EFFECT OF IRRIGATION INTERVALS AND PHOSPHORUS FERTILIZATION ON THE YIELD AND ITS COMPONENTS OF LENTIL CROP

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ABSTRACT

Two field experiments were carried out at the Agricultural Experimental Farm of Suez Canal University at Ismailia during 1998/99 and 1999/2000 seasons to study the effect of three irrigation intervals, i. e. 8, 12 and 16 days and four levels of phosphorus fertilizer, i. e. 15, 30, 45 and 60 kg P_2O_5/fed. on the yield and its components of lentil crop.

Data revealed that increasing irrigation intervals significantly decreased plant height, number of branches/plant, number of pods and seeds/plant , as well as weight of pods and seeds/plant, seed index, protein percentage, seed and protein yields kg/fed. in the two seasons.

Increasing phosphorus fertilizer rate up to 60 kg P_2O_5/fed. significantly increased plant height, number of branches/plant, number of pods and seeds/plant, weight of pods and seeds/plant, seed index, seed and protein yields kg/fed., whereas protein percentage in lentil seeds was not significantly affected.

The interaction between irrigation intervals and phosphorus fertilizer was significant for number of pods, seed index and seed yield kg/fed. in the two seasons.

INTRODUCTION

Lentil *(Lens cultinaris*, Med.) is one of the important food seed legumes all over the world. In Egypt, the production of lentil in recent years is still insufficient for local consumption. The suitable cultural treatments particularly irrigation and phosphorus fertilization can increase lentil yield per unit area.

Many investigators demonstrated that production of lentil was affected greatly by soil moisture stress. Sharma and Prasad (1984) reported that seed yield/ha. was significantly increased by increasing number of irrigations. Also, Lal *et al.* (1978) found that plant height, number of branches, number of pods/plant, weight of pods/plant and seed yield/ha. were increased with increasing irrigation water supply.

El-Rayes (1990), in sandy soil, found that increasing available soil moisture increased number of pods, number of seeds/pod, seed yield/plant, 1000 - seed

number and weight of pods and seeds/plant and seed index (1000 seed weight in g). Seed yield (kg/fed.) was determined based on the whole yield of each sub-plot. Seed crude protein content (%) was determined using the modified Microkjeldahl Apparatus according to method mentioned in A. O. A. C. (1975), and the obtained values were multiplied by 6.25 as used by Tripathi *et al.* (1971).

The data were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1982). L. S. D. at the 5 % level of significance was used to compare between averages.

RESULTS AND DESCUSSION

A - Effect of irrigation intervals:

Tables (1 and 2) show that plant height was significantly decreased by prolonging irrigation intervals in the two growing seasons. These results are quite expected since prolonging irrigation intervals caused water stress which decreased the activity of meristimic tissues and caused shortening of lentil plants. Meristimic tissues are responsible for the elongation of plant which is a resultant of the length of the internodes of plants. The shortening effect may be due to the decrease in the length of internodes, which is a resultant of the number and size of cells. These results are in harmony with those reported by Lal *et al.* (1988).

Number of branches/plant was decreased significantly by increasing irrigation interval from 8 to 12 and 16 days in the two growing seasons. Similar results were reported by Lal *et al.* (1988).

Number of pods and seeds/plant were significantly decreased by extending irrigation intervals in the two seasons as shown in Tables (1 and 2). The decrease in number of pods/plant with increasing irrigation intervals might be due to the abortion of some flowers as a result of the relationship between moisture stress (increasing irrigation intervals) and different physiological processes occurred in plant. These results are in harmony with those reported by Lal *et al.* (1988), El-Rayes (1990), Harb (1994) and Rashad *et al.* (1999).

Results in Tables (1 and 2) show that weight of pods and seeds/plant were significantly decreased as irrigation intervals were prolonged in the seasons. The decrease in weight of pods and seeds by increasing irrigation intervals might be due to the negative effect of moisture stress on vegetative growth of plants and consequently weight of pods and seeds per plant. These results are in agree with those obtained by Lal *et al.* (1988), El-Rayes (1990), Harb (1994) and Rashad *et al.* (1999).

Seed index also significantly decreased with prolonging irrigation intervals in the two seasons (Table 1 and 2). Similar results were reported by El-Rayes (1990) and Rashad *et al.* (1999).

Table (1): Effect of irrigation intervals and phosphorous fertilizer levels on yield and its components of lentil in 1998/99 season.

Treatments	Plant height (cm)	Number of			Weight (g) of			Seed yield (kg/fed)	Protein (%)	Protein yield (kg/fed)
		Branches /plant	Pods /plant	Seeds /plant	Pods /plant	Seeds /plant	1000-seeds			
Irrigation intervals:										
8 days	58.5 A	4.3 A	32.81 A	45.21 A	2.45 A	1.19 A	26.32 A	559.2 A	29.85 A	166.92 A
12 days	46.3 B	3.5 B	29.02 B	33.85 B	1.38 B	0.87 B	25.70 A	448.3 B	28.01 A	125.57 B
16 days	38.2 C	3.1 B	21.85 C	29.48 C	1.07 B	0.66 B	22.40 B	332.5 C	25.73 B	85.55 C
Phosphorous fertilizer levels (kg P_2O_5/fed):										
15	39.3 C	2.5 C	18.25 D	29.35 C	1.00 C	0.66 C	22.61 C	316.8 D	27.13 A	85.94 D
30	46.1 BC	3.5 B	25.32 C	34.85 BC	1.50 B	0.85 C	24.35 B	385.5 C	27.84 A	107.32 C
45	48.3 B	3.9 B	31.45 B	36.78 B	1.77 B	0.95 B	25.71 AB	488.7 B	28.05 A	137.08 B
60	57.1 A	4.5 A	36.56 A	43.70 A	2.26 A	1.16 A	26.63 A	595.6 A	28.42 A	169.27 A
Interaction:										
Irri. Phos.	NS	NS	*	NS	NS	NS	*	*	NS	NS

Table (2): Effect of irrigation intervals and phosphorous fertilizer levels on yield and its components of lentil in 1999/2000 season.

Treatments	Plant height (cm)	Number of			Weight (g) of			Seed yield (kg/fed)	Protein (%)	Protein yield (kg/fed)
		Branches /plant	Pods /plant	Seeds /plant	Pods /plant	Seeds /plant	1000-seeds			
Irrigation intervals:										
8 days	52.7 A	4.7 A	35.12 A	47.12 A	2.57 A	1.29 A	27.37 A	565.4 A	30.20 A	170.75 A
12 days	45.2 B	3.8 B	30.51 B	35.56 B	1.63 B	0.93 B	26.15 B	458.2 B	28.74 A	131.69 B
16 days	38.6 B	3.5 B	23.54 C	30.50 C	1.15 B	0.60 C	22.30 C	370.1 C	26.32 B	97.41 C
Phosphorous fertilizer levels (kg P_2O_5/fed):										
15	35.8 C	3.1 C	20.51 C	30.15 C	1.08 C	0.69 B	22.85 C	333.7 C	27.58 A	92.03 C
30	43.4 B	4.0 B	26.52 B	35.61 BC	1.67 B	0.89 B	24.93 B	399.8 B	27.95 A	111.74 C
45	46.3 B	4.1 A	32.70 B	39.69 B	1.91 B	1.04 AB	26.12 A	530.6 A	28.57 A	151.59 B
60	56.5 A	4.8 A	39.15 A	45.43 A	2.45 A	1.24 A	27.21 A	594.1 A	28.59 A	175.79 A
Interaction:										
Irri. Phos.	NS	NS	*	NS	NS	NS	*	*	NS	NS

Tables (1 and 2) show that seed yield (kg/fed.) was significantly decreased by increasing irrigation intervals in the two growing seasons. The decreases in seed yield/fed. were 19.83 % and 40.54 % with intervals of 12 and 16 days as compared with 8 days interval in 1998/99, being 18.96 % and 34.50 % in 1999/2000 season for the same respective intervals. It is aforementioned that moisture stress due to extending irrigation intervals affected negatively the vegetative growth of plants as expressed by plant height and number of branches per plant. This in turn affected negatively pod setting i.e. number of pods/plant as well as number of seeds/plant and 1000 seed weight resulting in less seed yield/plant and consequently decreased seed yield per fed. Sharma and Prasad (1984), Lal *et al.* (1988), El-Rayes (1990), Harb (1994), Gendy and Derar (1990) and Rashad *et al.* (1999) came to similar results.

Tables (1 and 2) show also that increasing irrigation intervals significantly decreased seed protein %, as well as protein yield/fed. in the two growing seasons. These results are in agreement with those obtained by Sharma and Prasad (1984) and Gendy and Derar (1995).

B - Effect of phosphorus fertilization:

Tables (1 and 2) present the effect of phosphorus fertilizer rates on plant height, number of branches, pods and seeds/plant, as well as weight of pods and seeds/plant, seed index and seed protein %, seed yield and protein yield kg/fed. in 1998/99 and 1999/2000 seasons.

Plant height was significantly increased by increasing phosphorus fertilizer application in the two seasons; while the differences between 30 and 45 kg P_2O_5/fed. in the two seasons were not significant.

Tables (1 and 2) indicate also that the numbers of pods and seeds/plant were significantly increased by increasing phosphorus application up to 60 kg P_2O_5/fed. in the two growing seasons. These results agree with those reported by Krishnareddy and Ahlawat (1996) and Sharief and Said (1998).

Increasing phosphorus fertilizer level up to 60 kg P_2O_5/fed. significantly increased weight of pods and seeds/plant in the two seasons; while the difference between 30 and 45 kg P_2O_5/fed. was not significant (Table 1 and 2). These results are in harmony with those obtained by Sharief and Said (1998).

Tables (1 and 2) show that seed index was consistently and significantly increased with increasing phosphorus fertilizer level from 15 to 60 kg P_2O_5/fed. That was true in the first and second seasons. Similar results were reported by Sharief and Said (1998).

Tables (1 and 2) present that seed protein % was not affected by phosphorus fertilizer levels in the two seasons. These results are in harmony with those reported by Sharma and Singh (1986) and Bremer *et al.* (1989).

Table (3): The effect of interaction between irrigation intervals and phosphorous fertilizer level on number of pods/plant,1000 -seed weight and seed yield kg/fed in 1998/1999 seasons.

Irrigation intervals	P_2O_5 (Kg/fad)	No. of pods/plant	1000 - seeds Weight (g)	Seed yield (kg/fad)
8 days	15	20.2 e	23.40 ef	347.6 e
	30	28.0 cd	26.00 bc	451.1 cd
	45	40.9 ab	28.10 a	673.4 ab
	60	42.8 a	28.40 a	764.3 a
12 days	15	19.5 ef	24.01 cde	315.9 e
	30	26.0 d	24.98 c	389.9 cde
	45	30.5 c	26.37 b	480.9 c
	60	38.1 b	26.58 b	606.9 b
16 days	15	16.1 f	19.50 h	267.2 e
	30	19.7 ef	21.45 g	275.2 e
	45	25.0 d	22.82 f	384.2 de
	60	26.4 d	24.00 cde	403.2 cde

Table (4): The effect of interaction between irrigation intervals and phosphorous fertilizer level on number of pods/plant, 1000-seed weight and seed yield kg/fed in 1999/2000 seasons.

Irrigation intervals	P_2O_5 (Kg/fad)	No. of pods/plant	1000 - seeds Weight (g)	Seed yield (kg/fad)
8 days	15	24.2 gh	25.46 c	375.4 efg
	30	32.0 de	26.60 bc	513.1 bc
	45	36.4 c	28.90 a	610.2 b
	60	47.7 a	28.96 a	763.3 a
12 days	15	19.7 l	24.03 d	342.4 efg
	30	27.5 fg	26.90 b	406.7 def
	45	33.4 cd	27.13 b	485.5 cd
	60	41.3 b	27.20 b	597.7 b
16 days	15	16.2 j	20.18 f	302.8 g
	30	22.2 hi	21.69 e	320.2 fg
	45	26.3 fg	22.84 de	420.0 cde
	60	29.3 ef	24.02 d	437.6 cde

Also, seed yield and protein yield kg/fed. were consistently and significantly increased as phosphorus fertilizer level had been increased up to 60 kg P_2O_5/fed. in the two growing seasons. The increase in seed yield/fed. by increasing phosphorus application might be due to the increase in number and weight of pods and seeds/plant , as well as seed index (Tables 1 and 2). These results are in harmony with those reported by Sharma and Singh (1986), Bremer *et al.* (1989), Chandra (1991), Rathor *et al.* (1992), Krishnareddy and Ahlawat (1996), Sharief and Said (1998).

C - Effect of the interaction:-

Results in Tables (3 and 4) show significant interaction between irrigation intervals and phosphorus fertilizer on number of pods/plant, seed index and seed yield kg/fed. in the two growing seasons. The lowest values, namely 16.2 and 16.2 pods/plant , 19.50 and 20.18 g/1000 seeds and 267.2 and 302.8 kg seeds/fed. resulted by irrigation every 16 days and applying 15 kg P_2O_5/fed. in 1998/99 and 1999/2000 seasons, respectively. Meanwhile, the highest values namely 42.8 and 47.7 pods/plant, 28.40 and 28.96 g/1000 seeds and 764.3 and 763.3 kg seeds/fed. were obtained with irrigation every 8 days and applying 60 kg P_2O_5/fed. in 1998/99 and 1999/2000 seasons, respectively.

It could be concluded that the irrigation every 8 days and adding 60 kg P_2O_5/fed. gave the highest yield and quality of lentil in sandy soil at Ismailia Governorate.

REFERENCES

A.O.A.C. (1975): Official methods of analysis 12 th Ed.; Assoc. Official Agric. Chem., Washington, D. C.

Bremer, E.; C. Van Kessel and R. Kramanos (1989): Inoculant, phosphorus and nitrogen response of lentil. Can. J. Plant Sci., 69: 691 - 701.

Chandra, R. (1991): Influence of different levels of Rhizobium inculm and phosphorus on nodulation, dry matter production and yield of lentil legumes 14 (3): 145 - 149.

El-Rayes, A. A. (1990): Response of some lentil varieties to some irrigation treatments in the sandy soil. M. Sc., Thesis, Fac. Agric. Al-Azhar Univ.

Gendy, E. N. and R. A. Derar (1995): Effect of irrigation and farmyard manure applications on lentil. Egypt. J. Agric. Res., 73 (4): 889 - 896.

Harb, O. M. S. (1994): Effect of irrigation regimes and seeding rates on yield and its components of some lentil crop varieties. Al - Azhar J. Agric. Res., (19): 43 - 51.

Krisnareddy, S. V. and I. Ahlawat (1996): Growth and yield response of lentil cultivars to phosphorus, zinc and biofertilizors. J. of Agric. and Crop. Science 177 (1): 49 - 59.

Lal, M. P. C.; P. C. Gupta and R. K. Pandey (1988): Response of lentil to different irrigation schedules. Lens Newsletter, 15 (1): 20 - 23.

Rashad, A. D ; M. A. Mohamed and H. A. Yaseen (1999): Effect of available soil. moisture depletion and sprinkler irrigation patterns on lentil plant in sandy soil. Proc.3rd Conf. On - Farm Irrigation and Agroclimatology. Soil, Water & Environment Research Institute Agric. Res. Cent. Minst. of Agric. and Land Reclamation. (1): 284 - 296.

Sharief, A. E. and EL. M. Said (1998): Response of lentil (*Lens cultinaris*, Med.) productivity to phosphorus fertilizer levels and some micronutrients. Proc. 8 th Conf. Agron., Suez Canal Univ., Ismailia, Egypt. 326 - 334.

Sharma, B. B. and R. R. Singh (1986): Response of lentil to seeding rates and fertility levels under semi-arid conditions. Lens News Letter, 13 (1): 23 - 25.

Sharma, R. N. and R. Prasad (1984): Effect of soil moisture regime on the yield and water use of lentil. Indian Irrigation Science 5 (4): 285 - 293.

Snedecor, W. G. and W. G. Cochran (1982): Statistical methods. 7th Ed. 2ned printing, Iowa State Univ., Press, Ames. Iowa, USA, 507 PP

Tripathi, S. K. and J. C. Kdward (1978): Response of Rhizobium culture inoculation, zinc and molybdenum application of soybean (*Glycine max* L.) Indian J. Plant Physiology, 21: 248 - 252.

الملخص العربى

تأثير فترات الرى والتسميد الفوسفاتى على المحصول ومكوناته فى العدس

محمد صبرى حمادة على يوسف

قسم المحاصيل - كلية الزراعة - جامعة قناة السويس - الإسماعيلية - مصر

أجريت تجربتان حقليتان بمزرعة **كلية الزراعة بالإسماعيلية جامعة قناة السويس** خلال موسمى ١٩٩٩/٩٨ ، ٢٠٠٠/٩٩ وذلك لدراسة **تأثير ثلاث فترات رى هى ٨ ، ١٢ و ١٦ يوم** و أربعة مستويات من التسميد الفوسفاتى هى **١٥ ، ٣٠ ، ٤٥ و ٦٠ كجم فوبأه/فدان** .أدت إطالة فترات الرى الى حدوث نقص فى ارتفاع النبات **وعدد الأفرع/نبات وعدد القرون والبذور/نبات** وكذلك وزن القرون **البذور/نبات** ووزن ألف **١٠٠٠ بذرة ونسبة البروتين بالبذور و محصول البروتين ومحصول البذور/فدان فى موسمى** الدراسة.

أدت زيادة معدل التسميد **الفوسفاتى من ١٥ الى ٦٠ وحدة فوبأه /الفدان الى زيادة ارتفاع النبات وعدد الأفرع/نبات وعدد القرون وعدد البذور/نبات ووزن القرون ووزن البذور/نبات** ووزن الف **١٠٠٠** بذرة ومحصول البذور **ومحصول البروتين/فدان فى موسمى الدراسة** . بينما لم تتأثر نسبة البروتين **بالبذور معنويا.**

ووجد تأثير معنوى للتفاعل بين **فترات الرى ومعدلات التسميد الفوسفاتى على عدد القرون ووزن الف ١٠٠٠** بذرة ومحصول **البذور/فدان فى موسمى الدراسة** حيث اعطى الرى كل ٨ يوم مع التسميد بمعدل ٦٠ كجم فوبأه/فدان اعلى **متوسطات لهذه الصفات** .