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EFFECT OF MINERAL NITROGEN APPLICATION TIMES AND FOLIAR BIOSTIMULANTS ON VEGETATIVE GROWTH, YIELD AND YIELD COMPONENTS OF TWO SNAP BEAN CULTIVARS

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ABSTRACT

The present work was carried out during two successive summer seasons of year 2005and 2006 in unheated plastic house at the Experimental Station, Faculty of Agriculture, Cairo university, Giza, to study the response of two snap bean (Phaseolus vulgaris,L.) cultivars, namely Bronco and Pulista to nitrogen application time i.e., three times or twice or adding nitrogen one time and foliar stimulants, i.e., Faster and Setter-2 . The experiment included 32 treatments which were a combination of two cultivars, and sixteen combination treatments between four nitrogen application time and four foliar biostimulants. There were no significant differences between the two cultivars, i.e., Bronco and Paulista, regarding vegetative growth characters, except Paulista cv. Which exceeded Bronco in the number of branches in the first season. Adding nitrogen in three doses, i.e., 25% at soil preparing + 50% three weeks after planting + 25% at flowering, significantly increased number of branches per plant in the first season, as compared with adding nitrogen once, three weeks after planting. Foliar spray had a significant effect on all characters of vegetative growth. All spray treatments, i.e., Faster, Setter-2 and Faster + Setter-2, significantly increased plant fresh weight, plant height and number of branches per plant in the second season. Bronco cv. Surpassed cv. Paulista in plant yield, early yield and total yield. All spray treatments, i.e., faster, faster + Setter-2 and Setter-2 led to a significant increment in plant yield and total yield in first season as well as early yield in second seasons.

INTRODUCTION

Snap bean (*Phaseolus vulgaris,L*.) is one of the most important vegetable crops grown in Egypt for local consumption as well as for exportation. Chemical fertilizers, which are commonly used, for fertilizing of vegetable crops in the Egyptian clay soil had various problems e.g., some application of N fertilizers imparts negative impact to the environment. Some of N fertilizer is stored in soil organic matter, some is converted to atmospheric nitrogen, and some is leached into the groundwater as nitrate pollutant. Improvement of such conditions could be accomplished by the addition of chemical fertilizers, especially nitrogen and phosphorus fertilizer, in different doses. Furthermore, the use of biostimulants, which in most cases contain some micro- and macroelements, in addition to amino acids and vitamins, is of particular interest to avoid the previously mentioned problems, and to give the plants their requirements for trace elements.

The literature describing the effectiveness of mineral nitrogen application times on vegetative growth, yield and chemical composition of plant for example. Nitrogen application during vegetative growth showed a negative effect on nodulation, whereas there was a large shoot growth

response. Carvalho *et al.* (2001) evaluated the effect of 7 application time combinations (0-0, 0-75, 15-60, 30-45, 45-30, 60-15, and 75-0 kg ha^{-1} of N, respectively at sowing time and 22 days after plant emergence) and found that a close of 75 kg ha-1 N at sowing provided an increase of 38% on total yield, as compared with the control. Ghosal *et al.* (2000) evaluated the effect of varying times of N application (full basal, 50% as basal + 50% at branching, 50% as basal + 50% at 50 % pod formation, and 25% as basal + 50% at branching + 25% at 50 % pod formation) on French bean. Among the different timings of application, N applied 50% as basal + 50% at branching gave the highest values for all the yield components. When Siliva *et al.* (1999) evaluated the effect of different time application of N (15, 25 and 35 days after emergence) on *P. vulgaris*, they observed that application time had no significant effects on the N content of leaves. Many investigators presented evidence for the importance role of the foliar fertilizers on plant growth of legumes. Abdo (2001) found that foliar spray with a mixture of Zn, Mn, and B resulted in significant increases in the morphological parameters of mung bean. The increases over the control were 49.6 % in stem length, 78.1 % in number of branches per plant and 92.2 % in the dry matter production of plant.

In contrast to these results, when pea plants, grown in sandy loam soil, were sprayed three times, 30, 45 and 60 days after sowing, with Zn, Mn, Fe, or a complete fertilizer, namely Fetrilon Combi, Ibrahim (1989) found that neither the microelements nor the complete fertilizer had a significant effect on number of branches and leaves. Nevertheless, all foliar treatments increased plant dry weight. Van Buren and peck (1962) working on snap bean, found that plant growth was good to excellent at all levels of Ca addition to the nutrient solution. In addition, El-Tohamy (2000) working on snap bean, found that plant height and fresh weight of plant were increased by foliar fertilizer with $CaCl_2$.

Spraying pea plants with a mixture of nutrient elements containing mixture for Zn, Mn, B, Mg, K_2O, Mo and S produced higher pod yield than the untreated plants (Jana and Arkel, 1996). The foliar spray with ammonium nitrate combined with Galafertile (a compound fertilizer) gave the greatest total and early pod yield and improved pod quality of pea plants (Adam and Abdallah, 1997**)**. Ismail (2002) found that yield of peas and its components was increased by using Biomagic (biostimulant contains amino acids, vitamins and macro- and microelements) as foliar spraying. As regard to the effect of microelements which are considered a main component of Setter 2 on minerals content of plant, Gabal *et al*. (1988b) indicated that artichoke plants sprayed with micro-nutrients (Mn in chelated form) improved the quality of receptacle and stimulated also accumulation of dry matter and N, P, K contents as compared with unsprayed plants.

Ibrahim (1989) working on pea reported that increasing P_2O_5 significantly increased the total uptake of N, P and K in herbage. El Mansi *et al.* (1991a) found that spraying broad bean plants with P_2O_5 solution at a rate of 12 kg /feddan increased chlorophylls. Moreover maximum concentration for P in both leaves and stem were obtained by spraying P2O5 at 18 kg/feddan. Olivera *et al.*(2004) pointed out that the P application increased shoot and root P content (4 and 6 fold respectively) in plant harvested at the

onest of flowering. However, P treatments decreased total soluble sugar in vegetative organs (leaf and root).

MATERIALS AND METHODS

The present work was carried out during two successive early and normal summer seasons of years 2005 and 2006 in unheated plastic house (40 X 8.5 m^2, at the Experimental Station, Faculty of Agriculture, Cairo University, Giza, to study the response of two snap bean (*P. vulgaris, L*.) cultivars, namely Bronco and Paulista, to nitrogen application times and foliar biostimulants, namely Faster and Setter-2. Seeds were sown on 9 th and 12 th February in the first and second year, respectively. The treatments were arranged in a split split plot design with four replications, where the two cultivars were allocated to the main plots, the four nitrogen application time treatments were randomly arranged in the sub main plots and the four foliar spray treatments were randomly distributed in the sub sub plots. The experiment included 32 treatments, which were a combination of two cultivars, four nitrogen application times and four foliar biostimulant treatments. The combination treatments were as follow:

1. Bean cultivars

a. Bronco
b. Paulista

2. Mineral nitrogen application times

a. Nitrogen was applied, as a dressing in the form of Ammonium Sulphate, in three split doses 25% before seed sowing + 50% three weeks after planting + 25% at flowering (N1 treatment).
b. Nitrogen was applied in two split doses 75% three weeks after planting + 25% at flowering (N2 treatment).
c. Nitrogen was applied once three weeks after planting (N3 treatment).
d. Nitrogen was applied once at flowering (N4 treatment).

3. Foliar biostimulants:

a. Spraying plants with Faster (obtained from Union for Agriculture Development). Faster contains of 0.1 % Ascorbic acid, 1% Citric acid, 30% K_2O and 5% P_2O_5 at 250 cm3/100 l water and was sprayed 3 times before flowering then once every week (F1 treatment).
b. Spraying plants with Setter-2 (obtained from Union for Agriculture Development). Setter-2 contains of 5000 ppm Ascorbic acid, 5000ppm Citric acid, 5000 ppm N, 1000 ppm Cu, 90000 ppm chelated Ca, 15000 ppm chelated B and 1000 pm Mn at 500 cm/200 l water. Setter-2 was sprayed 3 times at flowering then once every week (F3 treatment).
c. Spraying plants with mixture of Setter-2 and Faster (F2 treatment).
d. No spraying (F4 treatment).

The plot was 4.25 m^2 and consisted of two ridges, each 2.5 m long and 0.85 m wide. Seeds were sown in the plastic houses on both sides of ridges in sites at 15 cm apart. Three to five seeds were sown at each planting site. Ten days after sowing, plants were thinned to two plants per site. All other agricultural practices, such as weed control, irrigation, potassium and phosphorus fertilization, were conducted according to recommendations of

Ministry of Agriculture, in the clay soil. So, potassium (in the form of potassium sulphate) and phosphorus (in the form of calcium super phosphate) were applied at rate of 50 and 45 kg/fed., respectively.

Data recorded:

1. Plant growth measurement

Three plants were taken randomly from each experimental plot at the beginning of harvest; i.e., 68 days from seed sowing, as representative sample for recording plant fresh weigh, plant height and number of branches per plant.

2. Yield and yield components measurement

a. Plant yield: Weight of green pods at the beginning of harvest was measured on three plants taken randomly from each plot.

b. Early yield: Weight of green pods of the first harvest taken from each plot was recorded and then the average yield of green pods (g/m^2 in plastic house experiment and ton/feddan in open field experiment) was calculated and considered as early yield.

c. Total yield: Weight of green pods taken during all harvestings from each plot was recorded; thereafter the total weight of green pods g/m^2 in plastic house experiment and ton/feddan in open field experiment was calculated

d. Pods characteristics

Ten pods were taken randomly at the second harvest from each experimental plot for measuring the average pod weight (g), pod length (cm), pod diameter (mm) and total soluble solids (TSS %) using a hand refractometer.

3. Chemical composition

Dry sample measurements:

Hundred gram fresh weight of each of leaves and pods, obtained from the three sample plants taken randomly from each experimental plot at the beginning of harvest, were oven – dried at 70° C to a constant weight. The dry samples were taken to measure N, P and K in pods and to determine pod contents of total carbohydrates and crude fibers according the following methods.

1. Total nitrogen concentration in leaves and pods were determined according to method of Huphries (1956) by a modified micro -Kjeldahl apparatus.
2. Total phosphorus concentration in leaves and pods were determined according to the method Taussky and Shorr (1952).
3. Potassium concentration in leaves and pods were measured using flame photometrically as described by Brown and Lilliland (1964).
4. Carbohydrate and fiber concentration in pods were determined as described in A.O.A.C. methods (1980).
5. TSS % in pods was measured

All data were subjected to statisticaly analysis and means were compared using L.S.D. as described by Senedcor and Corchan (1980). The physical and chemical properties of the soil under study are presented in (Table 1).

Table 1. Chemical analysis of the soil experimental sites.

Microelements (ppm)				Macroelements (ppm)			Soluble anions (meq /L)			Soluble cations (meq /L)				E.C dS/m	pH 1:2.5	Calcium Carbonate %
Mn	Zn	Cu	Fe	K	P	N	SO_4^{-2}	Cl^-	HCO_3^-	K^+	Na^+	Mg^{+2}	Ca^{+2}			
16	3	2.4	4.4	720	34	90	29.1	6	1.4	1.6	9.9	6	19	4	7.6	3.6

RESULTS AND DISCUSSION

1- Vegetative growth

Effect of cultivars, mineral nitrogen application times and foliar biostimulants and their intraction are present in Table 3.

There were no significant differences between the two cultivars, i.e., Bronco and Paulista regarding vegetative growth characters, except Paulista cv. that exceeded Bronco in the number of branches in the second season and plant height in the first season.(Table2).

Table2. Effect of cultivars, mineral nitrogen application times and foliar biostimulants and the interaction between cultivars and mineral N application times on vegetative growth of snap beans

Treatments		Plant fresh weight (g)		Plant height (cm)		Branches number/ plant	
Cultivars		2005	2006	2005	2005	2005	2006
Bronco		74.109	68.15	65.40	52.90	2.10	2.37
Paulista		68.05	77.33	59.00	50.30	3.10	3.30
L.S.D $_{0.05}$		N.S	N.S	6.5	N.S	N.S	0.29
N application times*							
25%-50%-25%		75.69	78.80	61.30	52.10	2.70	2.29
0 - 75%- 25%		70.56	75.30	64.00	51.50	2.40	2.90
0 -100% -0		72.00	70.40	63.60	51.00	2.40	2.77
0 - 0 -100%		66.06	66.33	59.9	51.90	2.60	2.87
L.S.D $_{0.05}$		5.13	10.56	N.S	N.S	0.27	N.S
Foliar Biostimulant treatments							
Fatser		69.56	74.66	62.56	52.02	2.54	2.83
Faster + Setter-2		77.63	79.70	64.85	53.68	2.72	3.04
Setter-2		72.06	72.30	61.67	51.88	2.58	2.83
control		65.10	64.22	59.59	49.00	2.34	2.62
L.S.D $_{0.05}$		4.65	7.64	3.06	2.10	0.28	0.21
Interaction between cultivars (Cvs) and N application times (NAT)							
(Cvs)	(NAT)						
Bronco	25%-50%-25%	78.19	72.06	63.80	54.20	2.30	2.20
	0 - 75%- 25%	77.63	71.19	68.40	52.60	2.00	2.50
	0 -100% -0	68.81	65.13	66.10	52.30	1.70	2.30
	0 - 0 -100%	71.81	64.22	63.10	52.70	2.20	2.50
Paulista	25%-50%-25%	73.19	85.75	58.70	50.05	3.10	3.40
	0 - 75%- 25%	63.50	79.38	59.70	50.30	3.00	3.30
	0 -100% -0	75.19	75.75	61.10	49.80	3.20	3.30
	0 - 0 -100%	60.31	68.44	56.7	51.09	3.0	3.30
L.S.D $_{0.05}$		7.25	14.94	N.S	N.S	0.39	N.S

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

Application of nitrogen in spilt doses three times (first treatment), or twice (second treatment) or adding nitrogen one time, three weeks after planting (third treatment) caused a promotion in plant fresh weight, as compared with application of nitrogen fertilizer once at flowering stage.

Adding nitrogen in three doses, i.e., 25% at soil preparation + 50% three weeks after planting + 25% at flowering, significantly increased number of branches per plant in the first season, as compared with adding nitrogen once, at three weeks after planting. Foliar sprays had a significant effect on all characters of vegetative growth. All spray treatments, i.e., Faster, Setter-2 and Faster + Setter-2, significantly increased plant fresh weight, plant height and number of branches per plant in the second season.

Concerning the interaction between cultivars and mineral nitrogen application times, as shown in the same Table 2, adding nitrogen fertilizer to Bronco cv. in 3 applications (25% before seed sowing + 50% after 3 weeks from seed sowing + 25% at flowering) markedly increased plant fresh weight and number of branches per plant in the first season, as compared with adding nitrogen once after 3 weeks from sowing. Similarly adding nitrogen in two doses (75% after 3 weeks from sowing + 25% at flowering) had a similar stimulative effect on plant fresh weight of Bronco cv., as compared with adding nitrogen once three weeks from sowing.

Data concerning the effect of the interaction between cultivars and foliar biostimulants on the vegetative growth are presented in Table.3 .In cv. Bronco, spraying plants with Faster + Setter-2 caused producing the highest values of plant fresh weight, plant height and number of branches per plant as compared with no spraying. In cv. Paulista, in addition to spraying with Faster, which significantly promoted plant fresh weight in second season, spraying plants with a combination Faster and Setter-2 caused a significant increment in all vegetative growth characters in both seasons as compared with unsprayed plants. The interaction between mineral nitrogen application times and foliar biostimulants**.** Spraying plants with Faster + Setter-2 led to a remarkable increment in plant fresh weight and plant height in both seasons in the case of adding nitrogen in spilt applications; i.e., 25% before seed sowing + 50% after 3 weeks from sowing + 25% at flowering or 75% after 3 weeks from sowing + 25% at flowering. This spray treatment had a similar stimulative effect on plant fresh weight in the first season, and plant height and number of branches per plant in the second season when nitrogen was applied once after 3 weeks from seed sowing, as well as on the plant fresh weight in the first season in the case of adding nitrogen once at flowering. On the other hand, spraying plants with Setter-2 in the first season and Faster in the second season caused an increases in plant fresh weight and plant height, respectively in the case of adding nitrogen as 25% before seed sowing + 50% after 3 weeks from sowing + 25% at flowering. Concerning the effect of the interaction among cultivars, mineral nitrogen application and foliar biostimulants Data presented in Table 4 clearly indicate that the highest values of plant fresh weight, plant height and number of branches in the first

season were recorded in treatments of cv. Bronco + N1(25% N before seed sowing + 50% after 21days from seed sowing + 25% N after 40 days from seed sowing) + F2 (Faster + Setter-2), cv. Bronco + N2 + F2 and Paulista + N1 + F2, respectively, whereas there were Paulista + N1 + F2, Bronco + N1 + F2, and Paulista + N2 + F2, respectively in the second season. The present results are in agreements with those of Hensan (1991) who reported that the best management system for using nitrogen fertilizer was the application of nitrogen during vegetative growth. Similarly, microelements, which are main components of Setter-2, play essential roles in different physiological processes, which affect directly plant growth.

Table 3. Effect of the interactions cultivars × foliar biostimulants and mineral N application times × foliar biostimulants on vegetative growth of snap beans

Treatments		Plant fresh weight (g)		Plant height (cm)		Branches number/ plant	
Cvs	Foliar bio stimulant	2005	2006	2005	2006	2005	2006
Bronco	**Fatser**	71.56	6.81	65.27	52.88	2.00	2.35
	Faster + Setter-2	81.13	72.53	67.55	56.18	2.18	2.55
	Setter-2	76.25	69.00	65.50	53.4	2.13	2.4
	control	66.50	62.81	63.05	49.38	1.90	2.15
Paulista	**Fatser**	67.56	81.00	59.85	51.15	3.08	3.3
	Faster + Setter-2	73.13	86.88	62.15	51.17	3.25	3.53
	Setter-2	67.88	75.62	57.85	50.35	3.02	3.25
	control	63.69	65.63	56.13	48.62	2.78	3.08
L.S.D $_{0.05}$		6.58	12.22	4.33	2.55	0.39	0.29
Interaction between N application times (NAT) and foliar biostimulants (FB)							
NAT	**FB**						
25%-50%-25%	**Fatser**	73.63	81.00	60.05	53.7	2.65	2.75
	Faster + Setter-2	82.25	88.00	65.5	54.15	2.90	2.95
	Setter-2	78.25	78.50	61.25	52.15	2.80	2.90
	control	68.62	67.88	58.2	48.5	2.50	2.60
0 - 75%-25%	**Fatser**	70.25	80.38	64.85	50.65	2.45	2.85
	Faster + Setter-2	76.38	82.63	66.7	53.8	2.55	3.20
	Setter-2	71.6	75.5	63.2	52.6	2.55	2.90
	control	64.00	65.13	61.05	48.85	2.20	2.60
0 -100% -0	**Fatser**	68.13	72.63	64.45	52.00	2.45	2.90
	Faster + Setter-2	76.60	78.38	64.7	52.85	2.60	2.95
	Setter-2	75.75	66.75	63.65	50.75	2.40	2.70
	control	67.5	66.75	61.6	48.5	2.40	2.50
0-0 -100%	**Fatser**	66.25	66.88	60.9	51.75	2.60	2.80
	Faster + Setter-2	75.25	69.82	62.5	53.90	2.80	3.05
	Setter-2	62.51	68.5	58.6	52.00	2.60	2.80
	control	60.25	60.13	57.5	50.15	7.35	2.75
L.S.D $_{0.05}$		9.30	17.28	6.12	4.19	N.S	0.42

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

Table 4. Effect of the interaction among cultivars, mineral N application times and foliar biostimulants on vegetative growth of snap beans

Treatments			Plant fresh weight (g)		Plant height (cm)		Branches number/ plant	
Cvs	N application time	Foliar bio stimulants	2005	2006	2005	2006	2005	2006
Bronco	N1	Fatser (F)	77.25	71.25	63.4	55.8	2.2	2.2
		F + S	90.25	77.75	67.0	57.7	2.4	2.4
		Setter-2 (S)	78.25	73.50	64.7	54.4	2.4	2.3
		Control	67.00	65.25	60.2	48.8	2.2	2.0
	N2	Fatser (F)	73.75	72.25	67.7	51.2	1.9	2.5
		F + S	88.50	72.50	71.3	56.4	2.2	2.8
		Setter-2 (S)	78.75	73.75	68.4	53.7	2.2	2.6
		Control	69.50	66.25	66.1	49.1	1.7	2.2
	N3	Fatser (F)	65.00	64.50	67.0	52.4	1.7	2.3
		F + S	69.00	74.00	66.9	55.4	1.8	2.3
		Setter-2 (S)	77.50	62.25	66.0	52.4	1.7	2.3
		Control	63.75	59.75	64.5	48.9	1.7	2.1
	N4	Fatser (F)	70.25	64.50	63.0	52.1	2.2	2.4
		F + S	80.75	65.88	65.0	55.2	2.3	2.7
		Setter-2 (S)	70.50	66.50	62.9	53.1	2.2	2.4
		Control	65.75	60.00	61.4	50.7	2.0	2.3
Paulista	N1	Fatser (F)	70	90.75	56.7	51.6	3.1	3.3
		F + S	74.25	98.25	64	50.6	3.4	3.5
		Setter-2 (S)	78.25	83.5	57.8	49.9	3.2	3.5
		Control	70.25	70.5	56.2	48.2	2.8	3.2
	N2	Fatser (F)	66.75	38.5	62	50.1	3.0	3.2
		F + S	64.25	92.75	62.1	51.2	2.9	3.6
		Setter-2 (S)	64.5	77.25	58	51.5	2.9	3.2
		Control	58.5	64	56	48.6	2.7	3.0
	N3	Fatser (F)	71.25	81.25	61.9	51.6	3.2	3.5
		F + S	84.25	82.75	62.5	50.3	3.4	3.6
		Setter-2 (S)	74	71.25	61.3	49.1	3.0	3.1
		Control	71.25	67.75	58.7	48.1	3.0	2.9
	N4	Fatser (F)	62.25	69.25	58.8	51.3	3.0	3.2
		F + S	69.75	73.75	60.0	52.6	3.3	3.4
		Setter-2 (S)	54.5	70.5	54.3	50.9	3.0	3.2
		Control	54.75	60.25	53.6	49.6	2.7	3.2
L.S.D $_{0.05}$			13.17	24.44	8.61	5.93	0.7	0.6

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

2. Yield

Data presented in tables 5, 6 and 7 indicated that Bronco cv. surpassed cv. Paulista in plant yield, early yield and total yield in both seasons. However, such superiority was only significant in the second season

The effect of nitrogen application time on plant yield in first season as well as on early and total yield in both seasons was significant. N1(application of nitrogen in spilt doses three times (first treatment)) and N2 (application of

nitrogen in spilt doses twice (second treatment)) of nitrogen application times caused a significant promotion in plant yield as well as in early and total yield in the first season. Moreover, N3 treatment (adding nitrogen one time, three weeks after planting (third treatment)) had a similar stimulative effect on early and total yield in the first season as compared with N4 treatment. In the second season, early yield was improved by N1, N2 and N3 nitrogen application, while only N1 and N2 treatments significantly increased total yield All spray treatments, i.e., Faster, Faster + Setter-2 and Setter-2 led to a significant increment in plant yield and total yield in the first season as well as early yield in the second season. Spraying with Setter-2 and Faster + Setter-2 led to a remarkable increase in plant and total yield in the second season. Concerning the effect of the interaction on yield as shown in table 5, adding nitrogen fertilizer to Bronco cv. in split doses (25% before seed sowing + 50% after 3 weeks from seed sowing + 25% at flowering) significantly increased early and total yield in both seasons as compared with adding N once at flowering (N4). Also, adding N (75% after three weeks from sowing + 25% at flowering) led to a remarkable increase in early yield of cv, Bronco in second season as compared with adding nitrogen once at flowering

Table 5. Effect of cultivars, mineral nitrogen application times and foliar biostimulants and the interaction between cultivars and N application times on yield of snap beans

Treatments		Plant yield (g)		Early yield (g/m^2)		Total yield (g/m^2)	
Cultivars		**2005**	**2006**	**2005**	**2006**	**2005**	**2006**
Bronco		142.3	191.5	703.2	723.2	745.4	810.6
Paulista		129.5	146.6	674	562	735.1	648
L.S.D $_{0.05}$		N.S	33.3	N.S	35.75	N.S	79.82
N application times*							
25%-50%-25%		156.1	178.3	770.8	745	818.5	855.7
0 - 75%- 25%		136.4	171	717.5	672.4	761.7	752.3
0 -100% -0		132	165.1	680	595.7	719.1	686
0 - 0 -100%		119	162	586.1	552	661.8	623.2
L.S.D $_{0.05}$		15.29	N.S	38.92	37.13	43.79	102.4
Foliar biostimulants							
Fatser		133.8	164.8	674.1	617	710.1	706.5
Faster + Setter-2		139.4	175.1	713.7	676.8	791.2	764.9
Setter-2		152.9	180.8	796.5	713.1	845.5	808.4
control		117.7	155.7	750	558.1	614.4	637.5
L.S.D $_{0.05}$		11.01	14.69	37.05	40.89	34.97	90.27
Interaction between cultivars (Cvs) and N application times(NAT)							
Cvs	**NAT**						
Bronco	**25%-50%-25%**	152.3	203.3	791.6	803.3	823.1	915.7
	0 - 75%- 25%	146.6	194.6	704.7	774.4	736.1	832.6
	0 -100% -0	139.1	184.8	664.1	661.4	713.4	773.8
	0 - 0 -100%	131.2	183.6	652.3	653.7	708.8	720.4
Paulista	**25%-50%-25%**	159.9	153.3	750	686.5	813.8	795.6
	0 - 75%- 25%	126.1	147.3	730.2	581.6	787.2	672
	0 -100% -0	124.9	145.4	695.8	529.9	724.8	598.2
	0 - 0 -100%	106.8	140.3	519.8	450.1	614.8	526
L.S.D $_{0.05}$		21.62	N.S	550.4	52.52	61.93	144.8

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

Concerning effect of spray treatments on yield characters of cv. Bronco data presented in Table 20 indicate that plant yield was increased by spraying plants with Setter-2 + Faster or Setter-2 alone in the first season, and by spraying with Setter-2 in the second year. Regarding the effect of spraying treatments on cv. Paulista, spraying with Setter-2 caused significant increase in plant and total yield in the second season. Similarly, spraying plants with Faster + Setter-2 had a similar stimulative effect on the total yield. in the second season.

Table 6. Effect of the interaction of cultivars × foliar biostimulants and mineral N application times ×foliar biostimulants on yield of snap beans

Treatments		Plant yield (g)		Early yield (g/m^2)		Total yield (g/m^2)	
Cvs	Foliar bio stimulants	2005	2006	2005	2006	2005	2006
Bronco	Fatser (F)	137.1	185.4	702.3	693	742.9	791.8
	F + S	149.4	198.5	727.4	756.6	765.4	833
	Setter-2 (S)	156.4	204.2	793	783.1	846.3	893.3
	Control	126.5	178.1	590	649	627.1	724.4
Paulista	Fatser (F)	130.4	144.2	645.8	541	677.2	621.1
	F + S	129.3	151.7	700	597	817	696.7
	Setter-2 (S)	149.4	157.4	800	643	844.7	723.4
	Control	108.8	133.2	550	467.2	601.7	550.5
L.S.D $_{0.05}$		15.57	20.78	52.4	57.82	49.45	127.7
Interaction between N application times (NAT) and foliar biostimulants (FB)							
NAT	FB						
25%-50%-25%	Fatser (F)	145.8	177.3	775	728.2	824.2	834.6
	F + S	160.2	187.7	785.4	770	880.1	904.4
	Setter-2 (S)	191.3	187.1	821.9	828.1	851.9	953.3
	Control	127.3	161.2	700.9	653.6	717.9	730.6
0 - 75%-25%	Fatser (F)	138.9	161.4	704.2	609.4	736.9	709.8
	F + S	148.6	180.4	734.4	732.8	778.8	787.5
	Setter-2 (S)	142.2	190.9	758.4	767	855.4	854.8
	Control	116	151.3	672.9	580.5	675.4	657.2
0 -100% -0	Fatser (F)	132	160.6	636	590.7	667.3	672.3
	F + S	132.3	168.2	710.4	620.6	797.7	715.6
	Setter-2 (S)	139.9	175	823.5	646.1	804.9	723.8
	Control	124	156.8	550	525.4	606.8	632.4
0-0 -100%	Fatser (F)	118.3	159.9	581.3	539.9	611.7	609.2
	F + S	116.4	164.3	624.5	583.9	708.4	652
	Setter-2 (S)	138.3	170.3	782.3	611	869.8	701.6
	Control	103.1	153.3	356.3	473.1	457.3	529.7
L.S.D $_{0.05}$		22.02	29.38	61.11	81.78	59.94	180.5

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

In the first season, spraying plants with Setter-2 + Faster or Setter-2 increased plant yield when nitrogen was applied in the three doses (N1) or two (N2) doses. Also, spraying bean plants got nitrogen in two doses, 75% after 3 weeks from sowing and at 25% flowering, with Faster increased plant yield as compared with no spraying table 6. Concerning interaction among

cultivars, mineral nitrogen application times and foliar biostimulants, The present results agree with those of Carvalho *et al.* (2001) who reported that a close of 75 kg ha-1 N at sowing provided an increase of 38%, as compared to the control. Ghosal et al. (2000) evaluated the effect of various times of N application (full basal, 50% as basal + 50% at branching, 50% as basal + 50% at 50% pod formation, and 25% as basal + 50% at branching + 25% at 50% pod formation) on French bean. Among the different doses of application, N applied 50% as basal + 50% at branching gave the highest values for all the yield components. These results were expected, because this complex of biostimulants have all macro- and micro-elements, in addition to vitamins, amino acids and some plant hormones, which as mentioned before, are essential for optimum plant growth, and consequently for getting the highest yield.

The highest values of plant yield was recorded in the first season in cv. Paulista which got nitrogen in three doses (N1) and sprayed with Setter-2, while it was in the second season in cv. Bronco fertilized with nitrogen in two doses (N2) and sprayed with Setter-2(Table7).

3-Green pods character:

The effect of cultivars, nitrogen application times and foliar biostimulants as well as the interaction between cultivars and nitrogen application times on green pods characters are presented in Table 8. Bronco cv. surpassed cv. Paulista in pods diameter in both years. The reverse was true concerning pods length in the second season. The effect of foliar spray on pods length in the first season and pods diameter in both seasons was not significant. Spraying plants with Setter-2 alone or Setter-2 + Faster caused promotion in pods length in the second season. Concerning the effect of the interaction on pod characters of cv. Paulista, N1 application time significantly increased pods length in the first season (Table 8). In cv. Bronco, spraying plants with Setter-2 alone led to a remarkable increment on pods length and pods diameter in the second season. Meanwhile, in cv. Paulista, spraying plants with Faster had a stimulative effect on pods length in the second season and pods diameter in the first season. Spraying plants with Setter-2 significantly raised pods length in N2 application time in the second season (Table 9). The differences between the two cultivars in such characters may be attributed to the genetic variation. Similar results were recorded by El-Sayed (1990), Marghany (1999) and El-Shamma (2000). The present results are in line with those reported by Ismail (2002) who found that spraying peas with a biostimulant namely Biomagic (contains vitamins, amino acid and macro- and microelements) increased pod contents of carbohydrates, while it reduced total fiber.

Table 7. Effect of the interaction among cultivars, mineral N application times and foliar biostimulants on yield of snap beans

Treatments			Plant yield (g)		Early yield (g/m^2)		Total yield (g/m2)	
Cvs	N application time	Foliar Bio-stimulants	2005	2006	2005	2006	2005	2006
Bronco	N1	Fatser (F)	140	198.5	812.5	768.8	841.3	892.2
		F + S	162.8	215.5	825	831.3	866.3	937
		Setter-2 (S)	178.5	214.8	843.8	878.1	878.8	1030
		Control	127.8	184.3	685	735.2	706.3	803.8
	N2	Fatser (F)	146.8	179	700	709.4	723.8	813.1
		F + S	159.3	208	731.3	815.6	741.5	831.5
		Setter-2 (S)	151.5	220.5	712.5	849.5	845	943
		Control	129	170.8	675	678.1	634.3	742.8
	N3	Fatser (F)	139.5	180.3	634.4	650	713.8	761.7
		F + S	137.3	185.3	662.5	695	726.3	807.7
		Setter-2 (S)	149.3	193.5	809.4	717.2	732.5	809.4
		Control	130.5	180	550	583.6	681.3	716.3
	N4	Fatser (F)	122	183.8	662.5	643.8	692.5	700.3
		F + S	138	185.3	690.6	684.4	727.5	755.9
		Setter-2 (S)	146.3	188	806.3	687.5	928.8	790.7
		Control	118.5	177.3	450	599.2	486.3	634.7
Paulista	N1	Fatser (F)	151.5	156	737.5	687.5	807	776.9
		F + S	157.5	159.8	745.8	708.6	893.8	871.8
		Setter-2 (S)	204.0	159.3	800	778.1	825	876.5
		Control	126.8	138	716.7	571.9	729.5	657.3
	N2	Fatser (F)	131.0	143.8	708.3	509.4	750	606.5
		F + S	137.8	152.8	737.5	650	816	743.4
		Setter-2 (S)	132.8	161.3	804.2	684.4	865.8	766.5
		Control	103.0	131.8	670.8	482.8	716.5	571.5
	N3	Fatser (F)	124.5	140.8	637.5	531.3	620.8	582.8
		F + S	127.3	151	758.3	546.1	869	623.5
		Setter-2 (S)	130.5	156.5	837.5	575	877.3	638.1
		Control	117.5	133.5	550.0	467.2	532.3	548.4
	N4	Fatser (F)	114.5	136	500.0	435.9	530.8	518.1
		F + S	94.75	143.3	558.3	483.3	689.3	548.1
		Setter-2 (S)	130.3	152.5	758.3	534.4	810.8	612.5
		Control	87.75	129.3	262.5	346.9	428.3	424.6
L.S.D $_{0.05}$			31.15	41.56	104.8	115.6	98.91	255.3

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

Table 8. Effect of cultivars, mineral nitrogen application times and foliar biostimulants and the interaction between cultivars and N application times on green pods characters of snap beans

Treatments		Pod length (cm)		Pod diameter (mm)	
Cultivars		**2005**	**2006**	**2005**	**2006**
Bronco		12.10	12.79	7.01	7.38
Paulista		12.62	13.27	5.58	5.02
L.S.D $_{0.05}$		N.S	0.23	0.66	0.33
N application times*					
25%-50%-25%		12.56	13.07	6.28	6.25
0 - 75%- 25%		12.34	13.00	6.35	6.13
0 -100% -0		12.33	12.95	6.28	6.23
0 - 0 -100%		12.23	13.12	6.24	6.20
L.S.D $_{0.05}$		0.31	N.S	N.S	N.S
Foliar biostimulant treatments					
Fatser		12.29	13.03	6.33	6.21
Faster + Setter-2		12.36	13.10	6.28	6.21
Setter-2		12.32	13.14	6.30	6.26
control		12.47	12.86	6.26	6.13
L.S.D $_{0.05}$		N.S	0.19	N.S	N.S
Interaction between cultivars (Cvs) and N application times (NAT)					
Cvs	**NAT**				
Bronco	**25% -50%-25%**	12.25	12.77	7.00	7.50
	0 - 75%- 25%	12.10	12.86	7.00	7.25
	0 -100% -0	12.02	12.73	7.02	7.39
	0 - 0 -100%	12.04	12.81	7.00	7.39
Paulista	**25%-50%-25%**	12.86	13.36	5.58	5.00
	0 - 75%- 25%	12.57	13.13	5.70	5.00
	0 -100% -0	12.63	13.16	5.55	5.06
	0 - 0 -100%	12.42	13.43	5.48	5.00
L.S.D $_{0.05}$		0.44	N.S	N.S	N.S

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

4. Pod content of N, P and K

The effect of cultivars, nitrogen application times and foliar biostimulants as well as the interaction between cultivars and nitrogen application times on N, P and K concentration in pods is present in Table (11). Plants of cv. Paulista were significantly greater than those of cv. Bronco in P and K concentration in pods in both seasons. The effect of nitrogen application time on P and K concentration in pods in both seasons was significant, N1 application time significantly increased P and K in both seasons. Spraying plants with Setter-2 and Faster + Setter-2 caused a promotion in N, P and K concentration in pods in both seasons. Regarding the effect of interaction on pod contents of N, P and K it was found that adding nitrogen to Bronco cv. in N1, N2 and N3 nitrogen application times significantly increased in P and K concentration in pods in the first season. Also, N1 application time led to a stimulative effect on P and K concentration in the Bronco pods in the second season. N2 application times significantly increased P concentration in the Bronco pods in the second season. On the

other hand, in cv. Paulista, N1 application time significantly increased pods concentration of P in the second season as well as pods concentration of K in both seasons. These results are in agreement with Hanna and El-Gizy *et al.* (1999) who showed that the N-uptake of bean was affect by cultivar where the highest N-uptake was obtained from Flexo than Bronco. Amer *et al.* (2002) indicated that significant differences were detected in mineral uptake due to the varieties. The present results are in line with those of Ismail 2002 who recorded increases in leaves contents of N, P and K due to spraying their plants with Biostimulants, which contained N, P and K in their composition.

Table 9. Effect of the interaction cultivars × foliar biostimulants and mineral N application times × foliar biostimulants on green pods characters of snap beans

Treatments		Pod length (cm)		Pod diameter (mm)	
Cvs	Foliar bio stimulant	2005	2006	2005	2006
Bronco	Fatser (F)	12.15	12.75	7.00	7.42
	F + S	12.14	12.86	7.00	7.41
	Setter-2 (S)	11.97	12.98	7.02	7.46
	Control	12.16	12.59	7.00	7.25
Paulista	Fatser (F)	12.44	13.31	5.66	5.00
	F + S	12.58	13.33	5.56	5.00
	Setter-2 (S)	12.67	13.31	5.58	5.06
	Control	12.78	13.13	5.51	5.00
L.S.D $_{0.05}$		N.S	0.27	0.12	0.2
Interaction between N application times (NAT) and foliar biostimulants (FB)					
NAT	FB				
25%-50%-25%	Fatser (F)	12.6	13.13	6.36	6.34
	F + S	12.70	13.18	6.28	6.38
	Setter-2 (S)	12.26	13.13	6.24	6.16
	Control	12.68	12.82	6.28	6.13
0 - 75%- 25%	Fatser (F)	12.21	13.01	6.34	6.13
	F + S	12.20	13.16	6.38	6.13
	Setter-2 (S)	12.47	13.26	6.38	6.13
	Control	12.46	12.56	6.31	6.13
0 -100% -0	Fatser (F)	12.12	12.88	6.31	6.25
	F + S	12.23	12.89	6.25	6.04
	Setter-2 (S)	12.30	12.93	6.39	6.50
	Control	12.64	13.10	6.19	6.13
0-0 -100%	Fatser (F)	12.55	13.11	6.31	6.13
	F + S	12.32	13.16	6.21	6.29
	Setter-2 (S)	12.24	13.24	6.19	6.25
	Control	12.11	12.96	6.25	6.13
L.S.D $_{0.05}$		N.S	0.17	0.17	0.29

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

As shown in Table 10, the longest snap bean pods was recorded in cv. Paulista treated with N3 and F4 in the first season and N1 and F1 in the second season. On the other hand, the thickest were registered in both

seasons in the plants of cv. Bronco fertilized with nitrogen once after 21days from seed sowing and sprayed with Setter-2.

Table 10. Effect of the interaction among cultivars, mineral N application times and foliar biostimulants on green pods characters of snap beans

Treatments			Pod length (cm)		Pod diameter (mm)	
Cvs	N application times	Foliar bio stimulants	2005	2006	2005	2006
Bronco	N1	Fatser (F)	12.32	12.6	7.00	7.68
		F + S	12.46	13.09	7.00	7.75
		Setter-2 (S)	11.71	12.9	7.00	7.33
		Control	12.51	12.51	7.00	7.25
	N2	Fatser (F)	12.02	13.18	7.00	7.25
		F + S	12.04	12.89	7.00	7.25
		Setter-2 (S)	12.16	13.21	7.00	7.25
		Control	12.18	12.18	7.00	7.25
	N3	Fatser (F)	12.10	12.44	7.00	7.5
		F + S	11.91	12.70	7.00	7.08
		Setter-2 (S)	11.80	12.85	7.08	7.75
		Control	12.25	12.95	7.00	7.25
	N4	Fatser (F)	12.14	12.79	7.00	7.25
		F + S	12.14	12.76	7.00	7.58
		Setter-2 (S)	12.19	12.94	7.00	7.5
		Control	11.70	12.74	7.00	7.25
Paulista	N1	Fatser (F)	12.88	13.66	5.73	5.00
		F + S	12.93	13.27	5.55	5.00
		Setter-2 (S)	12.81	13.36	5.48	5.00
		Control	12.84	13.14	5.55	5.00
	N2	Fatser (F)	12.39	12.85	5.68	5.00
		F + S	12.36	13.42	5.75	5.00
		Setter-2 (S)	12.78	13.31	5.75	5.00
		Control	12.74	12.95	5.63	5.00
	N3	Fatser (F)	12.14	13.31	5.63	5.00
		F + S	12.54	13.09	5.50	5.00
		Setter-2 (S)	12.80	13.01	5.70	5.25
		Control	13.03	13.25	5.38	5.00
	N4	Fatser (F)	12.36	13.42	5.63	5.00
		F + S	12.50	13.55	5.43	5.00
		Setter-2 (S)	12.3	13.55	5.38	5.00
		Control	12.51	13.18	5.50	5.00
L.S.D $_{0.05}$			0.82	0.53	0.24	0.41

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

Data presented in Table 12 clearly indicate that spraying Bronco cv. with Faster caused a significant increase in P and K concentration in pods in both seasons. Concerning effect of the interaction on N, P and K concentration in Paulista pods, it was clear that all spray treatments showed a positive effect on the pods content of P and K in both seasons. In the first season, spraying plants with Faster + Setter-2 in N1 and N3 application times significantly increased N concentration in pods, whereas spraying with Setter-2 alone or Faster + Setter-2 in N3 application time increased N concentration

in pods in the second season. Spraying with Faster and Faster + Setter-2 in N2 increased P concentration in pods in the first season. Spraying with Faster and Faster + Setter-2 in N1, N2 and N4 application times significantly increased K concentration in pods in the first season. The highest values of N, P and K concentration in pods in the first season were recorded in treatment of cv. Bronco with N1 +F2, cv Paulista with N1+F2and cv. Paulista with N1+F2, respectively, whereas they were cv. Bronco with N4 +F2, cv Paulista with N3 +F2 and Paulista + N1 +F2, respectively in the second season (Table 13).

Table 11. Effect of cultivars, mineral nitrogen application times and foliar biostimulants and the interaction between cultivars and mineral N application times on N, P and K concentration in pods of snap beans

Treatments		Concentration (%)					
		N		P		K	
Cultivars		**2005**	**2006**	**2005**	**2006**	**2005**	**2006**
Bronco		2.27	2.47	0.46	0.52	2.4	2.56
Paulista		2.09	2.22	0.59	0.63	3.6	3.79
L.S.D $_{0.05}$		N.S	N.S	0.028	0.039	0.15	0.35
N application times*							
25%-50%-25%		2.16	2.28	0.55	0.66	3.54	3.7
0 - 75%- 25%		2.18	2.32	0.52	0.58	2.89	2.91
0 -100% -0		2.25	2.47	0.55	0.56	3.02	3.15
0 - 0 -100%		2.12	2.3	0.47	0.52	2.57	2.94
L.S.D $_{0.05}$		0.29	0.25	0.056	0.056	0.23	0.26
Foliar biostimulants							
Fatser		2.1	2.27	0.59	0.65	3.24	3.39
Faster + Setter-2		2.36	2.52	0.7	0.76	3.75	4.04
Setter-2		2.25	2.44	0.47	0.52	2.77	2.89
control		2.0	2.14	0.34	0.37	2.25	2.39
L.S.D $_{0.05}$		0.19	0.21	0.037	0.066	0.29	0.31
Interaction between cultivars (Cvs) and N application times (NAT)							
Cvs	**NAT**						
Bronco	**25%-50%-25%**	2.33	2.47	0.53	0.62	3	3.19
	0 - 75%- 25%	2.16	2.33	0.45	0.54	2.28	2.14
	0 -100% -0	2.26	2.51	0.47	0.49	2.37	2.49
	0 - 0 -100%	2.32	2.56	0.37	0.43	1.93	2.43
Paulista	**25%-50%-25%**	2	2.09	0.57	0.69	4.07	4.22
	0 - 75%- 25%	2.19	2.31	0.58	0.62	3.49	3.68
	0 -100% -0	2.25	2.43	0.63	0.62	3.66	3.82
	0 - 0 -100%	1.92	2.06	0.57	06	3.2	3.44
L.S.D $_{0.05}$		N.S	0.35	0.08	0.08	0.32	0.36

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

Table 12. Effect of the interaction cultivars × foliar biostimulants and mineral N application times × foliar biostimulants on N, P and K concentration in pods of snap beans

Treatments		Concentration (%)					
Cvs	Foliar bio stimulants	N		P		K	
		2005	2006	2005	2006	2005	2006
Bronco	Fatser (F)	2.21	2.42	0.48	0.56	2.49	2.67
	F + S	2.50	2.70	0.57	0.63	2.93	3.30
	Setter-2 (S)	2.30	2.56	0.43	0.50	2.29	2.28
	Control	2.05	2.18	0.34	0.39	1.89	2.00
Paulista	Fatser (F)	1.99	2.11	0.70	0.73	4.00	4.10
	F + S	2.21	2.35	0.82	0.89	4.58	4.77
	Setter-2 (S)	2.20	2.31	0.51	0.54	3.24	3.50
	Control	1.95	2.11	0.33	0.35	2.60	2.79
L.S.D $_{0.05}$		0.27	0.29	0.05	0.09	0.41	0.43
Interaction between N application times (NAT) and foliar biostimulants (FB)							
NAT	FB						
25%-50%-25%	Fatser (F)	2.10	2.23	0.57	0.75	3.93	3.98
	F + S	2.37	2.50	0.81	0.84	4.25	4.49
	Setter-2 (S)	2.22	2.31	0.52	0.59	3.27	3.57
	Control	1.95	2.09	0.30	0.44	2.70	2.78
0 - 75%- 25%	Fatser (F)	2.19	2.29	0.59	0.74	2.97	3.38
	F + S	2.30	2.47	0.71	0.74	4.21	3.87
	Setter-2 (S)	2.22	2.37	0.42	0.48	2.15	2.45
	Control	1.99	2.14	0.35	0.37	2.22	1.95
0 -100% -0	Fatser (F)	2.18	2.41	0.67	0.57	3.26	3.39
	F + S	2.46	2.65	0.71	0.88	3.39	3.86
	Setter-2 (S)	2.35	2.62	0.49	0.50	3.21	3.03
	Control	2.01	2.18	0.35	0.28	2.21	2.32
0-0 -100%	Fatser (F)	1.94	2.13	0.53	0.56	2.82	2.79
	F + S	2.30	2.47	0.56	0.59	3.15	3.93
	Setter-2 (S)	2.20	2.46	0.46	0.52	2.44	2.50
	Control	2.05	2.17	0.35	0.4	1.86	2.53
L.S.D $_{0.05}$		0.38	0.42	0.07	0.13	0.59	0.61

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

5. TSS , fiber and carbohydrate concentration in pod

Pods of cv. Paulista had significantly greater concentration of TSS and total carbohydrates than cv. Bronco pods in both seasons. N1 and N2 significantly increased concentration of carbohydrate in pods in both years as compared with N4. On the contrary, N4 had greater pods content of fiber than all application N time in both seasons (Table 14). The pods content of carbohydrate was increased by using any foliar spray treatment in both seasons. Meanwhile, pods concentration of TSS was increased by spraying with Faster + Setter-2 in both seasons and by spraying with Setter-2 in the first season(Table 14). Concerning the effect of the interaction on in cv. Bronco, N1, N2 and N3 led to a significant increment in pods concentration of carbohydrates in the first season as compared with N4 treatment. In cv. Paulista, N1 had a stimulative effect on pods concentration of carbohydrate in

the first season. On the contrary, N1 had less pods concentration of fiber than N4 treatment in both seasons (Table 14).

Table 13. Effect of the interaction among cultivars, mineral N application times and foliar biostimulants on N, P and K concentration in pods of snap beans .

Treatments			Concentration (%)					
Cvs	N application times	Foliar bio stimulants	N		P		K	
			2005	2006	2005	2006	2005	2006
Bronco	N1	Fatser (F)	2.21	2.41	0.54	0.64	3.19	3.28
		F + S	2.64	2.73	0.64	0.78	3.09	3.28
		Setter-2 (S)	2.28	2.41	0.54	0.61	2.79	3.19
		Control	2.18	2.34	0.34	0.45	2.97	3.00
	N2	Fatser (F)	2.17	2.32	0.43	0.70	2.00	2.62
		F + S	2.36	2.57	0.59	0.6	3.72	2.88
		Setter-2 (S)	2.21	22.39	0.41	0.47	1.70	1.95
		Control	1.92	2.04	0.37	0.4	1.69	1.10
	N3	Fatser (F)	2.18	2.53	0.54	0.47	2.27	2.49
		F + S	2.56	2.71	0.6	0.67	2.45	3.2
		Setter-2 (S)	2.29	2.69	0.45	0.46	2.76	2.17
		Control	1.99	2.09	0.29	0.38	2.02	2.08
	N4	Fatser (F)	2.29	2.43	0.42	0.45	2.49	2.29
		F + S	2.45	2.77	0.47	0.48	2.45	3.85
		Setter-2 (S)	2.42	2.77	0.31	0.45	1.92	1.80
		Control	2.12	2.26	0.28	0.33	0.89	1.79
Paulista	N1	Fatser (F)	2	2.05	0.61	0.86	4.66	4.69
		F + S	2.1	2.26	0.99	0.90	5.42	5.69
		Setter-2 (S)	2.15	2.2	0.51	0.56	3.75	3.94
		Control	1.73	1.84	0.17	0.44	2.44	2.55
	N2	Fatser (F)	2.22	2.27	0.76	0.77	3.93	4.13
		F + S	2.24	2.37	0.82	0.87	4.7	4.85
		Setter-2 (S)	2.24	2.35	0.43	0.48	2.59	2.96
		Control	2.08	2.23	0.33	0.34	2.74	2.79
	N3	Fatser (F)	2.17	2.29	0.8	0.66	4.26	4.29
		F + S	2.37	2.6	0.81	1.09	4.34	4.52
		Setter-2 (S)	2.41	2.55	0.52	0.53	3.65	3.90
		Control	2.03	2.27	0.4	0.18	2.41	2.55
	N4	Fatser (F)	1.59	1.83	0.64	0.66	3.15	3.3
		F + S	2.14	2.16	0.65	0.7	3.86	4.01
		Setter-2 (S)	1.98	2.15	0.58	0.58	2.96	3.2
		Control	1.98	2.09	0.42	0.46	2.82	3.26
L.S.D $_{0.05}$			0.54	0.59	0.103	0.19	0.82	0.86

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

Table 14. Effect of cultivars, mineral N application times and foliar biostimulants and the interaction between cultivars and mineral N application times on carbohydrates, fiber and TSS concentration in pods of snap beans

Treatments		Concentration (%)					
		Carbohydrate (%)		Fiber (%)		TSS (%)	
Cultivars		**2005**	**2006**	**2005**	**2006**	**2005**	**2006**
Bronco		42.89	46.61	10.43	10.63	4.2	5.25
Paulista		46.48	49.78	9.59	9.79	4.8	5.65
L.S.D $_{0.05}$		2.74	3.1	N.S	N.S	0.28	0.4
N application times							
25%-50%-25%		49.85	52.09	8.84	9.05	4.65	5.64
0 - 75%- 25%		45.04	48.99	10.24	10.44	4.61	5.45
0 -100% -0		43.70	47.23	10.38	10.57	4.45	5.38
0 - 0 -100%		40.85	44.54	10.57	10.78	4.31	5.3
L.S.D $_{0.05}$		4.26	3.71	0.23	0.23	N.S	N.S
Foliar biostimulants							
Fatser		42.70	45.84	9.93	9.05	4.47	5.39
Faster + Setter-2		52.19	55.81	9.43	10.44	4.72	5.61
Setter-2		46.02	50.29	9.10	10.57	4.56	5.48
control		38.28	40.85	11.58	10.78	4.25	5.28
L.S.D $_{0.05}$		3.17	3.76	0.31	0.31	0.28	0.21
Interaction between cultivars (Cvs) and N application times (NAT)							
Cvs	**NAT**						
Bronco	**25%-50%-25%**	42.78	52.28	8.98	9.18	4.28	5.36
	0 - 75%- 25%	51.41	47.76	10.58	10.78	4.25	5.31
	0 -100% -0	44.75	43.83	11.05	11.23	4.22	5.24
	0 - 0 - 100%	35.88	42.55	11.11	11.32	4.03	5.08
Paulista	**25%-50%-25%**	45.85	51.77	8.71	8.92	5.01	5.57
	0 - 75%- 25%	52.96	50.21	9.9	10.09	4.95	5.75
	0 -100% -0	47.20	50.62	9.71	9.92	4.69	5.73
	0 - 0 - 100%	39.92	46.54	10.03	10.24	4.57	5.48
L.S.D $_{0.05}$		6.02	5.24	0.33	0.33	N.S	N.S

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

In cv. Bronco, spraying plants with Settter-2 alone or Faster + Settter-2 significantly raised pods concentration of carbohydrate in both seasons. In cv. Paulista, spraying with Faster + Settter-2 or Setter-2 remarkably increased pods content of TSS in the first season (Table 15).

As shown in Table 15, in the first season, spraying plants with Setter-2 alone or Faster + Setter-2 significantly increased the pods concentration of carbohydrate in N1, N2 and N4 application times. The highest values of pods concentration of carbohydrates, fiber and TSS in the first season were recorded in treatment of cv. Bronco with N1 +F2, cv Bronco with N4 +F4 and cv. Paulista with N2+F2, respectively, (Table 16).

Table 15. Effect of the interaction cultivars × foliar biostimulants and mineral N application times × foliar biostimulants on carbohydrates, fiber and TSS concentration in pods of snap beans

Treatments		Concentration (%)					
Cvs	Foliar bio stimulants	Carbohydrate (%)		Fiber (%)		TSS (%)	
		2005	2006	2005	2006	2005	2006
Bronco	Fatser (F)	39.53	42.67	10.35	10.55	4.25	5.21
	F + S	51.41	56.02	9.65	9.85	4.32	5.47
	Setter-2 (S)	44.75	48.25	9.94	10.15	4.22	5.24
	Control	35.88	39.49	11.78	11.97	4.0	5.08
Paulista	Fatser (F)	45.86	49.01	9.51	9.73	4.57	5.57
	F + S	52.96	55.59	9.2	9.4	5.12	5.75
	Setter-2 (S)	47.20	52.33	8.26	8.46	4.91	5.73
	Control	39.93	42.2	11.38	11.58	4.51	5.49
L.S.D $_{0.05}$		4.48	5.42	0.44	0.43	0.39	0.30
Interaction between N application times (NAT) and foliar biostimulants (FB)							
NAT	FB						
25%-50%-25%	Fatser (F)	47.34	48.17	9.55	9.75	4.55	5.6
	F + S	58.49	60.11	8.47	8.68	4.70	5.75
	Setter-2 (S)	50.02	53.56	8.05	8.27	4.87	5.69
	Control	43.53	46.52	9.3	9.50	4.46	5.51
0 - 75%-25%	Fatser (F)	43.99	46.38	9.06	9.25	4.38	5.32
	F + S	53.65	59.06	10.38	10.57	5.03	5.69
	Setter-2 (S)	44.80	51.16	10.19	10.40	4.75	5.54
	Control	37.72	39.35	11.34	11.53	4.26	5.26
0 -100% -0	Fatser (F)	42.7	45.59	10.27	10.48	4.57	5.38
	F + S	48.05	53.79	9.42	9.62	4.80	5.50
	Setter-2 (S)	43.37	46.99	8.91	9.08	4.25	5.38
	Control	40.69	42.53	12.92	13.12	4.19	5.25
0-0 -100%	Fatser (F)	36.74	43.23	10.83	11.07	4.4	5.23
	F + S	48.54	50.54	9.43	9.63	4.34	5.5
	Setter-2 (S)	45.92	49.43	9.26	9.47	4.38	5.32
	Control	31.14	34.97	12.76	12.95	4.12	5.13
L.S.D $_{0.05}$		6.34	7.52	0.62	0.61	0.55	0.43

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

Table 16. Effect of the interaction among cultivars, mineral N application times and foliar biostimulants on carbohydrates, fiber and TSS concentration in pods of snap beans

Treatments			Concentration (%)					
Cvs	N application times	Foliar bio stimulants	Carbohydrate (%)		Fiber (%)		TSS (%)	
			2005	2006	2005	2006	2005	2006
Bronco	N1	Fatser (F)	49.62	46.7	9.53	11.47	4.25	5.31
		F + S	63.94	64.5	8.28	9.37	4.25	5.5
		Setter-2 (S)	50.42	54.17	8.71	10.57	4.5	5.5
		Control	37.7	43.76	9.41	13.53	4.13	5.13
	N2	Fatser (F)	40.82	43.2	9.49	9.7	4.25	5.13
		F + S	52.20	60.11	11.94	8.5	4.38	5.63
		Setter-2 (S)	42.38	46.18	9.98	8.93	4.25	5.33
		Control	40.64	41.55	10.92	9.6	4.13	5.13
	N3	Fatser (F)	39.54	42.12	11.26	9.7	4.25	5.25
		F + S	40.1	48.78	9.19	12.13	4.5	5.5
		Setter-2 (S)	39.7	42.4	10.38	10.2	4.13	5.13
		Control	38.95	42.02	13.36	11.1	4.0	5.06
	N4	Fatser (F)	31.12	38.67	11.11	11.33	4.25	5.13
		F + S	49.38	50.7	9.19	9.4	4.15	5.25
		Setter-2 (S)	46.49	50.25	10.7	10.9	4.0	5.0
		Control	26.24	30.61	13.44	13.63	3.75	5.0
Paulista	N1	Fatser (F)	48.06	49.63	9.58	9.5	4.85	5.88
		F + S	53.03	55.21	8.67	9.87	5.15	6.00
		Setter-2 (S)	49.61	52.94	7.4	7.6	5.25	5.88
		Control	46.39	49.28	9.19	12.7	4.78	5.88
	N2	Fatser (F)	47.16	49.55	8.62	9.8	4.5	5.5
		F + S	55.09	58	8.82	8.87	5.68	5.75
		Setter-2 (S)	47.21	56.14	10.4	7.6	5.25	5.75
		Control	34.87	37.15	11.76	9.4	4.38	5.38
	N3	Fatser (F)	45.85	49.06	9.28	8.8	4.88	5.5
		F + S	56.0	58.79	9.65	9	5.1	5.5
		Setter-2 (S)	47.04	51.58	7.43	10.6	4.38	5.63
		Control	42.42	43.03	12.48	11.97	4.38	5.44
	N4	Fatser (F)	42.36	47.79	10.55	10.8	4.54	5.38
		F + S	47.7	50.37	9.66	9.87	4.53	5.75
		Setter-2 (S)	44.93	48.67	7.82	8.03	4.75	5.63
		Control	36.03	39.33	12.08	12.27	4.48	5.25
L.S.D $_{0.05}$			8.96	10.6	0.87	0.86	0.78	0.61

N application times * : N applied before seed sowing, 21 days after seed sowing and 40 days after seed sowing

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استجابة صنفين من الفاصوليا لمواعيد اضافة التسميد النيتروجيني و المنشطات الحيوية الورقية تحت ظروف الصوب البلاستيكية

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اجريت هذه التجربة خلال موسمي الصيف و الخريف في عامي ٢٠٠٤ و ٢٠٠٥ تحت ظروف الصوب البلاستيكية الموجودة بمحطة التجارب بكلية الزراعة جامعة القاهرة. و تمت بغرض دراسة استجابة صنفى الفاصوليا برنكو و بوليستا للمواعيد اضافة مختلفة من النيتروجين (دفعة واحدة – مرتين – ثلاث دفعات)و المحفزات الورقية (فاستر – سيتر تو) علي النمو الخضري و المحصول ومكوناته. تفوق الصنف بوليستا عن الصنف برنكو فى عدد الفروع فى الموسم الأول. ادت إضافة النتروجين على ٣ مرات أو على مرتين أو مرة واحدة بعد ٣ أسابيع من الزراعة إلى زيادة الوزن الطازج للنبات بالمقارنة بمعاملة إضافة النتروجين الأرضى على مرة واحدة عند بداية الأزهار. تفوق الصنف برنكو عن الصنف بوليستا فى محصول النبات و المحصول المبكر و المحصول الكلى. تسببت معاملة إضافة النتروجين المعدنى على ٣دفعات أو على دفعتين أو دفعة واحدة بعد ٣ أسابيع من الزراعة إلى زيادة معنوية فى محصول النبات و المحصول المبكر و المحصول الكلى بالمقارنة بمعاملة إضافة النتروجين على مرة واحدة بعد ٣ اسابيع من الزراعة. أدى الرش بالمحفزات الورقية فاستر أو سيتر-تو أو سيتر-تو إلى زيادة فى محصول النبات و المحصول الكلى فى الموسم الأول و المحصول المبكر فى الموسم الثانى. تفوق الصنف بوليستا عن الصنف برنكو في تركيز القرون من الفسفور و البوتلسيوم فى كلا الموسمين, بينما و لم يكن هناك أى اختلافات معنوية بين كلا الصنفين بالنسبة تركيز القرون من النتروجين. أدى الرش سيتر-تو أو فاستر + سيتر-تو إلى زيادة فى تركيز القرون من الفسفور و البوتلسيوم و النتروجين فى كلا الموسمين, بينما أدى الرش بالفاستر فقط إلى إلى زيادة فى تركيز القرون من الفسفور و البوتاسيوم فى كلا الموسمين.

و يوصي الباحث باضافة النيتروجين علي ٣ مرات (٢٥% قبل الزراعة و ٥٠% و ٢٥% بعد ٢١ و ٤٠ يوم من الزراعة علي التوالي) و الرش بالمحفزات الورقية خاصة الفاستر + سيتر –تو للحصول علي اعلي قيم من المحصول المبكر و الكلي و زيادة محتوي النبات من العناصر الغذائية .