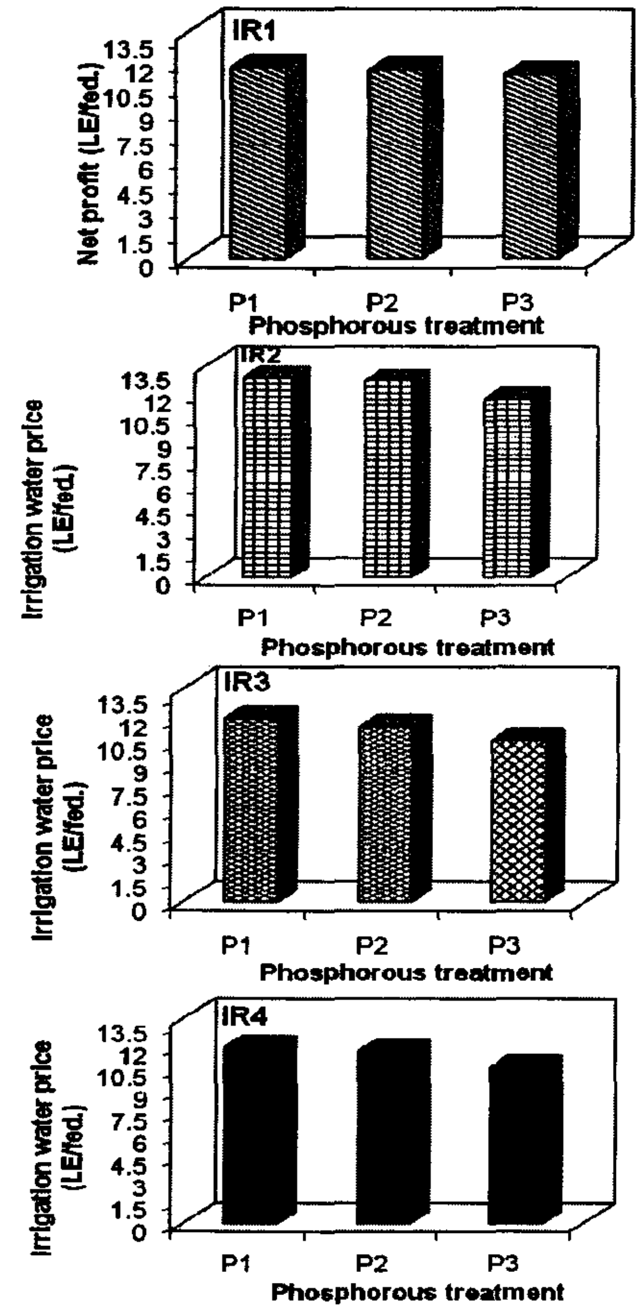

Fig.(4) : Irrigation water price of faba bean production at different irrigation and phosphorous treatments (GB).

CONCLUSION

Increasing, the income from irrigation water under conditions of the experiments necessitates the following:

(1) GB variety is recommended,

(2) P_2O_5 is necessary,

(3) plant must not be stressed during flowering stage and ,

(4) watering regime (IR2) is recommended.

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الملخص العربي

تأثير توفير مياه الري و مستوى التسميد الفسفوري وصنف الفول على العائد من وحدة المياه

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أجريت هذه الدراسة الحقلية فى تربة طمية طينية خلال موسمين للزراعة (٢٠٠٩ /٢٠١٠-٢٠١٠/٢٠١١) لدراسة تأثير توفير ريتين خلال مراحل النمو المختلفة للنبات ومستويات مختلفة من التسميد الفسفوري و صنفين من الفول البلدي علي عائد و حدة المياه، وكانت معاملات توفير المياه كالتالي:

IR_1 = إضافة مياه الري بنسبة ١٠٠ % (ET_c) على طول موسم النمو.

IR_2 = إضافة مياه الري بنسبة ١٠٠ % (ET_c) مع توفير ريتين خلال مرحلة الإنبات.

IR_3 = إضافة مياه الري بنسبة ١٠٠ % (ET_c) مع توفير ريتين خلال مرحلة الإزهار.

IR_4 = إضافة مياه الري بنسبة ١٠٠ % (ET_c) مع توفير ريتين خلال مرحلة الإثمار.

و كانت مستويات التسميد الفوسفوري هى P_1 و P_2 و P_3 (٢٠ و ١٥و١٠ كجم / فدان) خلال مرحلة اعداد مرقد البذرة و ذلك مع صنفين من الفول البلدي و هما جيزة بلانكا (GB) و جيزة٤٦١, (G461).

أظهرت النتائج المتحصل عليها أن إنتاجية GB تراوحت ما بين ثلاث إلى أربع أمثالها في صنف G461، كذلك فقد أدت الزيادة في التسميد الفوسفوري إلى الزيادة في عائد وحدة المياه بغض النظر عن معاملة الري أو صنف الفول، كما أوضحت النتائج أنه لا يجب تعريض الفول لأي إجهاد مائي خلال مرحلة الإزهار IR_3، و كان أعلى عائد لوحدة المياه ١٣,٢ و ٣,٥ جنيه / م^3 و ذلك للمعاملة IR_2 بينما كان أقل عائد لوحدة المياه ١١,٦ و ٢,٥ جنيه / م^3 و ذلك للمعاملة IR_3 لصنفي الفول GB و G461 على الترتيب.

يتضح من الدراسة أن المياه هي العنصر الذي لا يتم إدراج قيمته ضمن مدخلات الإنتاج فلا يجب منحه دون مقابل في أي نشاط إنتاجي بما في ذلك الزراعة، في المقابل يمكن للدولة دعم الفلاحين من خلال أوجه أخرى مثل ثمن التقاوي أو الأسمدة أو المبيدات و هي عناصر يمكن التحكم فيها سواء بشكل كلي أو جزئي، كما يمكن دعم الفلاحين من خلال عمليات الخدمة أو خفض الضرائب على الأراضي.

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