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EFFECT OF SOWING DATES AND MICRO-ELEMENTS ON THE PRODUCTIVITY AND QUALITY OF SOME SNAP BEAN CULTIVARS

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ABSTRACT

This work was conducted to study the effect of four sowing dates (15th Jul., 15th Aug., 15th Sept., 15th Oct.), three cultivars (Bronco, Paulista and Xera) and three micro-elements (Zn, Fe or Mn) on growth, pods yield quantity and quality and pods chemical constituents of snap bean grown under sandy soil conditions. It was carried out at the Experimental Farm of El Kassasein Research Station, Ismailia Governorate, during two consecutive seasons (2005 and 2006).

Plant growth characters (plant height, number of leaves and branches/plant and dry weight/plant), yield quantity and quality and pods chemical constituents (NPK and protein) were significantly increased with sowing plants at 15th Sept. or 15th Oct. Meanwhile, sowing date at 15th Oct. recorded the least value for white pods percentage compared with other sowing dates.

Paulista cultivar gave the highest values of vegetative growth and yield quantity, while Xera cultivar was the best cultivar which showed the least appearance of white pods and high values of pods chemical constituents (NPK and protein), while Bronco cultivar exhibited maximum appearance of white pods under study.

Spraying plants with Zn, Fe and Mn did not show any significant effect on growth and yield quantity and quality as well as pods chemical constituents.

In general, sowing Paulista cultivar on Sept. 15th or Oct. 15th gave the highest values of growth and yield quantity. Meanwhile, sowing Xera cultivar on Sept. 15th or Oct. 15th gave the least value of white pods percentage and high value of pods chemical constituents (NPK and protein).

INTRODUCTION

Snap bean *Phaseolus vulgaris,* L. is one of the most important member of *Fabaceae* crops in Egypt, for local consumption and export as an out of vegetable season to European countries. In recent years, production of snap bean faced some problems, which reduced export amounts of this crop. White green pods is one of the most problem caused such a reduction in the exportation of this crop.

The present work aimed to study the effect of some agriculture practices (sowing dates, cultivars and micro elements) which will be considered an attempt to solve this problem.

Some investigators dealt with the effect of sowing dates of some snap bean cultivars (Saini and Negi, 1998; Yaman,1998; Amer, 2004)on snap bean, who found that vegetative growth, green yield and pods chemical constituents of tested snap bean cultivars were clearly affected by sowing dates and cultivars were different in vegetative growth and yield.

On the other hand, some investigators studied the effect of sowing dates on photosynthesis pigments contents (El – Gamiely *et al.*, 1998; Nour, 1999; Mansour, 2006) who showed that sowing dates had a significant effect on photosynthesis pigments contents in pea leaves.

Some investigators studied the effect of micro-elements on growth, yield and pods chemical constituents. Singh *et al.* (1998) on mung bean, found that vegetative growth and yield were not significantly affected by spraying plants with micro-elements. On the other hand, some investigators found that spraying plants with micro-elements caused a significant effect on growth and yield (Negm *et al.*, 1997 on pea, Singer *et al.*, 1998 on snap bean; Abd-El-Lateef *et al.*, 1998 on mung bean).

MATERIALS AND METHODS

Two field experiments were carried out during the two successive seasons of 2005 and 2006 at the Experimental Farm of El-Kassasin Horticultural Research Station, Ismailia Governorate, to study the effect of sowing dates, cultivars and micro elements on growth, green pods yield quantity and quality and pods chemical constituents. The experimental soil was sandy in texture with 8.1 pH, 0.44 % organic matter, 81 ppm N, 23 ppm P and 103 ppm K.

This experiment included 36 treatments which were the combinations between four sowing dates (15^{th} Jul., 15^{th} Aug., 15^{th} Sept. and 15^{th} Oct.), three cultivars (Bronco, Paulista and Xera) and three micro-elements (Zn, Fe or Mn).

The experimental unit area was 18 m^2 (3.6 x 5 m) and each unit contained six lines with 5 m length for each and 60 cm width. Seeds were handy-sown in hills as 5 cm apart, foliar fertilizer of plants at 30 days after sowing with complete micro-elements nutrient solution, but at age 40 days, plants were sprayed with Zn or Fe or Mn solution each alone, at the concentration of 200 ppm, the normal agricultural practices of snap bean production under drip irrigation system of this area were followed according to the recommendations of Agriculture Ministry.

A split-split plot design with three replicates was used. Sowing dates were assigned at random in the main plots, while sub plots were devoted to cultivars and micro elements were allotted in the sub-sub plots.

Meteorological data of the area were recorded during the growth seasons (Table 1).

Table 1: Local meteorological data at El- Kassasin region

Season / Month	2005			2006		
	Air temp. (°C)	RH %	Rain mm	Air temp. (°C)	RH %	Rain mm
Jul.	29.22	56.19	0	28.39	55.10	0
Aug.	30.03	58.07	0	28.74	54.42	0
Sept.	28.13	56.12	0	27.19	56.15	0
Oct.	22.83	54.86	0	23.70	55.86	0
Nov.	18.23	57.98	5	17.66	58.55	0
Dec.	15.94	73.45	7.5	14.55	59.58	0

Data recorded

A. Plant Growth

A random sample of six plants from each plot was taken at flowering stage (45 days) and the following data were recorded: plant height (cm), number of leaves/plant, number of branches/plant,

Dry weight of whole plant (gm):

A random sample of other six plants from each plot was taken and dried at 70^0C till constant weight and the dry weight of whole plant was determined

B. Green Pods Yield and Quality

Mature green pods were continuously harvested when reached suitable maturity stages (2- 3 days between pickings). The following data were recorded:

$$1.\ \text{Number of green pods/plant} = \frac{\text{Total number of green pods /plot}}{\text{Number of plants/plot}}$$

$$2.\ \text{Weight of green pods/plant (gm)} = \frac{\text{Total weight of green pods/plot}}{\text{Number of plants/plot}}$$

3. Green pods yield

Total green pods yield (tons/fed) was calculated on the base of total yield along harvesting stages by summing (the sum of all harvests).

$$4\text{- White pods percentage} = \frac{\text{No. of white pods}}{\text{No. of total pods}} \times 100$$

C. Chemical Constituents

1. Photosynthetic pigments

Chlorophyll a, b and total chlorophyll (a + b) as well as carotenoids contents were determined in sample taken randomly from green pods at second harvest according to methods of Wettstein, 1957

2. Minerals contents (NPK)

Dried pods were finely ground separately and digested with sulfuric acid and percholoric acid (3:1) and nitrogen, phosphorus and potassium were determined according to the method described by Kock and McMeekin (1924), Murphy and Riley (1962) and Brown and Lilliland (1946), respectively.

3. Protein content

It was calculated as nitrogen content and converted to its equivalent protein content by multiplying with 6.25 (A.O.A.C.,1980)

Statistical analysis

The obtained data were subjected to statistical analysis according to the method described by Steel and Torrie (1980).

RESULTS AND DISCUSSIONS

1.Vegetative Growth

1. 1. Main effect of sowing dates, cultivars and micro-elements

The effect of sowing dates, cultivars and micro-elements on vegetative growth (plant height, number of leaves and branches/plant and dry weight/plant) are shown in Table 2. It is obvious that growth aspects were significantly affected by sowing dates and cultivars, but they were insignificantly affected by micro-elements. Sowing plants on Sept. 15th gave the highest values of vegetative growth, this may be due to that the prevailing temperature in this time was optimum for growth of snap bean plants. In addition, White and Mansfield (1978) reported that light quality, intensity and temperature had effect on snap bean plant growth.

Table 2: Effect of sowing dates, cultivars and micro-elements on vegetative growth of snap bean.

Season / Characters / Treatments	2005				2006			
	Plant height (cm)	No of leaves/ plant	No of branches/ plant	Dry weight/ Plant (gm)	Plant height (cm)	No of leaves/ plant	No of branches/ plant	Dry weight/ plant (gm)
Sowing dates								
15/7	29.35	9.90	3.76	7.89	28.04	9.53	3.59	7.75
15/8	32.02	12.60	4.30	9.22	31.15	11.03	3.86	8.84
15/9	35.41	13.94	5.16	11.89	34.32	13.04	4.61	11.27
15/10	31.76	13.01	4.86	11.16	31.71	12.11	4.32	10.28
$LSD_{0.05}$	1.84	0.85	0.21	0.61	0.72	1.76	0.40	0.66
Cultivars								
Bronco	31.09	12.02	4.31	9.57	30.40	10.88	4.12	9.18
Paulista	39.18	14.30	5.28	11.55	36.94	13.32	5.01	10.91
Xera	26.13	10.78	4.00	9.01	26.58	10.08	3.16	8.52
$LSD_{0.05}$	1.00	0.58	0.36	0.39	0.85	1.26	0.25	0.33
Micro-elements								
Zn	32.51	12.27	4.45	10.04	30.96	11.25	4.09	9.58
Fe	31.51	12.47	4.55	10.03	31.31	11.34	4.10	9.43
Mn	32.38	12.36	4.57	10.05	31.65	11.69	4.10	9.60
$LSD_{0.05}$	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Vegetative growth of Paulista cultivar recorded the highest values as compared to other cultivars, this may be different expressively of certain genes during ontogenetic processes, which may interact with the developmental and environmental factors in relation to water relationships, and indicated that genes that are responsible for the biosynthesis of such characters might be varied in their action (Yarnell, 1962; Arisha, 1982 on pea).

Spraying plants with micro-elements (Zn, Fe and Mn) did not reflect any significant effect on vegetative growth, this may be due to that plants received enough amounts of micro-elements from organic manure applied to soil and from the nutrient solution of micro-elements that was applied to the plants at 30 days after sowing. The obtained results are in accordance with those reported by Saini and Negi (1998), Yaman (1998) and Amer (2004) on snap bean.

1.2. Effect of interaction between sowing dates and cultivars

Data in Table 3 show the effect of interaction between sowing dates (15/7, 15/8, 15/9 and 15/10) and cultivars (Bronco, Paulista and Xera) on vegetative growth (plant height, number of leaves and branches/plant and dry weight/plant). It is clear that the interaction treatments had insignificant effect on number of leaves and branches/plant in two seasons and dry weight/plant in first season only. On the other hand it reflected a significant effect on plant height and the highest values of plant height and dry weight/plant were recorded after sowing Paulista cultivar on Sept. 15th.

Table 3: Effect of interaction between sowing dates and cultivars on vegetative growth of snap bean

Seasons / Characters / Sowing d. / Cult.		2005				2006			
		Plant height (cm)	No of leaves/ plant	No of branches/ plant	Dry weight/ plant (gm)	Plant height (cm)	No of leaves/ plant	No of branches/ plant	Dry weight/ plant (gm)
15/7	Bronco	29.80	9.68	3.58	7.57	27.86	9.34	3.67	7.11
	Paulista	33.66	12.38	4.68	9.33	32.22	11.84	4.23	9.15
	Xera	24.59	7.64	3.01	6.78	24.04	7.40	2.88	6.98
15/8	Bronco	31.09	11.79	4.21	8.94	30.59	10.76	3.85	8.45
	Paulista	38.83	14.24	4.93	10.92	35.98	13.20	4.68	10.75
	Xera	26.14	11.78	3.76	7.80	26.87	9.14	3.04	7.30
15/9	Bronco	34.79	13.69	4.95	11.09	32.12	11.49	4.59	10.95
	Paulista	44.03	15.73	5.89	13.44	41.75	15.23	5.82	12.48
	Xera	27.41	12.42	4.63	11.16	29.10	12.41	3.42	10.37
15/10	Bronco	28.68	12.92	4.51	10.68	31.01	11.93	4.36	10.19
	Paulista	40.20	14.85	5.62	12.52	37.81	13.02	5.29	11.24
	Xera	26.39	11.27	4.46	10.29	26.32	11.39	3.31	9.42
$LSD_{0.05}$		2.01	N.S	N.S	N.S	1.70	N.S	N.S	0.67

1.3. Effect of interaction between sowing dates and micro-elements

It is evident from the data in Table 4 that all interaction treatments between sowing dates (15/7, 15/8, 15/9 and 15/10) and micro-elements (Zn, Fe and Mn) had insignificant effect on plant height, number of leaves and branches/plant and dry weight/plant in both seasons.

Table 4: Effect of interaction between sowing dates and micro-elements on vegetative growth of snap bean

Seasons / Characters / Sowing d. / Micro.		2005				2006			
		Plant height (cm)	No of leaves/ plant	No of branches/ plant	Dry weight/ plant (gm)	Plant height (cm)	No of leaves/ plant	No of branches/ plant	Dry weight/ plant (gm)
15/7	Zn	30.87	9.77	3.67	8.05	27.97	9.27	3.60	7.69
	Fe	28.17	10.00	3.86	7.80	28.74	9.50	3.54	7.88
	Mn	29.01	9.94	3.74	7.82	27.41	9.81	3.64	7.66
15/8	Zn	31.99	12.46	4.17	9.08	30.10	10.93	3.95	8.92
	Fe	31.83	12.76	4.31	9.20	31.61	10.82	3.81	8.77
	Mn	32.25	12.59	4.42	9.39	31.73	11.34	3.81	8.82
15/9	Zn	34.61	13.92	5.16	11.77	33.62	12.56	4.60	11.29
	Fe	35.14	13.87	5.20	12.01	33.68	12.94	4.65	11.08
	Mn	36.47	14.04	5.12	11.91	35.67	13.62	4.60	11.43
15/10	Zn	32.58	12.93	4.79	11.28	32.17	12.24	4.20	10.40
	Fe	30.90	13.24	4.81	11.11	31.20	12.09	4.41	9.98
	Mn	31.79	12.86	4.99	11.10	31.77	12.01	4.35	10.48
$LSD_{0.05}$		N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

1.4. Effect of interaction between cultivars and micro-elements

Data in Table 5 show the effect of interaction between cultivars (Bronco, Paulista and Xera) and micro-elements (Zn, Fe and Mn) on plant height, number of leaves and branches/plant and dry weight/plant. It is obvious from the data that all interaction treatments had insignificant effect on vegetative growth of snap bean.

1.5. Effect of interaction among sowing dates, cultivars and micro-elements

Since vegetative growth characters of snap bean plants were not significantly affected by the triple interaction, therefore data were deleted.

Table 5:Effect of interaction between cultivars and micro-elements on vegetative growth of snap bean

Seasons / Characters / Sowing d. / Micro.		2005				2006			
		Plant height (cm)	No of leaves/ plant	No of branches/ plant	Dry weight/ plant (gm)	Plant height (cm)	No of leaves/ plant	No of branches/ plant	Dry weight/ plant (gm)
Bronco	Zn	31.64	11.88	4.27	9.54	29.90	10.55	4.09	9.19
	Fe	30.35	11.96	4.29	9.60	30.42	10.56	4.13	9.02
	Mn	31.28	12.22	4.39	9.56	30.86	11.52	4.14	9.32
Paulista	Zn	38.62	14.42	5.14	11.58	36.84	13.83	5.02	10.96
	Fe	39.08	14.50	5.29	11.45	37.10	13.38	5.01	10.77
	Mn	39.86	13.97	5.42	11.63	36.88	13.16	4.99	10.98
Xera	Zn	27.28	10.51	3.94	9.01	26.15	9.77	3.15	8.57
	Fe	25.11	10.94	4.07	9.04	26.40	10.08	3.16	8.49
	Mn	26.01	10.87	3.90	8.97	27.19	10.40	3.18	8.50
$LSD_{0.05}$		N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

2. Yield Quantity and Quality

2.1. Main effect of sowing dates, cultivars and micro-elements

Results given in Table 6 show the effect of sowing dates, cultivars and micro-elements on number and weight of pods/plant, pods yield/fed and white pods percentage. It is evident that both sowing dates and cultivars caused a significant effect on quantity and quality of yield, the favourable sowing date for increasing number and weight of pods/plant was 15th Sept. under Ismailia conditions. Meanwhile, white pods percentage decreased with delaying sowing date. Sowing plants on Oct. 15th gave the least value of white pod percentage. Paulista cultivar recorded the best values of number and weight of pods/plant and yield/fed as compared with other cultivars, while Xera cultivar exhibited a more tolerance for white pods problem, but Bronco cultivar appeared a more sensitive one for such problem.

Table 6: Effect of sowing dates, cultivars and micro-elements on yield and its components of snap bean

Season / Characters / Treatments	2005				2006			
	No of pods/ plant	Pods yield /plant (gm)	Pods yield /fed (ton)	White pods %	No of pods/ plant	Pods yield /plant (gm)	Pods yield/fed (ton)	White pods %
Sowing dates								
15/7	13.62	37.78	2.027	23.37	11.38	33.96	1.967	21.67
15/8	17.24	51.55	2.327	13.97	13.98	40.56	2.434	11.73
15/9	22.30	66.55	3.666	8.71	20.59	60.52	3.517	3.41
15/10	21.40	65.80	3.442	3.50	19.73	58.21	3.315	1.60
$LSD_{0.05}$	1.47	4.64	0.05	1.27	1.05	2.82	0.07	0.52
Cultivars								
Bronco	16.05	48.39	2.904	15.21	13.97	42.26	2.773	13.82
Paulista	21.29	61.58	3.121	12.56	19.35	56.45	3.211	8.86
Xera	18.58	56.29	2.572	9.39	15.94	46.16	2.441	6.13
$LSD_{0.05}$	1.12	3.08	0.10	0.75	0.76	2.55	0.08	0.68
Micro-elements								
Zn	18.48	55.06	2.861	12.77	16.53	48.38	2.818	9.81
Fe	18.61	55.22	2.885	12.34	16.52	48.48	2.794	9.58
Mn	18.83	55.98	2.851	12.05	16.22	48.01	2.813	9.42
$LSD_{0.05}$	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Spraying plants with solutions of Zn, Fe or Mn at 40 days after sowing had no significant effect on yield quantity and quality, this may be plants received enough amounts of micro-elements either from organic manure applied to soil or from complete micro-elements nutrient solution that was added to the plants at 30 days after sowing. These findings are in harmony with those of Singh *et al.* (1998) and Amer (2004) on snap bean.

2.2. Effect of interaction between sowing dates and cultivars

It is evident from data in Table 7 that all interaction treatments between sowing dates and cultivars had a significant effect on pods yield/fed and white pods percentage in the two seasons of study and number of pods/plant in second season only, but it had insignificant effect on pods yield/plant.

The best interaction treatment for increasing number of pods/plant and pods yield/fed was sowing plants on Sept. 15th with Paulista cultivar. Meanwhile, sowing Xera cultivar on Oct. 15th gave the least value of white pods percentage.

Table 7:Effect of interaction between sowing dates and cultivars on yield and its components of snap bean

Seasons / Characters / Sowing d / Cult.		2005				2006			
		No of pods/ plant	Pods yield /plant (gm)	Pods yield/fed (ton)	White pods %	No of pods/ plant	Pods yield /plant (gm)	Pods yield /fed (ton)	White pods %
15/7	Bronco	11.39	30.92	2.039	26.83	9.54	28.32	1.979	28.88
	Paulista	16.05	44.11	2.112	23.83	13.67	41.07	2.094	20.31
	Xera	13.41	38.31	1.931	19.45	10.94	32.48	1.829	15.83
15/8	Bronco	14.98	43.42	2.284	17.08	11.80	34.19	2.469	18.23
	Paulista	19.50	58.88	2.493	14.45	15.42	44.79	2.786	10.92
	Xera	17.25	52.35	2.206	10.37	14.70	42.40	2.046	6.06
15/9	Bronco	19.40	59.59	3.785	11.48	17.47	53.28	3.493	5.72
	Paulista	25.06	71.45	4.046	8.56	24.88	72.10	4.033	2.81
	Xera	22.43	68.61	3.168	6.10	19.42	56.17	3.026	1.70
15/10	Bronco	18.43	59.63	3.509	5.47	17.06	53.24	3.153	2.45
	Paulista	24.57	71.89	3.833	3.41	23.42	67.83	3.931	1.40
	Xera	21.21	65.88	2.984	1.63	18.72	53.57	2.861	0.95
$LSD_{0.05}$		N.S	N.S	0.20	1.50	1.53	N.S	0.15	1.37

2.3. Effect of interaction between sowing dates and micro-elements

Concerning the effect of interaction between sowing dates and micro-elements on number and weight of pods/plant, pods yield/fed and white pods percentage, it is obvious form Table 8 that all interaction treatments had insignificantly effect on yield quantity and quality.

2.4. Effect of interaction between cultivars and micro-elements

It is clear from the data in Table 9 that the interaction between cultivars (Bronco, Paulista and Xera) and micro-elements (Zn, Fe or Mn) did not show any significant effect on number and weight of pods/plant, pods yield and white pods percentage in two seasons

Table 8: Effect of interaction between sowing dates and micro-elements on yield and its components of snap bean

Seasons / Characters / Sowing d. / Micro.		2005				2006			
		No of pods/ plant	Pods yield /plant (gm)	Pods yield/fed (ton)	White pods %	No of pods/ plant	Pods yield/plant (gm)	Pods yield/fed (ton)	White pods %
15/7	Zn	13.46	36.76	2.015	23.63	11.59	34.66	1.982	22.43
	Fe	13.44	37.46	2.042	23.31	11.31	34.56	1.954	22.02
	Mn	13.96	39.13	2.024	23.17	11.25	32.65	1.966	20.56
15/8	Zn	16.67	50.80	2.315	14.74	14.33	40.90	2.462	11.50
	Fe	17.53	51.82	2.374	13.73	14.19	40.61	2.415	11.50
	Mn	17.52	52.03	2.293	13.43	13.40	39.87	2.424	12.20
15/9	Zn	22.02	67.12	3.622	8.85	20.51	59.77	3.502	3.65
	Fe	22.13	66.32	3.692	8.81	20.63	61.08	3.503	3.25
	Mn	22.73	66.21	3.685	8.48	20.64	60.71	3.547	3.33
15/10	Zn	21.67	65.56	3.493	3.87	19.67	58.18	3.327	1.66
	Fe	21.32	65.28	3.430	3.51	19.94	57.66	3.304	1.56
	Mn	21.12	66.56	3.403	3.13	19.59	58.80	3.313	1.58
$LSD_{0.05}$		N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Table 9: Effect of interaction between cultivars and micro-elements on yield and its components of snap bean

Seasons / Characters / Sowing d. / Micro.		2005				2006			
		No of pods/ plant	**Pods yield/plant (gm)**	**Pods yield /fed (ton)**	**White pods %**	**No of pods/ plant**	**Pods yield /plant (gm)**	**Pods yield /fed (ton)**	**White pods %**
Bronco	Zn	15.80	47.76	2.886	15.83	14.03	42.155	2.779	13.73
	Fe	16.44	48.63	2.924	15.17	13.98	42.07	2.770	13.60
	Mn	15.91	48.77	2.902	14.64	13.90	42.55	2.772	14.12
Paulista	Zn	21.33	61.64	3.109	12.87	19.58	57.16	3.220	9.28
	Fe	21.09	61.66	3.160	12.46	19.33	56.90	3.192	8.69
	Mn	21.46	61.45	3.095	12.37	19.13	55.28	3.221	8.61
Xera	Zn	18.31	55.78	2.588	9.62	15.96	45.82	2.456	6.43
	Fe	18.28	55.37	2.570	9.39	16.24	46.46	2.421	6.45
	Mn	19.14	57.72	2.557	9.15	15.63	46.19	2.445	5.53
$LSD_{0.05}$	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

2.5. Effect of interaction among sowing dates, cultivars and micro-elements

Since the effects of interaction among sowing dates, cultivars and micro-elements on yield quantity and quality were insignificant, therefore the data were deleted.

3. Photosynthetic Pigments

3.1. Main effect of sowing dates, cultivars and micro-elements

Data in Table 10 reveal the effect of sowing dates, cultivars and micro-elements on chlorophyll a, b, total chlorophyll (a + b) and carotenoids in green pods. It is obvious from such data that both sowing dates and cultivars caused a significant effect on photosynthetic pigments in green pods.

Sowing plants on Sept. 15th or Oct. 15th gave the highest values of chlorophyll a, b, total chlorophyll (a + b) and carotenoids contents in green pods with compared to other sowing dates under Ismailia conditions. This result may be caused increasing in yield quality and decreasing white pods percentage (Table 6). This results may be due to the favourable conditions of light and temperature for increasing photosynthetic pigments at such particular sowing dates. In addition, John *et al.* (1986) found that increasing temperature about 26^{o}C decreased chlorophyll content in sweet clover leaves.

green pods of Xera cultivar had high values of photosynthetic pigments compared to other cultivars. On the other hand, spraying plants with Zn, Fe or Mn solutions at 200 ppm each had insignificant effect on chlorophyll a, b, total chlorophyll (a + b) and carotenoids in green pods. These results agree with those obtained by El – Gamiely *et al.* (1998); Nour (1999) and Mansour (2006) on pea.

Table 10: Effect of sowing dates, cultivars and micro-elements on photosynthetic pigments (mg/gm d.w.) in snap bean pods

Season / Characters / Treatments	2005				2006			
	Chl. a	Chl. b	Total chl. (a+b)	Carot-enoids	Chl. a	Chl. b	Total chl. (a+b)	Carot-enoids
Sowing dates								
15/7	2.28	1.86	4.14	1.65	2.24	1.86	4.11	1.63
15/8	2.60	2.13	4.73	1.94	2.63	2.15	4.79	1.92
15/9	2.90	2.39	5.29	2.27	2.87	2.43	5.30	2.18
15/10	2.89	2.42	5.33	2.22	2.89	2.44	5.34	2.17
$LSD_{0.05}$	0.11	0.07	0.06	0.05	0.05	0.06	0.15	0.07
Cultivars								
Bronco	2.31	1.89	4.19	1.75	2.25	1.87	4.13	1.71
Paulista	2.66	2.11	4.80	2.05	2.63	2.15	4.79	2.00
Xera	3.02	2.61	5.62	2.27	3.09	2.64	5.72	2.22
$LSD_{0.05}$	0.06	0.04	0.06	0.05	0.05	0.07	0.09	0.05
Micro-elements								
Zn	2.65	2.19	4.86	2.02	2.67	2.21	4.91	1.97
Fe	2.65	2.20	4.86	2.02	2.65	2.22	4.87	1.98
Mn	2.69	2.21	4.90	2.03	2.66	2.22	4.87	1.98
$LSD_{0.05}$	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

3.2. Effect of interaction between sowing dates and cultivars

Data in Table 11 show the effect of interaction treatments between sowing dates and cultivars on photosynthetic pigments in green pods. It is clear the best interaction treatment for increasing chlorophyll a, b, total chlorophyll (a + b) and carotenoids contents in green pods was sowing Xera cultivar on Sept. 15th or Oct. 15th .

Table 11:Effect of interaction between sowing dates and cultivars on photosynthetic pigments (mg/gm d.w.) in snap bean pods

Seasons / Characters / Sowing d. / Cult.		2005				2006			
		Chl. a	Chl. b	Total chl. (a+b)	Carot-enoids	Chl. a	Chl. b	Total chl. (a+b)	Carot-enoids
15/7	Bronco	2.04	1.66	3.70	1.31	1.95	1.60	3.58	1.34
	Paulista	2.33	1.87	4.20	1.73	2.30	1.91	4.22	1.71
	Xera	2.46	2.06	4.52	1.92	2.46	2.06	4.52	1.84
15/8	Bronco	2.20	1.86	4.06	1.60	2.19	1.80	3.93	1.52
	Paulista	2.55	2.07	4.61	2.04	2.55	2.09	4.67	2.04
	Xera	3.05	2.47	5.51	2.19	3.17	2.54	5.71	2.21
15/9	Bronco	2.50	2.00	4.49	2.03	2.47	2.04	4.51	1.97
	Paulista	2.91	2.27	5.20	2.24	2.78	2.29	5.07	2.13
	Xera	3.28	2.90	6.16	2.54	3.36	2.97	6.33	2.43
15/10	Bronco	2.50	2.02	4.50	2.04	2.41	2.05	4.46	2.01
	Paulista	2.86	2.24	5.19	2.17	2.89	2.29	5.21	2.11
	Xera	3.30	3.00	6.28	2.44	3.36	2.97	6.33	2.41
$LSD_{0.05}$		0.13	0.08	0.11	0.10	0.10	0.13	0.18	0.10

3.3. Effect of interaction between sowing dates and micro-elements

The effect of interaction between sowing dates and micro-elements on photosynthetic pigments in green pods are presented in Table12. All interaction treatments had insignificant effect on chlorophyll a,b, total chlorophyll (a + b) and carotenoids contents in green pods.

Table 12: Effect of interaction between sowing dates and micro-elements on photosynthetic pigments (mg/gm d.w.) in snap bean pods

Seasons / Characters / Sowingd. / Micro.		2005				2006			
		Chl. a	Chl. b	Total chl. (a+b)	Carot-enoids	Chl. a	Chl. b	Total chl. (a+b)	Carot-enoids
15/7	Zn	2.26	1.87	4.14	1.66	2.28	1.86	4.17	1.63
	Fe	2.29	1.86	4.15	1.65	2.21	1.86	4.07	1.65
	Mn	2.28	1.85	4.13	1.65	2.21	1.86	4.08	1.61
15/8	Zn	2.59	2.12	4.71	1.94	2.61	2.14	4.75	1.90
	Fe	2.59	2.14	4.73	1.95	2.64	2.14	4.77	1.92
	Mn	2.61	2.13	4.74	1.93	2.65	2.16	4.83	1.94
15/9	Zn	2.87	2.37	5.24	2.26	2.87	2.41	5.28	2.18
	Fe	2.87	2.38	5.28	2.26	2.87	2.44	5.31	2.17
	Mn	2.95	2.41	5.33	2.29	2.90	2.44	5.31	2.18
15/10	Zn	2.89	2.40	5.33	2.21	2.90	2.41	5.42	2.17
	Fe	2.86	2.41	5.26	2.21	2.87	2.46	5.33	2.17
	Mn	2.91	2.44	5.38	2.24	2.90	2.44	5.26	2.17
$LSD_{0.05}$		N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

3.4. Effect of interaction between cultivars and micro-elements

It is obvious from the data in Table 13 that the interaction between cultivars and micro-elements had no significant effect on chlorophyll a, b, total chlorophyll (a + b) and carotenoids contents in green pods.

3.5. Effect of interaction among sowing dates, cultivars and micro-elements

Data of the effect of the triple interaction on photosynthetic pigments were insignificant effect on chlorophyll a, b, total chlorophyll (a + b) and carotenoids contents in green pods, so that they were deleted.

Table 13: Effect of interaction between cultivars and micro-elements on photosynthetic pigments (mg/gm d.w.) in snap bean pods

Seasons / Characters / Sowing d. / Micro.		2005				2006			
		Chl. a	Chl. b	Total chl. (a+b)	Carot-enoids	Chl. a	Chl. b	Total chl. (a+b)	Carot-enoids
Bronco	Zn	2.30	1.90	4.22	1.74	2.26	1.87	4.14	1.70
	Fe	2.28	1.89	4.17	1.74	2.51	1.87	4.12	1.71
	Mn	2.35	1.87	4.18	1.76	2.26	1.88	4.14	1.71
Paulista	Zn	2.66	2.10	4.81	2.04	2.64	2.13	4.85	1.99
	Fe	2.65	2.10	4.71	2.04	2.61	2.17	4.78	2.00
	Mn	2.68	2.13	4.88	2.06	2.64	2.14	4.74	2.01
Xera	Zn	3.01	2.58	5.53	2.27	3.10	2.63	5.73	2.23
	Fe	3.02	2.61	5.69	2.27	3.08	2.63	5.71	2.23
	Mn	3.04	2.63	5.63	2.27	3.09	2.64	5.73	2.21
$LSD_{0.05}$		N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

4. NPK and Protein contents

4.1. Main effect of sowing dates, cultivars and micro-elements

It is obvious from the data in Table 14 that sowing snap bean plants on Sept. 15th or Oct. 15th significantly increased minerals (NPK) and protein contents in pods as compared to other sowing dates, the superiority in minerals and protein contents when sowing plants on Sept. 15th or Oct. 15th may be due to the increase in plant height, dry weight and photosynthetic pigments (Table 2 and 10).

Data also show that minerals (NPK) and protein contents were significantly affected by cultivars of snap bean, except K content in first season only. Xera cultivar recorded the highest values on NPK and protein contents as compared to other cultivars.

Spraying plant with Zn, Fe or Mn solutions at 200 ppm each had insignificant effect on NPK and protein contents in two seasons under study. The obtained results are in accordance with those reported by Saini and Negi (1998), Yaman (1998) and Amer (2004) on snap bean.

Table 14: Effect of sowing dates, cultivars and micro-elements on minerals (NPK) and protein contents in snap bean pods

Season / Characters / Treatments	2005				2006			
	N	P	K	Protein	N	P	K	Protein
Sowing dates								
15/7	2.70	0.341	2.08	16.90	2.69	0.345	2.09	16.83
15/8	2.90	0.364	2.18	18.11	2.82	0.363	2.20	17.60
15/9	3.00	0.386	2.31	18.75	2.99	0.393	2.30	18.65
15/10	3.00	0.374	2.32	18.75	3.02	0.376	2.31	18.87
$LSD_{0.05}$	0.02	0.007	0.05	0.15	0.08	0.007	0.07	0.53
Cultivars								
Bronco	2.85	0.355	2.23	17.81	2.80	0.354	2.24	17.52
Paulista	2.90	0.366	2.21	18.12	2.89	0.371	2.21	18.05
Xera	2.95	0.378	2.23	18.45	2.94	0.382	2.22	18.39
$LSD_{0.05}$	0.04	0.005	N.S	0.22	0.03	0.005	0.03	0.18
Micro-elements								
Zn	2.90	0.367	2.21	18.13	2.88	0.370	2.21	17.97
Fe	2.90	0.366	2.25	18.11	2.88	0.369	2.23	17.99
Mn	2.90	0.367	2.22	18.14	2.88	0.369	2.23	18.00
$LSD_{0.05}$	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

4.2. Effect of interaction between sowing dates and cultivars

Data in Table 15 show the effect of interaction between sowing dates (15/7, 15/8, 15/9 and 15/10) and cultivars (Bronco, Paulista and Xera) on NPK and protein contents. It is clear that the interaction treatments had significant effect on N and protein contents in two seasons, and the best interaction for increasing N and protein contents was sowing Xera cultivar on Sept. 15th. On the other hand, all interaction treatments had insignificant effect on P and K contents in snap bean pods in two seasons under study.

Table 15: Effect of interaction between sowing dates and cultivars on minerals (NPK) and protein contents in snap bean pods

Seasons / Characters / Sowing d. / Cult.		2005 N	2005 P	2005 K	2005 Protein	2006 N	2006 P	2006 K	2006 Protein
15/7	Bronco	2.69	0.334	2.08	16.83	2.63	0.334	2.09	16.45
	Paulista	2.65	0.336	2.07	16.59	2.68	0.346	2.09	16.73
	Xera	2.77	0.353	2.09	17.28	2.77	0.356	2.10	17.31
15/8	Bronco	2.80	0.355	2.17	17.52	2.75	0.358	2.19	17.18
	Paulista	2.92	0.363	2.19	18.22	2.80	0.363	2.20	17.48
	Xera	2.97	0.372	2.20	18.59	2.90	0.368	2.21	18.14
15/9	Bronco	2.94	0.373	2.32	18.38	2.85	0.373	2.37	17.78
	Paulista	3.02	0.388	2.28	18.87	3.05	0.395	2.24	19.04
	Xera	3.04	0.398	2.34	19.00	3.06	0.411	2.28	19.11
15/10	Bronco	2.96	0.357	2.33	18.50	2.99	0.351	2.32	18.68
	Paulista	3.01	0.379	2.32	18.81	3.02	0.382	2.31	18.94
	Xera	3.03	0.387	2.31	18.92	3.04	0.394	2.30	18.98
$LSD_{0.05}$		0.07	N.S	N.S	0.45	0.05	N.S	N.S	0.35

3.3. Effect of interaction between sowing dates and micro-elements

It is evident from the data in Table 16 that all interaction treatments between sowing dates (15/7, 15/8, 15/9 and 15/10) and micro-elements (Zn, Fe and Mn) had insignificant effect on NPK and protein contents.

Table 16: Effect of interaction between sowing dates and micro-elements on minerals (NPK) and protein contents in snap bean pods

Seasons / Characters / Sowing d. / Micro.		2005 N	2005 P	2005 K	2005 Protein	2006 N	2006 P	2006 K	2006 Protein
15/7	Zn	2.72	0.343	2.09	16.99	2.70	0.347	2.10	16.85
	Fe	2.69	0.341	2.07	16.81	2.70	0.344	2.09	16.83
	Mn	2.70	0.339	2.09	16.90	2.70	0.344	2.09	16.81
15/8	Zn	2.89	0.363	2.15	18.05	2.80	0.364	2.17	17.50
	Fe	2.90	0.363	2.23	18.11	2.82	0.363	2.21	17.63
	Mn	2.91	0.364	2.17	18.17	2.83	0.363	2.21	17.66
15/9	Zn	3.00	0.387	2.31	18.73	2.99	0.389	2.30	18.68
	Fe	3.00	0.385	2.33	18.74	2.99	0.394	2.27	18.69
	Mn	3.01	0.387	2.29	18.78	2.98	0.395	2.31	18.57
15/10	Zn	3.00	0.372	2.29	18.75	3.02	0.378	2.27	18.85
	Fe	3.00	0.374	2.34	18.77	3.01	0.375	2.35	18.81
	Mn	3.00	0.377	2.33	18.72	3.02	0.374	2.31	18.94
$LSD_{0.05}$		N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

3.4. Effect of interaction between cultivars and micro-elements

It is clear from the data in Table 17 that the interaction between cultivars (Bronco, Paulista and Xera) and micro-elements (Zn, Fe or Mn) did not show any significant effect on NPK and protein contents.

3.5. Effect of interaction among sowing dates, cultivars and micro-elements

Since the effects of interaction among sowing dates, cultivars and micro-elements on NPK and protein contents were insignificant, therefore the data were deleted.

Table 17: Effect of interaction between cultivars and micro-elements on minerals (NPK) and protein contents in snap bean pods

Seasons / Characters / Sowing d. / Micro.		2005				2006			
		N	P	K	Protein	N	P	K	Protein
Bronco	Zn	2.86	0.355	2.24	17.86	2.79	0.352	2.24	17.44
	Fe	2.84	0.354	2.23	17.74	2.81	0.354	2.23	17.52
	Mn	2.85	0.355	2.21	17.84	2.81	0.356	2.27	17.60
Paulista	Zn	2.91	0.366	2.19	18.15	2.89	0.372	2.20	18.04
	Fe	2.89	0.365	2.24	18.06	2.89	0.372	2.20	18.10
	Mn	2.91	0.369	2.21	18.16	2.88	0.370	2.23	18.01
Xera	Zn	2.94	0.379	2.20	18.38	2.95	0.384	2.20	18.42
	Fe	2.96	0.377	2.27	18.53	2.94	0.382	2.26	18.36
	Mn	2.95	0.377	2.24	18.43	2.94	0.381	2.20	18.38
$LSD_{0.05}$		N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

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عبدالحميد حبشى عامر ، طه بغدادى على و فايزة محمد على
قسم بحوث الخضر – معهد بحوث البساتين- مركز البحوث الزراعية

أجرى هذا البحث لدراسة تأثير أربعة مواعيد زراعة (١٥ يوليو , ١٥ أغسطس, ١٥ سبتمبر, ١٥ أكتوبر) وثلاثة أصناف (برونكو, بوليستا, اكسيرا) وثلاثة عناصر صغرى (زنك أو حديد أو منجنيز) على النمو وإنتاجية وجودة محصول القرون والمحتوى الكيماوي لقرون الفاصوليا النامية تحت ظروف الاراضى الرملية. وقد أجرى البحث في مزرعة التجارب البحثية بمحطة بحوث البساتين بالقصاصين, محافظة الإسماعيلية، خلال موسمي ٢٠٠٥ , ٢٠٠٦ م.

زادت صفات النمو الخضري (ارتفاع النبات، وعدد الأوراق، والأفرع/نبات، والوزن الجاف/نبات)، وكمية المحصول وجودته والمحتوى الكيماوي للقرون (نيتروجين, فوسفور, بوتاسيوم, بروتين) معنويا عند زراعة النباتات في ١٥ سبتمبر آو ١٥ أكتوبر , في حين الزراعة في ١٥ أكتوبر سجلت اقل قيمة لنسبة القرون البيضاء مقارنة بباقي مواعيد الزراعة الأخرى.

أعطى الصنف بوليستا أعلى القيم للنمو الخضري، وكمية المحصول, بينما يعتبر الصنف اكسيرا أفضل الأصناف التي قل ظهور القرون البيضاء بها وأعطت أعلى القيم للمحتوى الكيماوي للقرون (نيتروجين, فوسفور, بوتاسيوم, بروتين)، ويعتبر الصنف برونكو أكثر الأصناف التي زاد ظهور القرون البيضاء بها تحت ظروف الدراسة.

لم يظهر اى تأثير معنوي على النمو وكمية المحصول وجودته والمحتوى الكيماوي عند رش النباتات بمحلول اى من العناصر الصغرى (الزنك، أو الحديد، أو المنجنيز).

وعموما فان زراعة الصنف بوليستا في ١٥ سبتمبر أو ١٥ أكتوبر أعطى اعلي القيم للنمو الخضري والمحصول, بينما زراعة الصنف اكسيرا في ١٥ أكتوبر أعطى اقل قيمة لنسبة القرون البيضاء وأعلى القيم للمحتوى الكيماوي للقرون (نيتروجين, فوسفور, بوتاسيوم, بروتين).