J. Agric. Sci. Mansoura Univ., 28(1): 513 - 528, 2003

EFFECT OF NITROGEN SOURCES, BORON AND MOLYBDENUM LEVELS ON YIELD AND YIELD COMPONENT OF SNAP BEAN

Abd El-Rahim, Aida M.
Veget. Res. Dept., Agric. Res. Centre, Cairo, Egypt.

ABSTRACT

This study was carried out at El-Baramoon Horticultural Research Farm during summer seasons of 1998 and 1999 to study the effect of N-sources, urea $[Co(NH_2)_2]$, Ca-nitrate $Ca(NO_3)_2$ and ammonium sulphate $[(NH_4)_2SO_4]$ at the rate of 50 kg N / fed, boron levels (0, 5 and 10 ppm) and Mo levels (0, 10 and 20 ppm) on growth, yield and quality of snap bean (*Phaseolus vulgaris*) cv. Bronco. The obtained results showed that Ca-nitrate application was the most effective treatment for increasing stem diameter, pod length, pod width, total yield / plot and total yield / feddan, followed by urea then ammonium sulphate.

With respect to the effect of boron levels applied, the 10 ppm boron level was the best level for increasing total yield / feddan and improving quality. While, the 5 ppm boron level decreased total yield / feddan compared with zero level of boron.

The best Mo level was 20 ppm, which recorded the highest values in most characters measured in both seasons of study.

Generally, the highest total yield and quality of snap bean plants were obtained when fertilized with Ca-nitrate at the rate of 50 kg N/fed, 10 ppm of boron and 20 ppm of molybdenum.

INTRODUCTION

Nitrogen is one of the major essential elements required by vegetable crops, it is known as a major constituent of amino acids, proteins, chlorophylls, nucleic acids and phytohormones. Many factors involved and affected the nutrition of plants with nitrogen, N-uptake, translocation and assimilation, thereby influenced N-status, growth and yield of plants. Among such factors are genotypes, N-sources and levels suggested to be of considerable effect in this case.

NO_3^- and NH_4^+ are the N carriers for most N fertilizers. NH_4^+ is partially adsorbed on soil colloids and it uptake rate is usually lower than of NO_3^- under field conditions. Thus, most crops do not respond as quickly to NH_4 fertilizers as to NO_3 application. Nitrate fertilizers are known to produce a rapid response in the plant.

Calcium uptake can be competitively depressed by the presence of other cations such as K^+ and NH_4^+, which are rapidly taken up by roots. Calcium translocation in the xylem sap may be depressed by NH_4 nutrition, soil water stress and high salt concentrations in the soil. The deficiency of Ca^{2+} can be first observed in the growing tips and youngest leaves.

Urea application leads to the loss of NH_3 by volatilization as urea is very rapidly converted to NH_3 particularly in alkaline soils. Considerable volatile losses of NH_3 may also occur after the application of urea even on acid soils. Losses are especially high if urea is surface applied and drying conditions prevail.

El-Bakry (1966) studied the effect of nitrogen on the snap bean plants, he found that ammonium sulphate increased plant height and both length and leaflet as well as it was significantly affected of the stem diameter. Widdowson *et al.* (1967) reported that $Ca(NO_3)_2$ gave larger grain yields of barley than $(NH_4)_2SO_4$.

Ibrahim *et al.* (1985) showed that $(NH_4)_2SO_4$ was the best N-source for growth and yield of cucumber compared with $Co(NH_2)_2$ and NH_4NO_3. While, Fathy (1986) found that NO_3-N was of a superior effect, $Co(NH_2)_2$ was of an intermediate effect and NH_4-N was of the least effect upon growth traits, yield and fruit quality of tomato plants.

Similar findings about the favourable effect of NO_3-N alone or NO_3 + NH_4 and the worst effect of NH_4-N alone upon growth and yield of vegetables were obtained by Pill and Lamberth (1977), Gibson and pill (1983), Zhang *et al.* (1991), Zornoza *et al.* (1992), Gill and Reisenauer (1993), Batel *et al.* (1994), Hohjo *et al.* (1995) and Byari and Mirdad (1996).

El-Sayed *et al.* (1997) found that the best N source for growth to maximize total yield and to improve fruit quality of cucumber plants was NH_4NO_3 followed by $(NH_4)_2SO_4$ and at least $Co(NH_2)_2$ as non favourable N source.

Boron is of interest in crop production, both from the viewpoint of its effects in deficiency and excess. It is also probably more important than any other micronutrients in obtaining quality high crop yields. Most soil B is unavailable to plants, the available B fraction ranging from 0.4 to 5 ppm (Gupta, 1979). Soluble B in the soil consists mainly of boric acid $B(OH)_3$. Under soil pH conditions, this acid is not dissociated and thus contrast to all other essential plant nutrients. B is mainly present in a non ionized form in soil solution, this may be the main reason why B can be leached so easily from the soil. Gupta (1979) reported that a continuous supply of B is required for maintenance of meristematic activity. B is required for the synthesis of N-bases such as uracil (Albert, 1968). Uracil is an essential component of RNA, thus affecting protein synthesis. Ribonucleic acid synthesis, ribose formation and the synthesis of protein are most important processes in meristematic tissues. Amberger (1975) reported the role of B and other plant nutrients in protein synthesis. Soils polluted with B can be corrected by irrigation with B free water. Boron availability and thus the uptake of excess B can also be depressed by liming (Judel, 1977).

The molybdenum content of plant material is usually low and less than 1 ppm in the dry matter. The uptake of Mo in plants per unit of dry matter production is greater in the presence of NO_3-N than NH_4-N (Giordano *et al.*, 1966). It is likely that plants grown exclusively with NH_4-N do not require Mo. Hewitt and Gundry (1970) showed that under sterile conditions cauliflowers grown with NH_4-N and without Mo did not develop Mo deficiency appeared. Most experiments comparing different forms of N in relation to Mo requirement have been conducted under non sterile conditions.

At the most important of Mo in plant metabolism is in NO_3-reduction, Mo deficiency resembles N deficiency (Hagstrom and Berger, 1965), old leaves becoming chlorotic first. In contrast to N deficiency, however, necrotic symptoms very quickly appear at the leaf margins because of nitrate accumulation (Maynard, 1979). The similarity to N deficiency is particularly applicable to the leguminosae in which Mo deficiency may restrict N nutrition by affecting both NO_3^- reduction and N_2 fixation.

The aim of this investigation was to study the effect of nitrogen sources and different boron and molybdenum levels on growth, yield and quality of snap bean plants. This study was carried out on Bronco variety of snap bean (*Phaseolus vulgaris*, L.).

MATERIALS AND METHODS

Two field experiments were carried out at El-Baramoon Horticultural Research Farm, Dakahlia Governorate during 1998 and 1999 growing seasons.

Experiments were carried out to study the effect of nitrogen sources as the rate of 50 units / fed, these units make urea 46% N = 108.7 kg, Ca-nitrate 15.5% N = 322.6 kg and ammonium sulphate 20.5% N = 243.9 kg/fed and three levels of both boron (0, 5 and 10 ppm) and molybdenum (0, 10 and 20 ppm) on growth, yield and quality of snap bean plants

The equivalent amounts of nitrogen from each N-source were divided into two equal doses, the first was applied 30 days after planting, the second was applied after 45 days from planting. While, the boron and molybdenum were applied as spray twice after 30 and 40 days from planting, respectively. Other cultural practices were followed as normally practiced.

To layout the experiment in both experimental seasons, a split split plot in a randomized complete block design with 3 replicates was used. The three nitrogen sources comprised the main plots and were randomly distributed in the main plot, while three tested levels of boron and molybdenum were randomly distributed in the sub-plots and sub-sub-plots, respectively. The sub-sub-plot size contained 3 ridges of 4.5 m long and 0.70 m wide, occupying an area of 9.45 m^2.

Seeds of snap bean were sown on 20 and 22 March of 1998 and 1999 seasons, respectively after the soil was irrigated and left to dry for about 6 days to be available for cultivating snap bean seeds, which were inoculated with *Rhizobium phaseoli* strain. The inoculated seeds were sown on lines. This method was adopted in all nitrogen forms studied.

Three plants of snap bean were randomly chosen and taken from each of the different treatments after 65 days from sowing to obtain the following data: plant height, number of branches per plant, stem diameter, plant dry weight, pod length, pod width in centimeter, average pod fresh weight in gm, total yield per plot in kg and total yield per feddan in ton.

Data were statistically analyzed according to the method described by Snedecor and Cochran (1967). Treatment means were compared at 5% level of probability by LSD test (Waller and Duncan, 1969).

RESULTS AND DISCUSSION

1. Effect of N-sources:

Data presented in Table (1) show the effect of urea [$Co(NH_2)_2$], Ca-nitrate $Ca(NO_3)_2$ and ammonium sulphate [$(NH_4)_2SO_4$] on traits of snap bean plants. Such data revealed that Ca-nitrate application was the most effective treatment for increasing stem diameter, pod length, pod width, total yield / plot and total yield / feddan, followed by urea then ammonium sulphate in both seasons. While, the differences between the three N-sources were not significant with respect to plant height, number of branches, plant dry weight and average pod weight. The beneficial effect of Ca-nitrate might be attributed to a rapid response of nitrate fertilizers in the plant, where the increase in plant fresh weight could be expected, since such N-source increased N content and to some extent photosynthetic pigments, that in tight relation with the accumulation of carbohydrates and N-assimilation, otherwise the balanced consumption of C skeleton during N-assimilation (Barker *et al.*, 1956), thereby the synthesis of amino acids, protein, nucleic acids and hormones, hence growth and development.

The data showed that the increase in total yield / feddan by Ca-nitrate N-source may be due to the increase in number of pods rather than the increase in average pod weight.

These results are in line with those reported by Fathy (1986), who found that NO_3-N had a superior effect, $Co(NH_2)_2$ had an intermediate effect and NH_4-N had the least effect upon growth traits, yield and fruit quality of tomato plants. Similar findings about the favourable effect of NO_3-N alone or NO_3 + NH_4 and the worst effect of NH_4-N alone upon growth and yield of vegetables were obtained by Pill and Lamberth (1977), Gibson and Pill (1983), Zhang *et al.* (1991), Zoronoza *et al.* (1992), Gill and Reisenauer (1993), Batal *et al.* (1994), Hohjo *et al.* (1995), Byari and Mirdad (1996), and El-Sayed *et al.* (1997. These results are in contrary with the findings of El-Bakry (1966) and Ibrahim *et al.* (1985).

2. Effect of boron levels:

Data presented in Table (2) revealed that the application of boron at the rate of 5 ppm decreased total yield / plot and total yield / feddan compared with zero level of boron. By increasing boron level to 10 ppm, the total yield / plot and the total yield / feddan were improved. These results mean that the boron levels of study were insufficient and it could be increased more than 10 ppm. These results agreed with Mengel and Kirkby (1982), who reported that boron is of interest in crop production, both from the viewpoint of its effects in deficiency and excess.

The response of snap bean plants to boron levels may be due to boron requirement of meristematic activity (Gupta, 1979). Where boron is required for the synthesis of N-bases, such as uracil(uracil is an essential component of RNA), thus affecting protein synthesis. Ribonucleic acid synthesis, ribose formation and the synthesis of protein are most important processes in meristematic tissues (Mengel and Kirkby, 1982).

Table 1. Effect of nitrogen sources on traits of snap bean plants in 1998 and 1999 seasons.

N sources	Vegetative traits				Yield and yield components				
	Plant Height (cm)	No. of branches	Stem diameter (cm)	Plant Dry weight (g)	Pod length (cm)	Pod Width (cm)	Average Pod weight (g)	Total yield /plot (kg)	Total yield/feddan (Ton)
					1998 season				
Urea	49.89	11.19	0.67	23.53	13.23	0.92	5.16	5.41	6.87
Ca-nitrate	48.82	10.41	0.72	24.15	13.34	0.93	5.62	5.54	7.04
Ammonium sulphate	48.84	10.82	0.67	22.92	12.46	0.79	5.70	4.19	5.33
LSD at 5%	NS	NS	0.02	NS	0.65	0.07	NS	0.82	1.04
					1999 season				
Urea	52.39	11.82	0.70	24.70	13.90	0.97	5.43	5.94	7.54
Ca-nitrate	51.26	10.93	0.75	25.37	14.02	0.97	5.90	6.10	7.73
Ammonium sulphate	51.27	11.48	0.71	24.06	13.09	0.83	6.04	4.62	5.87
LSD at 5%	NS	0.52	0.02	NS	0.19	0.04	NS	0.38	0.48

Table 2. Effect of boron levels on traits of snap bean plants in 1998 and 1999 seasons.

Treatments	Vegetative traits				Yield and yield components				
	Plant Height (cm)	No. of branches	Stem diameter (cm)	Plant Dry weight (g)	Pod length (cm)	Pod width (cm)	Average Pod weight (g)	Total yield / plot (kg)	Total yield /feddan (Ton)
					1998 season				
Boron levels (ppm):									
0	48.79	10.67	0.71	23.44	13.34	0.90	5.72	5.28	6.70
5	49.12	11.33	0.65	23.58	12.95	0.87	5.56	4.84	6.15
10	49.64	10.41	0.70	23.58	12.74	0.87	5.20	5.02	6.38
LSD at 5%	NS	0.53	0.03	NS	0.45	NS	0.41	0.20	0.26
Boron levels (ppm):					1999 season				
0	51.23	11.26	0.74	24.62	14.02	0.94	6.01	5.80	7.36
5	51.58	11.96	0.69	24.76	13.60	0.91	5.84	5.33	6.77
10	52.11	11.0	0.73	24.76	13.38	0.91	5.52	5.53	7.01
LSD at 5%	NS	0.33	0.02	NS	0.33	NS	0.32	0.23	0.29

3. Effect of nitrogen sources – boron levels interactions:

The results in Table (3) demonstrated that snap bean plants grown under Ca-nitrate N source and received high level of boron (10 ppm) gave rise to the highest values of pod weight, total yield / plot and total yield /feddan, followed by urea N source and zero boron level and later ammonium sulphate N source and zero boron level in both seasons of study.

These results are in line with Judel (1977), who found that boron availability and thus the uptake of excess B can also be depressed by liming. These results may be due to lower uptake of NH^{+}_{4}-N compared with NO^{-}_{3}-N, which produce a rapid response in the plant.

4. Effect of molybdenum levels:

Data presented in Table (4) cleared that the application of molybdenum at the rate of 10 ppm decreased plant dry weight, pod length, pod weight, total yield / plot and total yield / feddan compared with zero level of molybdenum. While, the increasing molybdenum level to 20 ppm gave rise to the highest values in most characters in both seasons of study. The response of snap bean plants to the high level of molybdenum (20 ppm) could be attributed to the important of the Mo in plant metabolism (NO^{-}_{3} reduction). When Mo was supplied, N-uptake was enhanced and Mo accumulated in the root nodules at the site of N_2 fixation. Mo is also eseential for microbial denitrification.

These results are in line with those reported by Candela *et al.* (1957), who found that the activity of nitrate reductase in cauliflower is enhanced by increasing levels of Mo supply. Mo deficiency in plants leads to a decrease in the activity of nitrate reductase.

5. Effect of nitrogen sources – Mo levels interactions:

Data presented in Table (5) revealed that snap bean plants grown under Ca-nitrate N source and received high level of Mo (20 ppm) gave rise to the highest values in all traits in both seasons of study, followed by urea with zero level of Mo and later ammonium sulphate with 20 ppm level of Mo. These results are in line with those reported by Giordano *et al.* (1966) and Hewitt and Gundry (1970). They found that the uptake of Mo in plants per unit of dry matter production is greater in the presence of NO_3-N than NH_4-N.

6. Effect of boron levels – Mo levels interactions:

The results in Table (6) showed that the interaction between 10 ppm boron level and 20 Mo level gave the highest measures in most traits after the combination between zero boron level and zero Mo level. Where there is response between 10 ppm boron level and different Mo levels by increasing total yield / feddan gradually when Mo level was increased.

7. Effect of nitrogen sources – boron and Mo levels interactions:

The results in Tables (7 and 8) cleared the effect of such interactions on traits of snap bean plants. Such data revealed that the highest values of total yield / plot and total yield / feddan were of the combination between Ca-nitrate x 10 ppm boron level x 20 ppm Mo level, followed by urea x zero

Table 3. Effect of nitrogen sources and boron levels interaction on traits of snap bean plants in 1998 and 1999 seasons.

Treatments		Vegetative traits				Yield and yield components					
N sources	Boron level (ppm)	Plant Height (cm)	No. of branches	Stem diameter (cm	Plant Dry weight (g)	Pod length (cm)	Pod width (cm)	Average Pod weight (g)	Total yield /plot (kg)	Total yield /feddan (Ton)
		1998 season								
Urea	0	49.83	10.56	0.70	22.77	13.87	0.92	5.56	5.65	7.18
	5	51.18	12.11	0.61	24.97	13.00	0.94	5.00	5.27	6.69
	10	48.67	10.89	0.69	22.87	12.82	0.90	4.92	5.30	6.73
Ca-nitrate	0	50.43	11.22	0.73	26.71	13.39	1.00	5.59	5.72	7.26
	5	48.93	10.44	0.71	23.26	12.92	0.86	5.59	5.17	6.57
	10	47.09	9.56	0.71	22.49	13.72	0.92	5.67	5.73	7.28
Ammonium Sulphate	0	46.09	10.22	0.70	20.86	12.78	0.78	6.00	4.46	5.67
	5	47.26	11.44	0.63	22.52	12.93	0.81	6.09	4.08	5.19
	10	53.18	10.78	0.69	25.38	11.67	0.79	5.00	4.04	5.13
LSD at 5%		2.42	0.91	NS	2.70	0.79	0.10	0.70	0.35	0.45
		1999 season								
Urea	0	52.32	11.11	0.73	23.89	14.57	0.97	5.86	6.19	7.86
	5	53.73	12.78	0.64	26.23	13.64	0.99	5.26	5.80	7.36
	10	51.10	11.56	0.72	23.99	13.48	0.94	5.17	5.83	7.38
Ca-nitrate	0	52.96	11.78	0.77	28.06	14.07	1.06	5.87	6.29	7.99
	5	51.38	11.00	0.74	24.43	13.58	0.89	5.87	5.69	7.23
	10	49.44	10.00	0.74	23.63	14.41	0.97	5.96	6.31	7.99
Ammonium Sulphate	0	48.40	10.89	0.73	21.90	13.43	0.81	6.31	4.91	6.23
	5	49.62	12.11	0.67	23.62	13.58	0.84	6.39	4.49	5.71
	10	55.78	11.44	0.72	26.64	12.26	0.82	5.43	4.45	5.66
LSD at 5%		1.69	0.56	0.03	1.83	0.58	0.07	0.55	NS	NS

Table 4. Effect of molybdenum levels on traits of snap bean plants in 1998 and 1999 seasons.

Treatments	Vegetative traits				Yield and yield components				
	Plant Height (cm)	No. of branches	Stem diameter (cm	Plant Dry weight (g)	Pod length (cm)	Pod width (cm)	Average pod weight (g)	Total yield /plot (kg)	Total yield /feddan (Ton)
					1998 season				
Molybd. levels (ppm):									
0	48.51	10.30	0.70	24.89	13.26	0.87	5.36	5.10	6.48
10	49.81	10.96	0.68	22.82	12.67	0.89	5.22	4.89	6.21
20	49.23	11.15	0.69	23.39	13.10	0.89	5.89	5.16	6.55
LSD at 5%	NS	0.53	NS	NS	0.45	NS	0.41	0.20	0.26
Molybd. levels (ppm):					1999 season				
0	50.92	10.85	0.73	25.62	13.93	0.91	5.64	5.61	7.11
10	52.30	11.59	0.71	23.96	13.32	0.92	5.49	5.37	6.82
20	51.69	11.78	0.72	24.56	13.76	0.93	6.24	5.67	7.21
LSD at 5%	0.98	0.33	NS	1.06	0.33	NS	0.32	0.23	0.27

Table 5. Effect of nitrogen sources and molybdenum levels interaction on traits of snap bean plants in 1998 and 1999 seasons.

Treatments		Vegetative traits				Yield and yield components				
N sources	Molybdenum level (ppm)	Plant Height (cm)	No. of branches	Stem diameter (cm	Plant Dry weight (g)	Pod length (cm)	Pod width (cm)	Average pod weight (g)	Total yield/ plot (kg)	Total yield feddan (Ton)
		1998 season								
Urea	0	48.92	10.22	0.67	23.07	13.39	0.93	5.33	5.70	7.24
	10	50.59	11.44	0.68	24.40	12.77	0.87	4.48	5.36	6.81
	20	50.17	11.89	0.66	23.13	13.53	0.97	5.67	5.16	6.56
Ca-nitrate	0	47.77	9.78	0.71	24.81	13.38	0.89	5.42	5.58	7.09
	10	48.34	10.56	0.72	22.03	13.66	0.93	5.67	5.24	6.65
	20	50.34	10.89	0.72	25.61	13.00	0.96	5.76	5.80	7.37
Ammonium Sulphate	0	48.84	10.89	0.71	25.30	13.00	0.79	5.33	4.01	5.10
	10	50.50	10.89	0.63	22.03	11.60	0.86	5.50	4.06	5.16
	20	47.18	10.67	0.68	21.42	12.78	0.73	6.26	4.51	5.73
LSD at 5%		2.42	0.91	NS	2.70	0.79	0.10	0.70	0.35	0.45
		1999 season								
Urea	0	51.37	10.78	0.70	24.22	14.07	0.98	5.60	6.27	7.94
	10	53.11	12.11	0.71	25.61	13.41	0.90	4.73	5.87	7.46
	20	52.68	12.56	0.69	24.28	14.21	1.02	5.94	5.68	7.21
Ca-nitrate	0	50.16	10.22	0.74	25.06	14.06	0.93	5.70	6.14	7.80
	10	50.77	11.11	0.76	23.16	14.34	0.98	5.94	5.76	7.30
	20	52.86	11.44	0.76	26.91	13.66	1.00	6.04	6.38	8.11
Ammonium Sulphate	0	51.23	11.56	0.74	26.57	13.66	0.82	5.61	4.42	5.61
	10	53.03	11.56	0.67	23.11	12.19	0.89	5.78	4.48	5.69
	20	49.53	11.33	0.71	22.49	13.42	0.77	6.74	4.96	6.30
LSD at 5%		1.69	0.56	0.03	1.83	0.38	0.07	0.55	0.39	0.50

Table 6. Effect of boron and molybdenum levels interaction on traits of snap bean plants in 1998 and 1999 seasons.

Treatments		Vegetative traits				Yield and yield components				
Boron Level (ppm)	Molybdenum level (ppm)	Plant Height (cm)	No. of branches	Stem diameter (cm)	Plant dry weight (g)	Pod length (cm)	Pod width (cm)	Average pod weight (g)	Total yield / plot (kg)	Total yield / feddan (Ton)
1998 season										
0	0	47.59	10.89	0.71	23.83	14.06	0.88	5.59	5.76	7.32
	10	48.09	11.22	0.71	23.67	13.10	0.96	5.89	4.95	6.29
	20	50.68	9.89	0.71	22.83	12.88	0.87	5.67	5.12	6.50
5	0	49.27	10.11	0.63	24.43	12.77	0.87	5.50	4.75	6.04
	10	48.68	11.56	0.67	22.77	12.53	0.87	5.17	4.61	5.86
	20	49.42	12.33	0.66	23.54	13.56	0.88	6.01	5.16	6.56
10	0	48.08	9.89	0.74	24.91	12.94	0.87	5.00	4.78	6.07
	10	52.67	10.11	0.66	22.03	12.39	0.83	4.59	5.10	6.48
	20	47.59	11.22	0.69	23.79	12.88	0.91	6.00	5.19	6.59
LSD at 5%		2.42	0.53	0.05	NS	0.79	NS	0.70	0.35	0.45
1999 season										
0	0	49.97	11.44	0.74	25.03	14.77	0.92	5.87	6.34	8.05
	10	50.50	11.89	0.74	24.83	13.77	1.00	6.21	5.42	6.88
	20	53.21	10.44	0.74	23.98	13.53	0.91	5.96	5.63	7.15
5	0	51.73	10.67	0.67	25.66	13.41	0.90	5.79	5.23	6.64
	10	51.11	12.22	0.70	23.91	13.16	0.90	5.42	5.07	6.44
	20	51.89	13.00	0.69	24.72	14.23	0.92	6.30	5.68	7.21
10	0	51.06	10.44	0.78	26.16	13.60	0.91	5.26	5.26	6.66
	10	55.30	10.67	0.69	23.13	13.02	0.87	4.82	5.62	7.12
	20	49.97	11.89	0.72	24.98	13.52	0.96	6.48	5.71	7.25
LSD at 5%		1.69	0.56	0.03	NS	0.38	0.07	0.55	0.39	0.50

Table 7. Effect of nitrogen sources, boron and molybdenum levels interaction on traits of snap bean plants in 1998 season.

Treatments			Vegetative traits				Yield and yield components				
N Sources	Boron level (ppm)	Mo level (ppm)	Plant Height (cm)	No. of branches	Stem diameter (cm	Plant dry weight (g)	Pod length (cm)	Pod width (cm)	Average pod weight (g)	Total yield / plot (kg)	Total yield / feddan(Ton)
Urea	0	0	45.50	9.00	0.67	19.30	14.50	0.87	5.50	6.34	8.05
		10	51.50	11.67	0.77	25.30	13.80	0.90	5.67	5.75	7.30
		20	52.50	11.00	0.67	23.70	13.30	1.00	5.50	4.88	6.20
	5	0	52.27	10.67	0.57	25.90	12.00	0.93	5.00	5.28	6.70
		10	50.77	12.00	0.67	24.20	13.50	0.90	4.50	4.99	6.33
		20	50.50	13.67	0.60	24.80	13.50	1.00	5.50	5.55	7.04
	10	0	49.00	11.00	0.77	24.00	13.67	1.00	5.50	5.48	6.96
		10	49.50	10.67	0.60	23.70	11.00	0.80	3.27	5.36	6.81
		20	47.50	11.00	0.70	20.90	13.80	0.90	6.00	5.06	6.43
Ca Nitrate	0	0	50.77	12.67	0.70	27.63	14.00	1.00	6.27	6.06	7.70
		10	49.77	12.00	0.70	24.80	13.17	1.10	5.50	4.87	6.18
		20	50.77	9.00	0.80	27.70	13.00	0.90	5.00	6.23	7.91
	5	0	45.77	8.67	0.67	24.80	12.30	0.80	5.00	5.39	6.84
		10	48.77	11.00	0.77	21.50	13.30	0.90	5.50	5.37	6.82
		20	52.27	11.67	0.70	23.47	13.17	0.87	6.27	4.76	6.05
	15	0	46.77	8.00	0.77	22.00	13.83	0.87	5.00	5.30	6.73
		10	46.50	8.67	0.70	19.80	14.50	0.80	6.00	5.48	6.96
		20	48.00	12.00	0.67	25.67	12.83	1.10	6.00	6.42	8.15
Ammon. sulphate	0	0	46.50	11.00	0.77	24.57	13.67	0.77	5.00	4.89	6.21
		10	43.00	10.00	0.67	20.90	12.33	0.87	6.50	4.24	5.38
		20	48.77	9.67	0.67	17.10	12.33	0.70	6.50	4.26	5.41
	5	0	49.77	11.00	0.67	22.60	14.00	0.87	6.50	3.60	4.57
		10	46.50	11.67	0.57	22.60	10.80	0.80	5.50	3.48	4.42
		20	45.50	11.67	0.67	23.37	14.00	0.77	6.27	5.18	6.58
	10	0	50.27	10.67	0.70	28.73	11.33	0.73	4.50	3.56	4.52
		10	62.00	11.0	0.67	22.60	11.67	0.90	4.50	4.47	5.68
		20	47.27	10.67	0.70	24.80	12.00	0.73	6.00	4.09	5.19
LSD at 5%			4.19	1.58	0.10	4.68	1.36	0.17	1.22	0.61	0.78

Table 8. Effect of nitrogen sources, boron and molybdenum levels interaction on traits of snap bean plants in 1999 season.

Treatments			Vegetative traits				Yield and yield components				
N sources	Boron level (ppm)	Mo level (ppm)	Plant Height (cm)	No. of branches	Stem diameter (cm	Plant dry weight (g)	Pod length (cm)	Pod width (cm)	Average pod weight (g)	Total yield / plot (kg)	Total yield / feddan (Ton)
Urea	0	0	47.77	9.33	0.70	20.27	15.23	0.90	5.77	6.96	8.84
		10	54.07	12.33	0.80	26.53	14.50	0.93	6.03	6.24	7.93
		20	55.13	11.67	0.70	24.87	13.97	1.07	5.77	5.36	6.81
	5	0	54.87	11.33	0.60	27.23	12.60	0.97	5.27	5.81	7.37
		10	53.30	12.67	0.70	25.43	14.17	0.93	4.73	5.49	6.97
		20	53.03	14.33	0.63	26.03	14.17	1.07	5.77	6.10	7.75
	10	0	51.47	11.67	0.80	25.17	14.37	1.07	5.77	6.03	7.59
		10	51.97	11.33	0.63	24.87	11.57	0.83	3.43	5.90	7.49
		20	49.87	11.67	0.73	21.93	14.50	0.93	6.30	5.56	7.07
Ca Nitrate	0	0	53.30	13.33	0.73	29.03	14.70	1.07	6.57	6.67	8.47
		10	52.27	12.67	0.73	26.03	13.83	1.17	5.77	5.35	6.80
		20	53.30	9.33	0.83	29.10	13.67	0.93	5.27	6.85	8.70
	5	0	48.07	9.00	0.70	26.03	12.93	0.83	5.27	5.93	7.53
		10	51.20	11.67	0.80	22.60	13.97	0.93	5.77	5.91	7.50
		20	54.87	12.33	0.73	24.67	13.83	0.90	6.57	5.24	6.65
	10	0	49.10	8.33	0.80	23.10	14.53	0.90	5.27	5.83	7.40
		10	48.83	9.00	0.73	20.83	15.23	0.83	6.30	6.03	7.59
		20	50.40	12.67	0.70	26.97	13.47	1.17	6.30	7.06	8.97
Ammon. sulphate	0	0	48.83	11.67	0.80	25.80	14.37	0.80	5.27	5.38	6.83
		10	45.17	10.67	0.70	21.93	12.97	0.90	6.83	4.66	5.92
		20	51.20	10.33	0.70	17.97	12.97	0.73	6.83	4.68	5.95
	5	0	52.27	11.67	0.70	23.70	14.70	0.90	6.83	3.96	5.02
		10	48.83	12.33	0.60	23.70	11.33	0.83	5.77	3.82	4.86
		20	47.77	12.33	0.70	23.47	14.70	0.80	6.57	5.70	7.24
	10	0	52.60	11.33	0.73	30.20	11.90	0.77	4.73	3.92	4.97
		10	65.10	11.67	0.70	23.70	12.27	0.93	4.73	4.95	6.29
		20	49.63	11.33	0.73	26.03	12.60	0.77	6.83	4.50	5.72
LSD at 5%			2.93	0.95	0.05	3.17	1.00	0.12	0.96	0.68	0.86

boron level x zero Mo level, since insignificant differences between them were found. Whereas, the combination Ca-nitrate x 10 ppm boron level x 20 ppm Mo level was the superior one in case of its effect on number of branches and plant dry weight in both seasons of study, and the latter one was the combination ammonium sulphate x 5 ppm boron level x 20 ppm Mo level.

Generally, the highest total yield and quality of snap bean plants were obtained when fertilized with N from $CaNO_3$ at the rate of 50 kg N/fed, 10 ppm of boron and 20 ppm of molybdenum. In addition, the highest record of number of branches was obtained from previous mentioned combination. Concerning with plant dry weight, the highest record was obtained from the combination between Ca-nitrate x zero boron level x zero Mo level, followed by Ca-nitrate x 10 ppm boron level x 20 ppm Mo level.

From the above mentioned data, it is clear that Ca-nitrate increased plant dry weight and snap bean plants need more than 10 ppm of boron and more than 20 ppm of Mo. Thus, another study concerning levels more than 10 ppm for boron and 20 ppm for Mo with nitrate fertilizer was needed.

REFERENCES

Albert, L.S. (1968). Induction and antagonism of boron-like deficiency symptoms of tomato plants by selected nitrogen bases. Plant Physiol., 43(5):51-54.

Amberger, A.; (1975). Protein biosynthesis and effect of plant nutrients on the process of protein formation. In fertilizer use and protein production, P. 75-89. Potash Inst., Bern.

Barker, A.V.; R.J. Volk and W.A. Jakson (1956). Effect of NH^{+}_{4} and NO^{-}_{3} nutrition on dark respiration of excised tomato leaves. Crop Sci., 5:439-404.

Batal, K.M.; D.M. Bondari; D.M. Granberry and B.G. Mullinix (1994). Effects of source, rate and frequency of N application on yield, marketable grades and rot incidence of sweet onion cv. Granex-33. J. Hort. Sci., 85(4):874-879.

Byari, S.H. and Mirdad, Z.M. (1996). The response of greenhouse cucumber cultivars to nitrogen sources. J. Agric. Sci. Mansoura Univ., 21(5):1861-1872.

Candela, M.J.; Fisher, E.G. and Hewitt, E.J. (1957). Molybdenum as a plant nutrient. X. Some factors affecting the activity of nitrate reductase in cauliflower plants grown with different nitrogen sources and molybdenum levels in sand culture. Plant Physiol., 32:280-288.

El-Bakry, A.M. (1966). Effect of plant density and nitrogen fertilizer on the growth and yield of snap bean. M.Sc. Thesis, Fac. of Agric., Ain Shams Univ., Egypt.

El-Sayed, A.E.H.; E.S.L. Fathy; M.A. Abd El-Rahman and S.A. Ashour (1997). Response of two cucumber F_1-hybrid cvs to different N-sources and levels. J. Agric. Sci. Mansoura Univ., 22(3):863-882.

Fathy, E.S.L. (1986). Effect of different N forms and Ca-levels in nutrient solution on growth and yield of tomato plants. M.Sc. Thesis, College of Agric., Univ. of Baghdad.

Gibson, G.J. and W.G. Pill; (1983). Effect of preplant P-fertilization rate and of nitrate and ammonium liquid feed on tomato growth in peat vermiculite. Amer. Soc. Hort. Sci., 108(6):1007-1011.

Gill, M.A. and H.M. Reisenauer; (1993). Nature and characterization of ammonium effects on wheat and tomato. Agronomy J., 85(4):874-879.

Giordano, P.M.; H.V. Koontz; and E.J. Rubins (1966). C^{14} distribution in photosynthate of tomato as influenced by substrate copper and molybdenum level and nitrogen source. Plant and Soil, 24:437-446.

Gupta, M.C. (1979). Boron nutrition of crops. Adv. Agron., 31:273-307

Hagstrom, G.R., and K.C. Berger (1965). Molybdenum deficiencies of Wisconsin soils. Soil Sci., 99:52-56.

Hewitt, E.J. and C.S. Gundry (1970). The molybdenum requirement of plants in relation to nitrogen supply. J. Hort. Sci., 45:351-358.

Hohojo, M.; C. Kuwato; K. Yoshikawa; F. Togoni; T Namiki.; A. Nukaya and I. Maruo (1995). Effects of nitrogen form, nutrient concentration and Ca concentration on the growth, yield and fruit quality in NFT tomato plants. Acta Horticulturae, 396:145-152.

Ibrahim, S.A.; A.L. El-Zawily and E.A. Sayed (1985). Growth, yield, and chemical composition of cucumber plant (*Cucumis sativus*, L.) as affected by N-sources. Egypt. J. Soil Sci., 26(3):219-229.

Judel, G.K. (1977). Fixation and mobilization of boron in soils with high boron contents toxic to crops. Landw. Forsch. Sonderh, 34(11):103-108.

Maynard, D.N. (1979). Nutritional disorders of vegetable crops: A review. J. Plant Nutr., 1:1-23.

Mengel, K. and Kirkby, E.A. (1982). Principles of Plant Nutrition. 3rd Ed. P. 527. International Potash Institute, Bern, Swizerland.

Pill, W.B. and Lambeth, N.V. (1977). Effect of NH_4 and NO_3 nutrition with and without pH adjustement on tomato growth, ion composition and water relation. J. Amer. Soc. Hort. Sci., 102(1):78-81.

Snedecor, W.G. and Cochran, G.W. (1967). Statistical Methods. 6th Ed. P. 393. Iowa State Univ. Press, Ames, USA.

Waller, R.A. and Duncan, D.B. (1969). Abbeys rule for the symmetric multiple comparison problem. Amer. Stat. Assoc. J. December, 1985. 1504.

Widdowson, F.V.; Penny, A. and Williams, R.J.B. (1967). Experiments measuring effects of ammonium and nitrate fertilizers, with and without sodium and potassium on spring barley. J. Agric. Sci., 69:197-207.

Zhang, F.M.; B.Z. Liu and Z.T. Liu (1991). Effect of nitrogen form on growth and development of cucumber in soiless culture. Hort. Abst., 63(10):7535.

Zornoza, P.; R. Ruiz DeOlano; A. Masaguer and O. Carpena (1992). Effect of nitrate / ammonium ratio on growth and mineral composition of cucumber plants. Agriculture Mediterranean, 122(2):147-150 (C.F. Crop Physiol. Abst., 19(6):3405).

تأثير مصادر النتروجين ومستويات مختلفة من البورون والموليبدينم على المحصول ومكوناته فى الفاصوليا

عايده محمد محمود عبد الرحيم
قسم بحوث الخضر – مركز البحوث الزراعية – القاهرة – مصر

أجرى هذا البحث فى المزرعة البحثية بالبرامون بمحافظة الدقهلية فى الموسم الصيفى ١٩٩٨ ، ١٩٩٩ وذلك بهدف دراسة تأثير مصادر النتروجين (اليوريا ، نترات الكالسيوم وسلفات الأمونيوم) بمعدل ٥٠ كيلو جرام نتروجين / فدان ومستويات مختلفة من البورون (صفر ، ٥ ، ١٠ جزء فى المليون) والموليبدنم (صفر ، ١٠ ، ٢٠ جزء فى المليون) على النمو والإنتاج والجودة للفاصوليا صنف برونكو٠ ويمكن تلخيص النتائج المتحصل عليها فيما يلى:-

١- تأثير مصادر النتروجين: كان أفضل مصدر نتروجينى لزيادة قطر الساق ، طول القرن ، الإنتاج الكلى للقطعة التجريبية والإنتاج الكلى للفدان هو نترات الكالسيوم يليه اليوريا وفى النهاية سلفات الأمونيوم٠
٢- تأثير مستويات البورون: كان أفضل مستوى لزيادة الإنتاج وتحسين الجودة هو ١٠ جزء فى المليون ، بينما أدى المستوى ٥ جزء فى المليون إلى نقص الإنتاج بالمقارنة بالمستوى صفر٠
٣- تأثير مستوى الموليبدنم: كان أفضل مستوى للحصول على أعلى القيم فى معظم الصفات المدروسة فى كلا الموسمين هو ٢٠ جزء فى المليون٠ بينما أدى المستوى ١٠ جزء فى المليون إلى نقص القيم فى معظم الصفات المدروسة بالمقارنة بالمستوى صفر٠
٤- تأثير التفاعل بين مصادر النتروجين ومستويات البورون والموليبدنم: كانت أفضل معاملة تفاعل للحصول على أعلى القيم بالنسبة للإنتاج الكلى للقطعة التجريبية والإنتاج الكلى للفدان هو معاملة نترات الكالسيوم × ١٠ جزء فى المليون بورون × ٢٠ جزء فى المليون موليبدنم فى كلا الموسمين