J. Agric. Sci. Mansoura Univ., 32 (9): 7641 - 7651, 2007

EFFECT OF SOME AGRICULTURAL PRACTICES ON YIELD, PROTEIN AND NITRATE ACCUMULATION OF THE GREEN AND DRY BROAD BEAN SEEDS

Masoud, A.M.*; Y.B. El-Waraky* and R.E. Knany**

*** Veg. Res. Dept., Hort. Res. Inst. Agric. Res. Center, Giza Egypt**

**** Soils, Water and Environment Res. Inst., Agric. Res. Center, Giza, Egypt**

ABSTRACT

The objective of the present study is to investigate the effect of three spaces between plants of 15, 20 and 25 cm and three nitrogen forms of $(NH_4)_2$ SO_4 20% N, NH_4NO_3 33% N and urea ammonium nitrate liquid (UAN) 32% N on broad bean var. Kassasen 1 growth, yield, protein and nitrate accumulation. Two field experiments were conducted at Disuq district Kafr El-Sheikh Governorate during the two successive winter seasons of 2004/2005 and 2005/2006. The results could be summarized as the following:

1. Wider space (25 cm) between plants had the highest vegetative growth i.e., number of leaves plant^{-1}, number of branches and leaf area plant^{-1}, as well as the highest number of pods plant^{-1}, green pods weight and green pods plant^{-1}. On the other hand, the narrow spaces (15 cm) had the highest green pods weight fed.$^{-1}$ and the lowest nitrate, phosphorus %, total nitrogen % and total protein %.
2. Urea ammonium nitrate had the highest vegetative traits parameter while the lowest values were recorded with ammonium sulphate form. Also, the highest yield and yield components values were obtained with urea ammonium nitrate in both seasons. The lowest nitrate accumulation in the green pods and dry seed samples were obtained with $(NH_4)_2$ SO_4 in both seasons. The highest phosphorus % values were observed with $(NH_4)_2$ SO_4 in both seasons while the highest protein % values were recorded with UAN forms.

INTRODUCTION

Broad bean is one of the most important legume crops as a cheap form of protein and less requirements of fertilizer. It can grow throughout different types of soils. Contaminant food is a reason of human diseases. Nitrate is one of the contaminating materials which affect human health. Nitrate accumulation in edible plants is a problem when eaten. Part of the ingested nitrate may be converted to nitrite causing methaemoglobinaemia or even to carcinogenic nitrosamines. ESCF (1997) reported that the committee has established an acceptable daily intake (ADI) of 0-5 mg of nitrate per kg body weight expressed as sodium nitrate equivalent to 0-3.7 mg/kg body weight for the nitrate ions.

Arnaoot (2001) reported that the highest permissible limit for human total consumption is 3.65 mg NO_3-N and 0.133 mg NO_2-N for adult one. The determination of nitrate and nitrite in food stuffs become increasingly important because of the concern over excessive human dietary intake of these species causing a hazard effect on healthy (Abd El-Hamied, 2001). Nitrate occurs naturally in plants and it's levels in vegetables are influenced by genetic and interrelated geographic and seasonal factors of light intensity, temperature, extent of fertilizer use and weather. Strong positive response to supplementary nitrogen and low nitrogen use efficiency can result in high levels of nitrate accumulation in the marketable crops (Kaya *et al.,* 2001). For examples, nitrate accumulation of rice grain (Knany and Atia, 2003), nitrate accumulation of cucumber fruits (Knany and Abd Alla, 2006) and nitrate accumulation of spinach (Lamyaa, 2007).

Spaces between plants can affect broad bean productivity, seed quality and nitrate accumulation. Numerous researchers working on some legumes reported variation in yield and yield components due to the change in plant density by changing either inter or intra row spacing Sharaf *et al.* (1980) and Uddin (1981) on soybean found that narrowing row spacing from 60 to 30 cm apart decreased number of pods plant^{-1}, 100 seed weight and seed yield. The closer, within row spacing and closer inter-row spacing were preferable in the highest yield. Moreover, large plant population and high density were economic value owing to obtained higher yield (White and Anderson, 1971 on pea, Saleh *et al.,* 1980 on cowpea and Hussein *et al.,* 1994 on faba bean). Total seed yield fed^{-1} increased with decreasing the spacing between plants, Mohamed and Helal (1999), Masoud (2002). Concerning the effect of nitrogen forms. Nitrogen forms can affect broad bean productivity and nitrate accumulation of the pods. Knany *et al.* (2002) studied the effect of nitrogen forms on cowpea productivity. They reported that nitrogen forms significantly affected seeds yield.

The objectives of the present study is to investigate effect of spacing between plant (light intensity) and nitrogen forms on broad bean productivity and nitrate accumulation in the seeds at different growth stages.

MATERIALS AND METHODS

Two field experiments were carried out at Disuq district Kafr El-Sheikh Governorate during two successive winter seasons of 2004/2005 and 2005/2006 to assess effect of three spacing of 15, 20 and 25 cm between plants and the effects of three nitrogen forms of $(NH_4)_2$ SO_4, NH_4 NO_3 and urea ammonium nitrate (UAN) on faba bean var. Kassasen 1 growth, yield and green pods quality. In all treatments broad bean seeds were inoculated by an effective strain of *Rhizobium* bacteria just before sowing. Broad bean seeds were sown in November 5 and 10 in the first and second seasons, respectively.

The experiments were conducted using split-plot system in a randomized complete block design, with four replications. The main plots were assigned by three spaces between plants and the sub-plot were assigned by three nitrogen forms. Each sub-plot contained 4 rows, 5 m in length and 0.6 m in width, comprising an area of 12 m^2. Sowing was done on one side of row, 2 seeds in the hill. The other recommended agricultural practices were used. The experiments soil was loamy clay in texture. Some soil characteristics were measured according to Jackson (1958) and Black *et al.* (1965) and presented in Table 1.

According to soil analysis 15 kg P_2O_5 fed^{-1} was applied as super phosphate calcium 15% P_2O_5 during soil preparation. The nitrogen fertilizer was applied as three forms of $(NH_4)_2$ SO_4 20% N, NH_4NO_3 33% N and UAN 32% N at the rate of 15 kg N fed^{-1} 20 days after sowing. Broad bean growth, green yield and yield component were recorded. The obtained data were statistically analysed using COSTAT Software (1985), and revised LSD test was used to compare the differences among treatments means (Snedecor and Cochran, 1972).

Fresh samples were collected during the growth period for monitoring nitrate states in green pods as follow:

1. The first mature leaf (the fourth from top) with the first pod stage.
2. The first green pod on the plant (when the seeds become suitable for eaten).
3. The fifth green pod (the mid stage for the plants).
4. Seeds at harvest.

Nitrate in the seeds of the collected samples were determined according to Singh (1988).

Ten samples oven dried at 70°C, crashed and digested using sulphoric + perchloric acids according to Piper (1947).

Total nitrogen was determined by Kjeldahel method, phosphorus was determined colorimetercally according to Jackson (1958), protein was calculated by multiplying total N% by 6.25.

Table (1): Some soil characteristics.

Season	Mechanical analysis			Texture	pH*	EC** dSm^{-1}	O.M %	Available nutrients mg kg^{-1}		
	Sand %	Slit %	Clay %					N	P	K
1st	9.0	51.0	40	Loamy clay	7.9	1.2	1.8	32	5.5	440
2nd	8.7	52.0	39.3	Loamy clay	7.9	1.1	1.8	29	5.5	380

*** 1: 2.5 soil: water suspension**
*** Soil past extract.**

RESULTS AND DISCUSSION

I. Vegetative growth characters:

a. Effect of spacing:

Data presented in Table (2) show that all vegetative traits, i.e. plant height, number of leaves, number of branches, leaf area and number of nods to first flower were affected by plant spacing. Plants grown under narrow spacing of 15 cm between plants were tallest (100 and 88.7 cm) and number of nods to first flower increased (5.2 and 5.0) than those grown under wider spacing of 25 cm between plants. The differences were significant in both seasons. On the other hand, it is clear that the other vegetative traits were improved as spacing between plants increased. The results may reasonably be explained as the narrower planting space causes more competition between plants for nutrients and light. While the wider space between plants gave the chance for more branching and correspondingly more leaves can be born by the increased number of branching per plant (Abd El-Rahman *et al.,* 1983; Morsy, 1986; Metwally *et al.,* 1998 and Masoud, 2002).

b. Effect of nitrogen forms:

Data in Table (2) show that nitrogen forms significantly affected plant height, number of leaves, number of branches, leaf area and number of nodes to first flower in both seasons. The highest values of vegetative growth were obtained by urea ammonium nitrate (UAN) fertilizer in both seasons. On the other hand, the number of nodes to the first flower had the highest value with $(NH_4)_2 SO_4$ in both seasons. This may be due to UAN is fertilizer contain the nitrogen in negative ions (NO^-_3), positive ions (NH_4) and organic molecular as urea which increased absorption. These results are in agreement with those obtained by Blondel and Blane (1973), Rao and Rains (1976) and Knany *et al.* (2002).

Table (2): Effect of distance between plants and nitrogen forms on broad bean vegetative growth characters in 2004/2005 and 2005/2006 seasons.

Treatments	Plant height (cm)		No. of leaves plant^{-1}		No. of branches plant^{-1}		Leaf area plant^{-1} (cm^2)		Nods to first flower (no.)	
Season	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**
Spacing (cm)										
15	100.0 a	88.7 a	54.7 c	41.0 c	2.5 a	1.9 b	3010.6 b	2744.9 c	5.2 a	5.0 a
20	83.0 c	78.1 c	56.8 b	43.5 b	2.6 a	2.0 b	4041.1 a	2940.7 b	4.9 b	4.9 a
25	86.7 b	81.5 b	62.4 a	47.5 a	2.6 a	2.5 a	4127.3 a	3388.1 a	4.9 b	4.5 b
Nitrogen forms										
$(NH_4)_2 SO_4$	86.8 c	79.0 c	55.1 c	41.2 c	2.4 a	1.8 c	3562.9 c	2788.1 c	5.4 a	5.1 a
NH_4NO_3	89.7 b	81.5 b	56.9 bc	43.5 b	2.5 a	2.2 b	3739.5 b	2985.5 b	5.1 b	4.7 bc
UAN	93.3 a	87.8 a	61.8 a	47.3 a	2.6 a	2.4 a	3876.8 a	3300.1 a	4.6 c	4.5 c

Values having a similar alphabetical letter, within a comparable group of means, are not significantly different, using revised L.S.D. test at 0.05 level.

c. Effect of spacing between plants and nitrogen forms interaction:

Data presented in Table (3) show that the interaction between spacing and nitrogen forms was significant for plant height, number of leaves, number of branches, leaf area and number of nods to the first flower, where the highest values of plant height 106.8 and 98.4 cm were obtained with 15 cm between plants and UAN in the first and second seasons, respectively. The plants grown in wider space 25 cm and UAN produced more number of leaves, number of branches and leaf area in both seasons. On the other hand, the plants grown in narrow space 15 cm and (NH_4) SO_4 produced highest values of number of nodes to the first flower in both seasons.

Table (3): The effect of interaction between distance between plants and nitrogen forms on broad bean vegetative growth characteristics in 2004/2005 and 2005/2006 seasons.

Treatments		Plant height (cm)		No. of leaves plant^{-1}		No. of branches plant^{-1}		Leaf area plant^{-1} (cm^2)		Nods to first flower (no.)	
Spacing (cm)	**Nitrogen forms**	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**
15	$(NH_4)_2 SO_4$	92.9 c	82.3ef	52.9 c	38.5 d	2.3 a	1.8 a	2826.4 e	2425.3 g	5.8 a	5.3 a
	NH_4NO_3	100.4 b	85.4 b	54.1 c	41.0 cd	2.5 a	1.9 de	3037.1 d	2765.5 f	5.2 c	4.9 b
	UAN	106.8 a	98.4 a	57.0 bc	43.5 cd	2.6 a	2.1 bcd	3168.2 cd	3043.8 d	4.8 de	4.8 b
20	$(NH_4)_2 SO_4$	81.3 g	74.0 l	54.0 c	40.4 d	2.5 a	1.9 de	3927.5 b	2742.5 f	5.3 bc	5.2 ab
	NH_4NO_3	82.4 g	77.9 gh	55.5 c	42.5 cd	2.5 a	2.0 cde	4038.8 b	2790.7 ef	5.0 cd	4.7 b
	UAN	85.5fg	82.5 de	61.0 b	47.5 b	2.8 a	2.1 bcd	4157.1 ab	3288.9 bc	4.6 e	4.7 b
25	$(NH_4)_2 SO_4$	86.1 fg	80.6 g	58.5 bc	44.6 bc	2.5 a	1.9 de	3934.2 b	3196.3 c	5.3 bc	4.8 b
	NH_4NO_3	86.3 ef	81.3 f	61.3 b	47.0 b	2.5 a	2.8 a	4142.7 ab	3400.4 b	5.0 cd	4.6 b
	UAN	87.8 d	82.6 cd	67.5 a	51.0 a	2.8 a	3.0 a	4305.1 a	3567.6 a	4.4 e	4.0 c

Values having a similar alphabetical letter, within a comparable group of means, are not significantly different, using revised L.S.D. test at 0.05 level.

II. Green pods yield and its components:

a. Effect of spacing between plants:

Data presented in Table (4) show that broad bean plants grown at wider spacing (25 cm between plants) produced the highest values of number of pods per plant, five green pods weight and green pods weight per plant. While, broad bean plants grown under narrow spacing (15 cm between plants) produced the lowest value. The differences were significant in both seasons. Pod length and number of seeds per pod were not significantly affected by spacing between plants in both seasons.

On the other hand, broad bean grown at 15 cm between plants produced the highest green pods yield, i.e. 4.8 and 5.3 ton/fed. in the first and second season, respectively, while plants grown at 25 cm between plants produced the lowest green pods yield i.e., 3.0 and 3.3 ton/fed. in the first and second season, respectively. This may be due to 15 cm spacing between plants led to increase number of plants per fed. 66% (93000 plant fed^{-1}) rather than that of 25 cm space (56000 plant fed^{-1}). In this respect, many investigators reported that yield per feddan significantly increased as spacing between plants decreased. Saleh *et al.* (1980) on cowpea, found that less crowded plants led to higher seed yield per plant but lower seed yield per feddan.

Table (4): Effect of distance between plants and nitrogen forms on green pod yield and its components for broad bean in 2004/2005 and 2005/2006 seasons.

Treatments	No. of pods plant^{-1}		Five green pods weight (gm)		Green pods weight plant^{-1} (gm)		Green pods weight fed-1 (ton)		Pod length (cm)		No. of seeds pod^{-1}	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Spacing (cm)												
15	11.5b	12.9a	50.2de	50.3b	117.9b	133.3b	4.8a	5.3a	10.0a	9.8a	3.7a	3.8a
20	11.7ab	13.4a	51.9c	51.0ab	124.2a	136.9ab	3.9b	4.4b	9.8a	9.9a	3.7a	3.8a
25	12.2a	13.6a	54.1a	52.5a	126.8a	139.9a	3.0c	3.3c	10.1a	9.9a	3.9a	3.9a
Nitrogen forms												
$(NH_4)_2\ SO_4$	10.2c	11.5d	49.8e	49.9c	101.5c	115.9c	3.2c	3.7c	9.8b	9.7b	3.5c	3.6c
NH_4NO_3	11.5b	12.9c	52.0bc	51.0bc	124.9b	136.4b	4.0b	4.4b	10.1a	9.8b	3.8b	3.8b
UAN	13.7a	15.5a	54.5a	52.8a	142.7a	157.9a	4.5a	5.0a	10.2a	10.2a	4.0a	4.0a

Values having a similar alphabetical letter, within a comparable group of means, are not significantly different, using revised L.S.D. test at 0.05 level.

b. Effect of nitrogen forms:

Data presented in Table (4) clearly show that nitrogen forms significantly affected number of pods per plant, five green pods weight, green pods weight per plant, green pods weight per feddan, pod length and number of seeds per pod in both seasons. The highest value were obtained by urea ammonium nitrate (UAN) fertilizer. This due to UAN is fertilizer contain NO_3, NH_4 and urea which help the plants in nitrogen absorption under widdly soil conditions and different plant stages. These results are in agreement with those obtained by Blondel and Blanc (1973) and Rao and Raino (1976).

c. Effect of spacing between plants and nitrogen forms interaction:

Table (5) shows the comparisons among the various treatment combinations of spacing between plants and nitrogen forms application on green yield and its components, of broad bean plants.

Data revealed that number of pods plant^{-1} and five green pods weight increased progressively with increasing spacing between plants up to 25 cm at urea ammonium nitrate (UAN) fertilizer in both seasons. On the other hand, no significant effects of the interaction between spacing between plants and nitrogen forms on green pods weight plant^{-1}, green pods weight fed^{-1}, pod length and number of seeds pod^{-1} in both seasons.

Table (5): The effect of interaction between spacing between plants and nitrogen forms on broad bean yield and yield component in 2004/2005 and 2005/2006 seasons.

Treatments		No. of pods plant^{-1}		Five green pods weight (gm)		Green pods weight plant^{-1} (gm)		Green pods weight fed^{-1} (ton)		Pod length (cm)		No. of seeds pod^{-1}	
Spacing (cm)	Nitrogen forms)	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
15	$(NH_4)_2 SO_4$	10.2f	11.3h	48.8f	48.9d	99.2a	114.2a	4.0cd	4.6a	9.8a	9.5a	3.5a	3.6a
	NH_4NO_3	11.1e	12.6e	50.1ef	50.5cd	120.5a	135.0a	5.0ab	5.4a	10.0a	9.8a	3.7a	3.7a
	UAN	13.4b	14.9b	51.8cd	51.3c	134.2a	150.8a	5.4a	6.0a	10.1a	10.0a	4.0a	3.8a
20	$(NH_4)_2 SO_4$	10.2f	11.4gh	49.9ef	50.0cd	101.7a	115.3a	3.3e	3.8a	9.7a	9.6a	3.5a	3.6a
	NH_4NO_3	11.3de	13.0d	51.5de	51.0c	125.0a	135.2a	3.9d	4.3a	10.0a	9.8a	3.7a	3.7a
	UAN	13.6ab	15.7a	54.4b	51.9bc	146.6a	160.3a	4.7b	5.2a	10.2a	10.3a	4.0a	4.0a
25	$(NH_4)_2 SO_4$	10.3f	11.8fg	50.8e	50.9c	104.1a	118.2a	2.5f	2.8a	9.8a	9.6a	3.6a	3.7a
	NH_4NO_3	12.1c	13.2cd	54.3b	51.4c	129.2a	138.9a	3.1e	3.3a	10.1a	9.8a	3.9a	3.9a
	UAN	14.3a	15.9a	57.3a	55.3a	147.2a	162.5a	3.5d	3.9a	10.2a	10.2a	4.1a	4.1a

Values having a similar alphabetical letter, within a comparable group of means, are not significantly different, using revised L.S.D. test at 0.05 level.

III. Chemical analysis:

a. Plant distance:

1. Effect of spaces between plants on nitrate concentration:

It is quite obvious from the data presented in Table (6) that spaces between broad bean plants clearly affected nitrate concentration in leave samples collected with the first pod time, nitrate concentration in the first pod samples, nitrate concentration in the fifth green pod sample (mid plant life) and nitrate concentration in the dry seed sample (end plant life).

Nitrate gradually increased due to increase space between plants. The highest nitrate values of 83.1, 85.7 mg kg^{-1} in the leaves, 51.7, 67.9 mg kg^{-1} in the first pod, 19.3,18.1 mg kg^{-1} in the fifth pod period and 7.4, 10.2 mg kg^{-1} in the dry seed in the first and second season, respectively. These may be due to plants cultivated under wide spaces had good chance for roots distribution and nodulation, large distribution in the roots led to increases of nitrogen absorption from the microbial form (symbiotic and non symbiotic fixation) and the added fertilizer form. Light intensity had no effects on nitrate concentration because broad bean surface area contacted with light is large (compound leaves).

Also, data show that nitrate concentration decreased in pods with increasing plant age i.e., 45.0, 17.0 and 6.0 mg kg^{-1} in the first pod, fifth pod and dry seed, respectively with 15 cm space in the first season.

2. Effect of space between plants on phosphorus %:

Data presented in Table (6) show that space between plant clearly affected phosphorus percentage of broad bean green pods of all samples collected. The highest values 0.20 and 0.19 in the leaves sample, 0.44 and

0.49 of the first green pod, 0.45 and 0.46 of the fifth green pod and 0.44% in the dry seed were obtained with 25 cm between plants in the first and second season, respectively. This may be due to large space make good root distribution and decrease the competitive between plants on available nutrients like phosphorus (Tisdal *et al.,* 1992).

3. Effect of spaces between plants on total nitrogen and total protein in the dry seed:

Data presented in Table (6) show that, total nitrogen in broad bean dry seeds was increased by increasing spaces between plants. Also, protein % had the same sequence. The highest protein values of 29.1 and 28.6 were obtained with 25 cm space in the first and second season, respectively.

b. Nitrogen forms:

1. Effect of nitrogen forms on nitrate concentration:

Results presented in Table (6) show that nitrogen forms clearly affected nitrate concentration in broad bean during both seasons.

The highest nitrate concentration values were recorded with NH_4NO_3 of 85.3 and 88.9 mg kg^{-1} in the leaves sample which collected with the first pod period, 52.4 and 70.8 mg kg^{-1} in the first pod sample, 23.2 and 19.5 mg kg^{-1} in the fifth pod sample and 10.0 and 13.6 mg kg^{-1} in the dry seeds sample in the first and second season, respectively. On the other hand, the lowest nitrate values were obtained with $(NH_4)_2SO_4$ in both seasons. This may be due to NO^-_3 ions absorbed by roots need more glucose molecular for reduction in order to confirm to NH_2 which bond in amino acids. In the winter season there are cloudy periods which affect phototheneses and glucose production, thus some nitrate still in absorbed type (Tisdal *et al.,* 1992).

2. Effect of nitrogen forms on phosphorus percentage:

Results tabulated in Table (6) show that the highest phosphorus % values were obtained with $(NH_4)_2$ SO_4 in both season, while the lowest values were observed with urea ammonium nitrate in both seasons. This may be due to $(NH_4)_2$ SO_4 led to decrease soil pH (microsite) which increase phosphorus absorption. Similar results reported by Kadar and Pusztai (1997).

3. Effect of nitrogen forms on total nitrogen and protein %:

Data in Table (6) show that urea ammonium nitrate had the highest N% and protein % in both seasons, while the lowest N% and protein % were observed with $(NH_4)_2$ SO_4 in both seasons.

c. Effect of the interaction between spacing and nitrogen forms:

1. Nitrate concentration:

Data presented in Table (7) show that the interaction between spacing and nitrogen forms significantly affected nitrate concentration of first green pod in the first season, where the lowest value of 40.1 mg kg^{-1} was obtained with 15 cm spacing x $(NH_4)_2$ SO_4 as nitrogen forms.

6+7

On the other hand, the highest value of 58.6 mg kg^{-1} was observed with 25 cm spacing x NH_4NO_3. Nitrate concentration of the fifth green pod significantly affected by the interaction between spacing x nitrogen forms in the first season. The lowest value of 11.4 mg kg^{-1} was obtained with 15 cm space x (NH_4) SO_4 , while the highest value of 26.0 mg kg^{-1} was recorded with 25 cm space x NH_4NO_3.

In the dry seed the interaction between spacing x nitrogen forms significantly affected nitrate concentration in the second season. The lowest nitrate value of 3.0 mg kg^{-1} was obtained with 15 cm space x $(NH_4)_2$ SO_4.

2. Phosphorus percentage:

No significant effects of the interaction between spacing and nitrogen forms on phosphorus % in the all sample studied in both seasons.

3. Total nitrogen and protein %:

No significant effects were detected in both seasons due to the interaction between spacing x nitrogen forms.

CONCLUSION AND RECOMMENDATION

- The suitable nitrogen form for faba bean green pods production is $(NH_4)_2$ SO_4 because it was the reason of low nitrate concentration in the green pods and high phosphorus %.
- Nitrate concentration clearly decreased with increasing plant age, thus we can use faba bean green pods after the third pod period.

REFERENCES

Abd El-Hamied, A. (2001). Evaluation of nitrite, nitrate and nitroseamien compounds in Upper Egypt vegetables. Alex. Sci. Exch. J. 22(3): 323-332.

Abd El-Rahman, K.A.; M.A. Abd El-Rahim; E.A. Shalaby and I.A. Rizk (1983). Influence of irrigation frequency, population density and nitrogen fertilizer on growth characters of field bean. Assiut. J. Agric. Sci. 14(1): 233-248.

Arnaoot, M.E. (2001). Human and environment pollution. The Egyptian Home for Books. pp. 229-238 (In Arabic).

Black, C.A.; D.D. Evans; J.L. White; L.E. Ensuminger and F.E. Clark (1965). Method of Soil Analysis. Am. Soc. Agron. Inc. Publisher. Madison, Wisonsin, U.S.A.

Blondel, A. and D. Blane (1973). Influence of ammonium ion uptake and reduction in young wheat. Plants, C.R. Acad.Sci. (Paris) Ser. D., 277, 1325-1327.

COSTAT (1985). User's Manual. Verson 3, Cohort, Tusson, Arizona, USA.

ESCF (1997). Report of the European Scientific Committee for food. Luxembourg Office for Official Publications of the European Communities.

Hussein, A.H.A.; R.F. Dossoky; M.A. El-Deeb and M.M. El-Morsy (1994). Effect of sowing dates and plant densities on yield and yield components of new faba bean cultivars (Giza Blanka) in Newly reclaimed land. J. Agric. Sci. Mansoura Univ. 19(2): 447-451.

Jackson, M.L. (1958). Soil chemical analysis. Nitrogen determination for soils and plant tissue. Prentice Hall, Inc. 183-205.

Kadar, I. and A. Pusztai (1997). Studies of the effect of N fertilizers in pot experiments Agrokemia Talajtan 46(1-4): 217-230.

Kaya, C.; N. Kucuk and D. Higgs (2001). Relationships between NaCl and nitrate accumulation in spinach. Fertilizers in context with Resource Management in Agriculture. 13th International Symposium of CIEC.

Knany, R.E. and M.A. Abd Alla (2006). Impact of mineral and bionitrogen fertilization on nitrate accumulation of cucumber. J. Agric. Sci. Mansoura Univ. 31: 1175-1184.

Knany, R.E. and R.H. Attia (2003). Primary study on nitrate pollution of rice grain in Kafr El-Sheikh Governorate. The 11th Annual Conference of Misr Soc. Eng. 15-16 Oct. 685-694.

Knany, R.E.; A.M. Masoud and M.H. Kasem (2002). Response of new cowpea cultivars to the nitrogen fertilizer sources and rates. 2nd Inter. Conf. Hort. Sci., 10-12 Sept. 2001, Kafr El-Sheikh, Tanta Univ., Egypt. Vol. (28): NO. (3/11): 613-624.

Lamyaa, A.G. (2007). Studes on some different composted organic sources and it's effect on some vegetable crops productivity and nitrate contents. M.Sc. Thesis, Fac. Agric. Tanta Univ., Egypt.

Masoud, M.M. (2002). Evaluation new cultivars of cowpea under different plant densities. 2nd Inter. Conf. Hort. Sci. 10-12 Sept. 2002, Kafr El-Sheikh, Tanta Univ., Egypt. Vol. (28): No. (3/III): 1026-1034.

Mohamed, F.I. and F.A. Helal (1999). Effect of planting method and foliar spray with manganese, zinc, boron and iron on growth, green yield and its components and chemical content of broad bean plants. J. Agric. Res. Minufiya Univ., 24(3): 1033-1045.

Metwally, E.I.; S.A. Moustafa; A.Y. Mazrouh and A.M. Fayed (1998). Effect of genotype, plant density and fertilizer level on seed yield and its components of cowpea. J. Agric. Res. Tanta Uiv., 24(2): 237-246.

Morsy, M.A. (1986). Efect of plant density and N-fertilizer on seed yield of cowpea. M.Sc. Thesis, Zagazig Univ. Benha Branch, Fac. Agric. Moshothor. Egypt.

Piper, C.S. (1947). Soil and plant analysis. The Univ. of Adelaiada, Adelaiada.

Rao, K.P. and D.W. Rains (1976). Nitrate absorption by barley. Plant Physiol., 57, 55-58.

Saleh, H.H.; A.M. Hammoda and M.H. Khalifa (1980). Effects of density treatments and fertilization levels on the productivity of cowpea. Agric. Res. Review 58(3): 77-86.

Singh, I.P. (1988). A rapid method for determination of nitrate in soil and plant extracts. Plant and Soil, 110: 137-139.

Sharaf, H.H.; A.M. Hammoda and M.H. Khalifa (1980). Effect of density treatments and fertilization on the productivity of cowpea. Agric. Res. Review; 58(3): 77-86.

Snedecor, G.W. and W.G. Cochran (1972). Statistical methods. 6th Ed. pp. 593. The Iowa State Univ. Press, Ames. Iowa, USA.

Tisdale, S.L.; W.L. Nelson and J.D. Beaton (1992). Soil fertility and fertilizers (fourth edition. Macmillan Publishing Company. New York.
Uddin, M.S. (1981). Effect of row spacing and NPK fertilizer on the yield components of soybean. Bangladesh. J. Agric. Res., 6(2): 15-19.
White, J.G.H. and J.A.D. Anderson (1971). The effect of plant spacing and irrigation on the yields of green peas (*Pisum sativum* Hortene L.). Department of Plant Sci. of the Agric. Sci. of New-Zealand 1: 121-128, 7 ref.

تأثير بعض المعاملات الزراعية على المحصول والبروتين وتراكم النترات فى بذور الفول الرومى الأخضر والجاف

علی محمد الدسوقی مسعود* ، یونس بیومی أحمد الورقی* ، رمضان إسماعیل کنانی**
*** قسم بحوث الخضر - معهد بحوث البساتين - مركز البحوث الزراعية - الجيزه - مصر**
**** معهد بحوث الأراضى والمياه والبيئة - مركز البحوث الزراعية - الجيزه - مصر**

يهدف البحث إلى دراسة تأثير ثلاثة مسافات زراعية (١٥ ، ٢٠ ، ٢٥سم) بين النباتات وثلاثة صور للأسمدة النيتروجينية (سلفات الأمونيوم ٢٠% ن ، نترات الأمونيوم ٣٣%ن ، ونترات الأمونيوم واليوريا كسماد سائل جديد ٣٢%ن) على النمو والمحصول وتركيز البروتين وتراكم النترات فى الفول الرومى صنف قصاصين ١. ولتحقيق الهدف أجريت تجربتان حقليتان بمنطقة دسوق - كفرالشيخ خلال الموسمين الشتويين ٢٠٠٤/٢٠٠٥م ، ٢٠٠٥/٢٠٠٦م.

ويمكن تلخيص النتائج على النحو التالى:

١- أعطى أتساع المسافة بين النباتات (٢٥سم) أعلى قياسات خضرية (عدد الأوراق للنبات ، عدد الأفرع للنبات والمساحة الورقية للنبات) ، وكذلك أعلى عدد قرون للنبات ووزن خمس قرون خضراء ووزن القرون الخضراء للنبات ، بينما أعطت المسافة (١٥سم) بين النباتات أعلى محصول قرون خضراء للفدان ، وفى نفس الوقت أعطت أقل محتوى من النترات والفوسفور والبروتين.

٢- أعطت صورة النيتروجين (نترات الأمونيوم واليوريا السائلة) أعلى قيم للقياسات الخضرية بينما كانت أقل القيم مع صورة النيتروجين (سلفات الأمونيوم). كما أعطت صورة النيتروجين (نترات الأمونيوم واليوريا السائلة) أعلى قيم للمحصول ومكوناته. وقد كانت أقل قيم للنترات المتراكمة فى القرون الخضراء والبذور الجافة مع المعاملة بسلفات الأمونيوم فى الموسمين ، كما أعطت أعلى قيم للفوسفور. وقد لوحظ أن أعلى قيم للبروتين فى البذور الجافة مع صورة نترات الأمونيوم واليوريا السائلة.

ويمكن التوصية بالآتى:

١- يفضل تسميد الفول الرومى بسماد سلفات الأمونيوم كصورة للنيتروجين لتقليل التلوث النتراتى بالفول.

٢- يفضل استخدام الفول الرومى للاستهلاك الأخضر بعد القرن الثالث حيث لوحظ أن تركيز النترات فى القرون يقل بتقدم عمر النبات.

Table (6): Effect of spacing between plants and nitrogen forms on nitrate (mg kg^{-1}), phosphorus, nitrogen and protein concentration (%) of broad bean in 2004 and 2005 and 2005/2006 seasons.

Treatments	Nitrate mg kg^{-1}								Phosphorus %								Total N % in dry seed		Total protein % In dry seed	
	Leaves with the first pod		First green pods		Fifth green pods sample		Seed dry sample		Leaves with the first pod		First green pods		Fifth green pods sample		Seed dry sample					
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Spacing (cm)																				
15	78.0b	79.8c	45.0c	50.0c	17.0bc	15.1c	6.7b	7.9c	0.19b	0.18b	0.40b	0.41b	0.37b	0.44b	0.36b	0.52a	4.5b	4.3c	27.7b	27.0c
20	80.0b	83.1b	46.2bc	62.6b	19.3a	16.3b	6.9ab	9.4b	0.20a	0.19a	0.42ab	0.47a	0.42a	0.45ab	0.41a	0.50a	4.6a	4.4b	28.2ab	27.5bc
25	83.1a	85.7a	51.7a	67.9a	16.7c	18.1a	7.4a	10.2a	0.20a	0.19a	0.44a	0.49a	0.45a	0.46a	0.44a	0.44a	4.6a	4.5a	29.1a	28.6a
Nitrogen forms																				
$(NH_4)_2SO_4$	73.9c	76.6c	42.3c	50.8c	12.8c	12.9c	3.0c	3.1c	0.22a	0.20a	0.47a	0.49a	0.45a	0.49a	0.44a	0.49a	4.3c	4.2c	26.7b	26.9c
NH_4NO_3	85.3a	88.9a	52.4a	70.8a	23.2a	19.5a	10.0a	13.6a	0.19b	0.19b	0.41b	0.47a	0.42b	0.45b	0.40b	0.45ab	4.6b	4.4b	28.9a	27.7b
UAN	81.7b	83.1b	48.2b	58.8b	15.1b	16.5b	8.1b	10.9b	0.18c	0.18c	0.38c	0.41b	0.38c	0.41c	0.37c	0.41b	4.7a	4.6a	29.5a	28.5a

Table (7): Effect of interaction between spacing between plants and nitrogen forms on nitrate (mg kg^{-1}), phosphorus, nitrogen and protein concentration (%) of broad bean in 2004/2005 and 2005/2006 seasons.

Treatments		Nitrate mg kg^{-1}								Phosphorus %								Total N % in dry seed		Total protein % In dry seed	
Spacing (cm)	Nitrogen sources	Leaves with the first pod		First green pods		Fifth green pods sample		Seed dry sample		Leaves with the first pod		First green pods		Fifth green pods sample		Seed dry sample					
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
15	$(NH_4)_2SO_4$	71.6a	72.9a	40.1h	40.5a	11.4f	12.0a	2.9a	3.0g	0.21a	0.20a	0.44a	0.45a	0.42a	0.48a	0.40a	0.51a	4.2f	4.1a	25.7a	26.1a
	NH_4NO_3	82.7a	85.4a	48.8de	59.0a	21.2c	17.8a	9.8a	11.7d	0.18a	0.18a	0.40a	0.41a	0.37a	0.44a	0.35a	0.45a	4.6c	4.3a	28.3a	27.1a
	UAN	79.6a	81.0a	45.9f	50.5a	12.3fg	15.4a	7.5a	9.2e	0.17a	0.17a	0.35a	0.38a	0.32a	0.39a	0.32a	0.40a	4.7b	4.5a	29.1a	27.8a
20	$(NH_4)_2SO_4$	72.8a	76.2a	41.4g	54.8a	11.4g	12.0a	3.0a	3.0g	0.21a	0.20a	0.46a	0.51a	0.45a	0.48a	0.45a	0.53a	4.4e	4.3a	26.5a	26.9a
	NH_4NO_3	85.6a	89.7a	50.0cd	72.5a	22.3bc	19.6a	9.8a	13.9b	0.20a	0.19a	0.41a	0.49a	0.42a	0.45a	0.41a	0.49a	4.6c	4.4a	28.8a	27.5a
	UAN	81.3a	83.3a	47.5ef	60.5a	16.5d	15.6a	8.1a	11.4d	0.18a	0.17a	0.38a	0.42a	0.41a	0.41a	0.37a	0.44a	4.7b	4.5a	29.2a	28.0a
25	$(NH_4)_2SO_4$	77.3a	80.7a	45.4f	57.1a	15.6e	14.9a	3.1a	3.3fg	0.23a	0.21a	0.51a	0.51a	0.49a	0.50a	0.47a	0.53a	4.5d	4.4a	27.9a	27.7a
	NH_4NO_3	87.7a	91.5a	58.6a	81.0a	26.0a	21.1a	10.4a	15.2a	0.20a	0.19a	0.42a	0.52a	0.45a	0.45a	0.43a	0.50a	4.7b	4.6a	29.5a	28.6a
	UAN	84.4a	85.0a	51.1bc	65.5a	16.5d	18.4a	8.7a	12.1cd	0.18a	0.18a	0.41a	0.43a	0.42a	0.43a	0.40a	0.47a	4.8a	4.7a	30.1a	29.6a

J. Agric. Sci. Mansoura Univ., 32 (9): 7641 - 7651, 2007