RESULTS AND DISCUSSION

4- RESULTS AND DISCUSSION

4-1- First experiment:

Effect of bio-fertilizers, organic manure and mineral fertilizers on:

4-1-1 Vegetative growth characteristics:-

Data presented in Table (2) show the effect of bio-fertilizers, organic manure and mineral fertilizers on different studied vegetative growth characteristics of snap bean plants expressed as plant height, number of branches and leaves, average leaf area as well as fresh and dry weight per plant. The results clearly indicate that vegetative growth characteristics significantly increased when the plants fertilized with bio-fertilizer, organic manure or mineral fertilizer compared with the control treatment during the two seasons of this study.

With respect to the effect of bio-fertilizer, the same data in the Table (2) reveal that application of bio-fertilizer either in a single or in combination form gave a significant positive effect on vegetative growth characteristics, i. e. plant height, number of branches and leaves, average leaf area as well as fresh and dry weight per plant compared with the control treatment. In this respect, Rhizobacterine + Phosphorine treatment gave the highest values of different studied characters during both seasons compared with other bio-fertilizers treatments in a single form or control treatments. The increases in vegetative growth of snap bean plants by application of bio-fertilizers might be due the synergistic effect

Table (2): Effect of bio-fertilizers, organic manure and mineral fertilizers on some vegetative growth characteristics of snap bean cv. Bronco.

Seasons	2001						2002					
Characteristics / Treatments	Plant height (cm)	Number/plant		Leaf area (cm^2)	Plant weight (g)		Plant height (cm)	Number/plant		Leaf area(cm^2)	Plant weight (g)	
		Branches	Leaves		Fresh	Dry		Branches	Leaves		Fresh	Dry
Control	28.20	3.59	10.48	352.1	30.60	3.64	25.16	3.85	9.00	312.5	29.25	3.54
Rhizobacterin	35.70	4.33	13.82	434.0	40.72	4.89	29.98	4.35	11.18	394.3	38.26	4.27
Phosphorine	34.67	4.17	13.50	392.0	39.75	4.52	29.70	4.30	10.82	393.4	37.06	4.12
Rhiz.+Phos.	35.85	4.67	14.00	461.7	41.80	5.17	30.70	4.41	12.00	395.0	38.27	4.39
Biogas manure (40 kg N/fed)	37.03	5.67	15.02	523.7	47.00	6.06	34.58	5.12	12.90	437.2	41.85	5.32
Biogas manure (20 kg N/fed) + Rhiz.+Phos.	36.17	5.44	14.68	514.4	45.23	6.05	32.81	5.12	12.63	413.3	41.46	5.26
Biogas manure (40 kg N/fed) + Rhiz.+Phos.	38.17	5.58	16.00	585.9	49.15	6.71	35.17	5.37	13.57	455.3	42.06	5.68
*Full dose of NPK	36.35	4.78	14.20	493.9	43.35	5.72	30.65	4.25	12.13	396.8	39.63	4.66
**Half dose of NPK +Rhiz.+Phos.	36.80	4.91	14.23	485.4	43.03	5.53	30.79	4.55	12.32	397.2	39.13	4.59
*Full dose of NPK +Rhiz.+Phos	36.80	4.95	14.63	523.9	46.80	6.00	32.85	4.85	12.45	409.6	40.40	5.30
Biogas manure. (20 kg N/fed) + Rhiz. + Phos. + **Half dose of NPK	38.10	5.67	15.23	567.0	48.85	6.19	36.90	5.45	13.30	477.9	42.26	6.12
LSD at 0.05	0.35	0.29	0.37	5.43	0.85	0.14	0.49	0.09	0.25	6.504	0.38	0.09

*Full dose = 40Kg N+ 48 Kg P_2O_5 + 48 K_2O/fed

**Half dose = 20Kg N+ 24 Kg P_2O_5 +24 K_2O/fed

of these microorganisms on physiological and metabolic activities of the plant and consequently on plant growth. This enhancing effect may induce exudates of some hormonal substances like cytokinins and auxins of some material expected by organisms it self which might also encourage plant vegetative growth.

Concerning the improving effect of bio-fertilizer on vegetative growth characteristics, obtained results are in agreement with those reported by ***Wange et al. (1996), El-Gizy et al. (1999), Merghany (1999), Thakur et al. (1999), Abd El-Fattah*** and ***Arisha (2000), Shiboob (2000), Singer et al. (2000), El-Bassiony (2003)*** and ***Hewedy et al. (2003) all working*** on common bean, they mentioned that inoculation with different bacterial bio-fertilizers types generally, increased plant height, number of leaves and leaves area / plant and shoot fresh weight.

On the other hand, ***Alvarez et al. (1996)*** on *Phaseolus vulgaris* and *Vicia faba* who found that inoculation with Rhizobacterin leguminosarum had no effect on plant-dry weight.

Regarding the effect of organic manure on vegetative growth characteristics, data presented in Table (2) reveal that application of biogas manure in a single or in combination form with bio-or mineral fertilizers gave significant increases in plant height, number of branches and leaves per plant, average leaf area and fresh and dry weight / plant compared with control treatment. Moreover, fertilizing common bean plants with biogas manure at (20 kg N/fed.) combined with Rhiz. + Phos. + Half dose of recommended mineral fertilizers (20 kg N + 24 kg P_2O_5 + 24 kg K_2O) or biogas manure at (40 kg N/fed.) + Rhiz. + Phos. showed the highest values for all vegetative growth characteristics when

compared with the other tested treatments. The increment effect of organic fertilizer on plant growth characteristics may be attributed to the role of the macronutrients that are the main contents of organic fertilizers, in increasing cell division and cell elongation and consistently increased plant growth. In addition, the main role of such nutrients in increasing the photosynthetic pigments assimilation in plant leaves (Table, 3) which is necessary for cell formation and division and consequently increased plant growth. Moreover, the favorable affect of the organic manures on the soil physical and chemical properties, which may reflected on the vegetative growth of snap bean plants.

With respect to the effect of organic manure on vegetative growth characteristics, many investigator working on these respect as ***Guu et al. (1995), Singer et al. (1998), Hanna*** and ***El-Gizy (1999), Shafeek*** and ***El–Habbasha (2000), Singer et al. (2001)*** and ***El-Bassiony (2003)*** all working on common bean, they showed that the tallest plants and the highest recorded of number of leaf and branches as well as leaves and stems fresh and dry weight were obtained when plants fertilized with cattle manure + mineral fertilizer and poultry manure as compared to the other treatments.

The same data presented in Table (2) illustrated that vegetative growth characteristics expressed as plant height, number of branches and leaves per plant, leaf area and plant fresh and dry weight were significantly increased when the plants fertilized with recommended dose of mineral fertilizers (40 kg N+48 kg P_2O_5+48 kg K_2O/fed) alone or in combination with bio-fertilizers (Rhizobacterine + Phosphorine) or with the half recommended dose of mineral fertilizers (20kg N+24Kg P_2O_5+24Kg k_2O/fed) +

Rhizobacterine + Phosphorine compared with the control treatment during both seasons of this study. Moreover, the treatment (20 kg N as biogas manure + Rhiz. + Phos. + half recommended dose of mineral fertilizers (20kg N+24Kg P_2O_5+24Kg K_2O/fed.) gave the highest values of different studied characters during both seasons compared with the control and other treatments. This increment in vegetative growth characteristics was probably due to the quick release of N P and K from mineral fertilizers and the role of these elements on the meristematic activity of plant tissues. In this regard, ***Bidwell(1979)*** and ***Edmond et al. (1981)*** concluded that nitrogen is an indispensable elementary constituent of numerous organic compounds of general importance such as amino acids, proteins and nucleic acids and it is needed also in the formation of protoplasm and new cells, as well as, encouragement for cell elongation. Furthermore, they also added that, phosphorus plays indispensable role in the enzyme system necessary for the energy transform in photosynthesis and respiration. In addition to the slow release of the nutrients resulted from the organic manure (biogas manure) by the biodegrading of soil microorganisms creates favorable conditions for nutrient uptake to plant roots and reflects better photosynthetic activity which in turn resulted in a higher vegetative growth.

Concerning the effect of mineral fertilizers on vegetative growth characteristics, these results corroborate those of ***Shafshak (1991), Abou El-Hassan et al. (1993), Fekry (1994), Helal (1995), Lodeiro et al. (1999), Rajput et al. (1999) Shahein et al. (2000) and Ismael (2001)*** all working on common bean, they revealed that application of (40 Kg N + 32 Kg P_2O_5 + 48 Kg K_2O /fed.) increased plant height as well as fresh and dry weight / plant.

4-1-2- Chemical composition of plant foliage :-

Data in Table (3) represent the effect of bio-fertilizers, organic manure and mineral fertilizers on chemical composition of plant foliage expressed as photosynthetic pigments, total N, P and K content. Such data declared that chemical composition of plant foliage was significantly increased when the plants were fertilized with bio-fertilizer, organic manure or mineral fertilizers compared with the control treatment during the two seasons of this study.

Concerning the effect of bio-fertilizers, the same data in Table (3) reveal that application of bio-fertilizers either in a single or in combination form gave a significant positive effect on chlorophyll a, b, carotenoids, N, P and K percentage of snap bean plant foliage compared with the control treatment. In this regard, Rhizobacterine + Phosphorine treatment gave the highest values of chlorophyll a, b, total carotenoids, N, P and K percentage compared with using them in a single form or control treatments. This was true during both seasons of growth. Thus, it may be concluded that bio-fertilizer encouraged the formation of chlorophyll in plant leaves.

Regarding the effect of bio-fertilizers on photosynthetic pigments, obtained results are in agreement with those indicated by ***El-Bassiony (2003)*** on bean, ***El-Mansi et al. (2000)*** on pea and ***Shams (2003)*** on sweet pepper, they illustrated that application of a mixed bio-fertilizer and a single bio-fertilizer significantly increased chlorophyll a, b, as well as total carotenoids.

Concerning the effect of bio-fertilizer on N, P, and K percentage of snap bean plant foliage, results are in accordance with

Table (3): Effect of bio-fertilizers, organic manure and mineral fertilizers on chemical composition of plant foliage of snap bean cv. Bronco.

seasons	2001						2002					
Characteristics / Treatments	Chlorophyll (mg/100g F. W.)		Total carotenoids (mg/100g F. W.)	N %	P %	K %	Chlorophyll (mg/100g F. W.)		Total carotenoids (mg/100g F. W)	N %	P %	K %
	a	b					a	b				
Control	167.8	56.4	98.11	1.87	0.358	2.75	168.7	53.1	93.51	1.72	0.389	2.82
Rhizobacterin	187.8	68.9	136.6	2.58	0.529	3.32	187.2	73.4	129.9	2.60	0.528	3.40
Phosphorine	176.8	63.0	134.1	2.53	0.515	3.14	183.7	70.8	150.9	2.56	0.510	3.32
Rhiz.+Phos.	191.5	71.0	140.9	2.62	0.536	3.33	195.2	75.7	143.0	2.64	0.542	3.46
Biogas manure (40 kg N/fed)	192.3	82.8	155.7	2.76	0.631	3.78	223.9	94.4	163.2	2.91	0.636	3.76
Biogas manure (20 kg N/fed) + Rhiz.+Phos.	223.9	85.2	158.2	2.84	0.599	3.53	212.9	93.7	157.8	2.88	0.581	3.49
Biogas manure (40 kg N/fed) + Rhiz.+Phos.	227.6	89.9	159.5	2.97	0.624	3.69	205.3	91.5	160.5	2.85	0.607	3.62
*Full dose of NPK	194.2	74.9	148.7	2.62	0.549	3.44	197.8	77.4	134.6	2.64	0.556	3.47
**Half dose of NPK +Rhiz.+Phos.	196.5	77.4	142.2	2.62	0.561	3.48	198.7	87.8	147.4	2.67	0.566	3.50
*Full dose of NPK +Rhiz.+Phos	200.7	79.9	152.8	2.70	0.576	3.58	203.6	90.6	151.5	2.79	0.601	3.55
Biogas manure (20 kg N/fed) + Rhiz. + Phos. + **Half dose of NPK	235.6	93.3	164.3	3.15	0.630	3.65	227.2	95.7	177.0	3.11	0.634	3.84
LSD at 0.05	29.88	0.11	0.09	0.05	0.130	0.56	0.18	0.23	4.28	0.39	0.050	0.23

*Full dose = 40Kg N+ 48 Kg P_2O_5 + 48 K_2O/fed

**Half dose = 20Kg N+ 24 Kg P_2O_5 +24 K_2O/fed

those reported by ***Merghany (1999), El-Shamma (2000)*** and ***El-Bassiony (2003)*** all working on common bean. They reported that Phosphorine or Rhizobium alone or in combination increased N, P and K percentage in plant foliage.

Regarding the effect of organic manure on photosynthetic pigments, N, P and K percentage in plant foliage, data presented in Table (3) reveal also that application of biogas manure in a single or in combination forms with bio-or mineral fertilizers gave significant increases in chlorophyll a, b total caroteniods, N, P and K percentage in plant foliage compared with control treatment. Moreover, fertilizing snap bean plants with biogas manure (20kg N/fed.) + Rhiz. + Phos. + Half of the recommended dose of NPK /fed.) or (biogas manure (40 kg N/fed) + Rhiz. + Phos. + Full recommended dose of NPK /fed.) recorded that the highest values for chlorophyll a, b, total caroteniods N, P and K percentage in plant foliage of snap bean when compared with the other treatments or control. These results may be due to the role of organic manure (biogas) in improving the physical and chemical properties of soil, which might be reflected on the vigrosity of the vegetative growth of plants.

With respect to the effect of organic manure on photosynthetic pigments of plant leaves of snap bean, obtained results are in agreement with those indicated by ***El-Mnasi et al. (1999)*** and ***Ali (2000)*** both on pea who found that using (50kg N as biogas manure / fed.) or (25kg N from biogas manure + 25kg N from ammonium sulphate /fed.) increased chlorophyll a, b and total carotonoids of plant leaves.

Regarding the effect of organic manure on NPK percentage in plant foliage, many investigators working on these respect as ***Araujo et al. (1982), Soliman et al. (1991), Guu et al. (1997)*** and ***El-Bassiony (2003)*** all working on common bean, they illustrated that adding biogas manure led to increase of N, P and K content of plant foliage.

As regard to the effect of mineral fertilizers on chemical composition of plant foliage, it was revealed from data shown in Table (3) that chlorophyll a, b, total caroteniods, N, P and K percentage were significantly increased when the plants were fertilized with recommend dose of mineral fertilizers (40kg N + 48kg P_2O_5 + 48kg K_2O /fed.) alone or in combination with bio-fertilizers (Rhiz. + Phos.) or with the half recommended dose of mineral fertilizers (20kg N + 24kg P_2O_5 + 24kg K_2O /fed.) + Rhiz. + Phos. compared with the control treatment during both seasons of this study, except chlorophyll a in first season which failed to reach the 5% level of significance for the control treatment. The increment in chlorophyll and carotenoids with the addition of NPK fertilizers may be probably due to that nitrogen is as constituent of chlorophyll molecule. Phosphorus has enhancing influence on photosynthesis and respiration (***Edmond et al., 1981***).In addition, the high content of total N, P and K percentage in plant foliage may be due to the increasing availability of such mineral elements in the soil solution and the high efficiency of the plant roots in absorbing these elements.

Concerning the effect of mineral fertilizers on photosynthetic pigments of plant leaves, data are in accordance with those obtained by ***Abaza (1991), Fekry (1994), Furlani et al.***

(1996) and ***Ismael (2001)*** all working on common bean, they indicated that chlorophyll a, b and total carotenoids in leaves content was significantly increased with increasing nitrogen and Phosphorus fertilizer level of 40 kg N + 32 kg P_2O_5 + 48 Kg KO_2 /fed.

With respect to the effect of mineral fertilizers on NPK content in plant foliage, the obtained results were coincided with those reported by ***Mack (1983), Fekry (1994), Chavan et al. (2000), El-Shamma (2000),Shahein et al.(2000), Ismael (2001)*** and ***Ali (2002)*** all working on common bean, they found that increasing N and P level increased N, P and K contents of bean foliage.

On the other hand, ***Smith (1977)***, ***Palanlyandi*** and ***Smith (1978)*** and ***Mack (1983)*** on bean, they found that higher NPK rates, 224- 296- 184 Kg /ha., respectively had no constant effect on leaf content of P and K.

4-1-3- Green pod yield and its components:-

The results reported in Table (4) show the effect of bio-fertilizers, organic manure and mineral fertilizers on green pods yield and its components expressed as pod length, pod diameter, pod weight, yield per plot and total green pods yield per feddan as well as dry matter percentage in pods. The results clearly indicate that green pods yield and its components were significantly increased when the plants fertilized with bio-fertilizer, organic manure or mineral fertilizers compared with the control treatment during the two seasons of this study.

Table (4): Effect of bio-fertilizers, organic manure and mineral fertilizers on green pod yield and its components of snap bean cv. Bronco.

seasons	2001						2002					
Characteristics / Treatments	Pod			Yield		Dry matter %in pod	Pod			Yield		Dry matter %in pod
	Length (cm.)	Diameter (cm.)	Fresh weight (g)	Plot (Kg)	Feddan (ton)		Length (cm.)	Diameter (cm.)	Fresh weight (g)	Plot (Kg)	Feddan (ton)	
Control	10.78	0.61	3.48	3.80	1.629	6.23	10.77	0.60	4.08	4.64	1.987	5.63
Rhizobacterin	11.29	0.67	4.12	8.73	3.743	7.40	11.31	0.66	4.75	9.22	3.950	6.18
Phosphorine	11.27	0.64	4.03	8.59	3.683	7.10	11.26	0.63	4.60	7.72	3.306	6.15
Rhiz.+Phos.	11.29	0.65	4.20	8.79	3.768	7.45	11.28	0.64	4.76	8.94	3.833	6.08
Biogas manure (40 kg N/fed)	11.28	0.69	4.25	9.86	4.224	7.78	11.45	0.67	5.28	11.04	4.733	6.48
Biogas manure (20 kg N/fed) + Rhiz.+Phos.	11.32	0.69	4.29	10.49	4.249	7.60	11.49	0.67	5.18	10.81	4.662	6.43
Biogas manure (40 kg N/fed) + Rhiz.+Phos.	11.38	0.69	4.35	9.91	4.494	7.80	11.45	0.67	5.02	10.88	4.634	6.40
*Full dose of NPK	11.21	0.67	4.04	8.93	3.849	7.45	11.27	0.65	4.72	8.79	3.766	6.23
**Half dose of NPK +Rhiz.+Phos.	11.31	0.66	4.24	8.92	3.824	7.50	11.29	0.65	4.86	9.64	4.130	5.95
*Full dose of NPK +Rhiz.+Phos	11.33	0.67	4.29	9.32	3.995	7.63	11.37	0.66	4.93	9.72	4.167	6.33
Biogas manure (20 kg N/fed) + Rhiz. + Phos. + **Half dose of NPK	11.35	0.69	4.39	10.64	4.559	7.73	11.64	0.69	5.38	11.42	4.896	6.55
LSD at 0.05	0.06	0.06	0.05	1.21	0.13	0.21	0.06	0.05	0.11	0.81	0.20	0.13

*Full dose = 40Kg N+ 48 Kg P_2O_5 + 48 K_2O/fed

**Half dose = 20Kg N+ 24 Kg P_2O_5 +24 K_2O/fed

With respect to the effect of bio-fertilizers, data presented in Table (4) reveal that application of bio-fertilizer either in a single or in combination form gave a significant positive effect on green pods yield and its components compared with the control treatment Rhizobacterin + Phosphorine treatment gave the highest values of different studied characters in the first season. While, Rhizobacterin treatment gave the highest values in the second season compared with Phosphorine bio-fertilizers treatments or control. Such increment effect of bio-fertilizers on yield and its components was due to the enhancing effect on vegetative growth (Table, 2) and increasing the macro-nutrient (N P K) content of plant foliage (Table, 3) which judging the productivity of plants. Concerning the improving effect of bio-fertilizers on green pod yield and its components, similar results were recorded by ***Mckenzie et al. (1996), Wange et al. (1996), El-Gizy et al. (1999), Merghany (1999), Thakur et al. (1999), Abd El-Fattah and Arisha (2000), El-Shamma et al. (2000), Shiboob (2000), Singer et al. (2000), El-Bassiony (2003)*** and ***Ewais (2003)*** all working on common bean, they mentioned that using bio-fertilizer (Rhizobacterine + Phosphorine) increased pod length, pod weight total green pod yield / fed. of bean.

Regarding the effect of organic manure on green pods yield and its components, the data illustrating such effect are shown in Table (4) declared that application of biogas manure in a single or in combination forms with bio-or mineral fertilizers gave significant increment in pod length, pod diameter, average pod weight, yield per plot and total green pods yield per feddan as well as dry matter percentage in pods compared with control treatment. Moreover,

fertilizing snap bean plants with biogas manure (20kg N/fed.) + Rhiz. + Phos. + half dose of mineral fertilizers or biogas manure (40kg N/fed) + Rhiz. + Phos. showed the highest values for green pods yield and its components when compared with the other tested treatments or control. The superiority of these treatments may be due to the influence of such treatment in increasing the plant vegetative growth characteristics (Table, 2) and increasing the macro-nutrient (N P K) content of plant foliage (Table, 3).

Concerning the effect of organic manure on green pods yield and its components, obtained results agree with that of ***Guu et al. (1995), Tamayo*** and ***Munoz (1996), Guu et al. (1997), Signer et al. (1998), Hanna*** and ***El-Gizy (1999), Jasrotia and Sharma (1999), Gabr (2000), Shafeek*** and ***El-Habbasha (2000), Santos et al. (2001), Singer et al. (2001)*** and ***El-Bassiony (2003)*** all working on common bean. They found that the yield of common bean was significantly affected by application of organic manure.

The same data presented in Table (4) illustrated that, green pod yield and its components expressed as pod length, pod weight, yield per plot and total green pods yield per feddan as well as dry matter percentage in pods were significantly increased when the plants were fertilizes with recommended dose of mineral fertilizers (40kg N + 48kg P_2O_5 + 48kg K_2O /fed.) alone or in combination with bio-fertilizers (Rhiz. + Phos.) or with the half recommended dose of mineral fertilizers (20kg N + 24kg P_2O_5 + 24kg K_2O /fed.) + Rhiz. + Phos. compared with the control treatment during both season of this study. Moreover, the treatment 20 kg N as biogas manure + Rhiz. + Phos. + Half recommended dose of mineral fertilizers /fed gave the highest values of different studied characters

during both seasons compared with the control and other treatments. The increment in yield was probably due to the favorable effect of mixed organic manure with mineral fertilizers, which reserved the sufficient amounts of N and K for plant development. As general, addition organic manure with chemical fertilizers together caused an increase in the nutrients elements in rooting zone, consequently it increase its uptake. Therefore, this increase reflected on the growth and yield of plant.

With respect to the effect of mineral fertilizers on green pods yield and its components, these results agree with those reported by ***Abou-El-Hassan et al.(1993), Fekry (1994), Helal (1995), Rajput et al. (1999), Roy and Parthasarathy (1999), Thakuria and Choudhary (1999), Thakur et al. (1999) and Ismael (2001)*** all working on common bean they mentioned that increasing rates of both N and P applications increased green pods yield.

4-1-4- Mineral composition of green pods:-

The results reported in Table (5) show the effect of bio-fertilizer, organic manure and mineral fertilizers on total N, P and K percentage in pods of snap bean, the results indicate that total N, P and K percentage in pods were significantly increased when the plants were fertilized with bio-fertilizer, organic manure and mineral fertilizers compared with the control treatment during the two seasons of this study.

As regard to the effect of bio-fertilizers, date in Table (5) reveal that application of bio-fertilizer either in a single or in combination form gave a significant positive effect on N, P and K content in pods of snap bean compared with the control treatment.

Table (5): Effect of bio-fertilizer, organic manure and mineral fertilizer on N, P and K of pods.

Seasons	2001			2002		
Characteristics / Treatments	N %	P %	K %	N %	P %	K %
Control	1.93	0.403	2.53	1.85	0.423	2.66
Rhizobacterin	2.71	0.632	3.25	2.72	0.667	3.29
Phosphorine	2.64	0.615	3.01	2.64	0.644	3.22
Rhiz.+Phos.	2.74	0.651	3.27	2.77	0.689	3.36
Biogas manure (40 kg N/fed)	3.01	0.739	3.63	3.19	0.775	3.56
Biogas manure (20 kg N/fed) + Rhiz.+Phos.	3.08	0.717	3.33	3.04	0.722	3.39
Biogas manure (40 kg N/fed) + Rhiz.+Phos.	3.14	0.728	3.51	3.01	0.757	3.48
*Full dose of NPK	2.78	0.664	3.29	2.78	0.697	3.36
**Half dose of NPK +Rhiz.+Phos.	2.87	0.689	3.32	2.88	0.721	3.40
*Full dose of NPK +Rhiz.+Phos	3.00	0.709	3.35	2.95	0.748	3.41
Biogas manure (20 kg N/fed) + Rhiz. + Phos. + **Half dose of NPK	3.25	0.669	3.49	3.21	0.773	3.59
LSD at 0.05	0.05	0.06	0.60	0.27	0.05	0.24

*Full dose = 40Kg N+ 48 Kg P_2O_5 + 48 K_2O/fed

**Half dose = 20Kg N+ 24 Kg P_2O_5 +24 K_2O/fed

In this connection Rhizobacterine + Phosphorine treatment gave the highest values of N, P and K percentage in pods during both seasons compared with bio-fertilizers in a single form or control treatments. This increment might be due to the increase in nutrients content of plant foliage (Table, 3) resulted by using bio-fertilizer, which in turn increased N, P and K contents of pods.

Obtained results are in agreement with those reported by ***El-Gizy et al. (1999), Abd El-Fattah*** and ***Arisha (2000), Shiboob (2000), El-Bassiony (2003)*** and ***Ewais (2003)*** all working on common bean. They also reported that inoculation of seeds with (Rhizobacterine + Phosphorine) increased N, P and K percentage compared to without bio-fertilizers.

Regarding the effect of organic manure (Biogas manure) on total N, P and K percentage in pod of snap bean, data presented in Table (5) showed that application of biogas manure in single or in combination form with bio- or mineral fertilizers gave significant increase in total N, P and K percentage compared with bio-fertilizers and mineral fertilizers as well as the control treatments. Moreover, biogas manure (20 kg N /fed.) + Rhiz. + Phos. + Half dose of mineral fertilizers gave the highest values for nitrogen. While, using biogas manure (40 kg N /fed.) gave the highest values for phosphorus and potassium percentage compared with the other tested treatments or control. The results were true in both seasons. Such superiority may be due to the application of biogas manure led to an increasing the availability of such mineral elements in the soil solution and the efficiency of the plant roots in absorbing these elements consequently; pods content of nutrients might be higher.

With respect to the effect of organic manure on N, P and K percentage in pod of snap bean. These results are in harmony with those obtained by ***Araujo et al. (1982)*** and ***El-Bassiony (2003)*** both working on common bean. They found that using 43 kg N as cattle manure + 43 Kg N as ammonium sulfate or poultry manure increased nitrogen, potassium and phosphorus in pod of snap bean. As regard to the effect of biogas manure on chemical composition of other vegetable crops, ***Ali (2000)*** on pea and ***Aly (2002)*** on squash found that using 60 kg N /fed. as biogas manure increased, in general, fruits content of N, P and K compared to the other used fertilizers.

The same data presented in Table (5) illustrated that chemical composition of snap bean green pods expressed as N, P and K percentage were significantly increased when plant were fertilized with recommended dose of mineral fertilizers (40 kg N + 48 kg P_2O_5 + 48 kg K_2O /fed.) alone or in combination with bio-fertilizers (Rhiz + Phos) or with the half recommended dose of mineral fertilizers (20 kg N +24 kg P_2O_5 +24 kg K_2O /fed.) alone or in combination with bio-fertilizers (Rhiz. + Phos.).

Concerning the effect of mineral fertilizers on N, P and K percentage, these results corroborate of ***Eid (1991)***, ***Shafshak (1991)***, ***Fekry (1994)*** and ***Ismael (2001)*** on common bean, showed that using (40 kg N + 32 kg K_2O /fed.) led to a significant increase in NPK percentage.

4-1-5- Organic chemical constituents in pods:-

The results reported in Table (6) show the effect of bio-fertilizers, organic manure and mineral fertilizers on organic chemical constituents in pods of snap bean cv. Bronco expressed as crude protein, reducing, non -reducing, and total sugars as well as fiber percentage in pods. The results clearly indicate that, crude protein, reducing, non reducing and total sugars percentage were significantly increased and fiber percentage in pods was decreased when the plants were fertilized with bio-fertilizer, organic manure or mineral fertilizer compared with the control treatment. The results are true in both seasons of this study.

With respect to the effect of bio-fertilizer, data in Table (6) revealed that application of bio-fertilizer either in a single or in combination gave a significant positive effect on organic chemical constituents in pod of snap bean cv. Bronco compared with the control treatment. In this respect, Rhizobacterine + Phosphorine treatment gave the highest values of crude protein, reducing, non - reducing, and total sugars in pods, in the same time it gave the lowest values of fiber percentage in pods of snap bean compared with using bio-fertilizers alone and the control treatments. This result confirms the role of bio-fertilizer on soil of the experiment, which might be reflected on plant metabolism.

Similar results were reported by ***El-Gizy et al. (1999), Merghany (1999), El-Shamma (2000), Shiboob (2000), Singer et al. (2000), El-Bassiony (2003)*** and ***Ewais (2003)*** all working on common bean. They mentioned that inoculation with bio-fertilizers (single or combination) increased protein, sugars in pods and decreased fiber percentage as compared to bean without bio-fertilizers.

Table (6) : Effect of bio-fertilizers, organic manure and mineral fertilizers on organic chemical constituents in pod for snap bean cv. Bronco.

seasons	2001					2002				
Characteristics / Treatments	Protein %	Sugars (%)			Fiber %	Protein %	Sugars (%)			Fiber %
		reducing	Non-reducing	Total			reducing	Non-reducing	Total	
Control	12.05	8.370	2.300	10.67	10.30	11.56	7.930	2.020	9.95	10.990
Rhizobacterin	16.94	10.15	2.870	13.02	9.944	17.00	9.930	2.620	12.55	10.640
Phosphorine	16.51	9.785	2.885	12.67	10.06	16.50	9.200	2.665	11.86	10.75
Rhiz.+Phos.	17.11	10.42	2.930	13.35	9.91	17.31	10.59	2.705	13.27	10.540
Biogas manure (40 kg N/fed)	19.06	11.17	3.327	14.50	9.368	19.94	11.07	3.223	14.29	9.929
Biogas manure (20 kg N/fed) + Rhiz.+Phos.	19.25	11.40	3.310	14.71	9.440	19.00	11.18	3.015	14.19	10.04
Biogas manure (40 kg N/fed) + Rhiz.+Phos.	19.66	11.32	3.570	14.89	9.218	18.81	11.09	2.980	14.07	10.17
*Full dose of NPK	17.38	10.55	2.770	13.47	9.795	17.38	10.60	2.890	13.49	10.40
**Half dose of NPK +Rhiz.+Phos.	17.94	10.78	2.938	13.72	9.730	18.00	10.85	2.798	13.65	10.39
*Full dose of NPK +Rhiz.+Phos	18.75	11.03	3.390	14.17	9.549	18.44	11.01	2.918	13.93	10.28
Biogas manure (20 kg N/fed) + Rhiz. + Phos. + **Half dose of NPK	20.33	11.52	3.650	15.17	9.080	20.06	11.19	3.150	14.34	9.89
LSD at 0.05	0.28	0.08	0.40	0.59	0.57	0.09	0.26	0.24	0.29	0.38

*Full dose = 40Kg N+ 48 Kg P_2O_5 + 48 K_2O/fed

**Half dose = 20Kg N+ 24 Kg P_2O_5 +24 K_2O/fed

Regarding the effect of organic manure (biogas) on organic chemical constituents in pod of snap bean cv. Bronco, data presented in Table (6) reveal that application of biogas manure in a single or in combination form with bio- or mineral fertilizers gave significant increases in crude protein, reducing, non -reducing, and total sugars percentage as well as decreased fiber percentage in pods compared with control treatment. Moreover, fertilizing the plants with biogas manure (20 kg N /fed.) + Rhiz. + Phos. + half dose of mineral fertilizers showed the highest values of crude protein, reducing, non-reducing and total sugars as well as the lowest values of fiber percentage in pods. Such promoting effect due to the use of bio-fertilizers and organic manure, may be due to these materials were favorable for soil structure, good aeration and higher water holding capacity, which create suitable conditions for the plant roots to grow better. Moreover, the slow release of nutrients is suitable for the absorption of plants. Consequently, pods and other organs content of different might be higher (***Cook, 1972***) and its role on photosynthetic pigments and consequently the assimilation of CO_2 to carbohydrates and in turn, the synthesis of sugars.

These results agree with that of ***Singer et al. (1998), Jasrotia*** and ***Sharma (1999), Gaber (2000), Singer et al. (2001)*** and ***El-Bassiony (2003***) all working on common bean, found that using organic manure resulted in higher protein and sugars content and lower fiber percentage in pod of snap bean. In addition, with respect of biogas manure ***Ali (2000)*** on pea, ***Aly (2002)*** on squash and ***Shams (2003)*** on sweet pepper mentioned that using 30 kg N as biogas manure + 30 kg mineral. N + PK gave the highest total sugars content of fruits.

On the other hand, ***El-Gizy (1990)*** showed that the protein percentage in dry seed of common bean was insignificant raised by manure application.

The same data presented in Table (6) illustrated that organic chemical constituents in pod of snap bean cv. Bronco expressed as crude protein, reducing, non -reducing, and total sugars percentage in pods were significantly increased and fiber percentage was decreased when the plants were fertilized with recommended dose of mineral fertilizers (40 kg N + 48 kg P_2O_5 + 48 kg K_2O / fed.) alone or in combination with bio-fertilizers (Rhiz. + Phos.) or with the half recommended dose of mineral fertilizers (20 kg N + 24 kg P_2O_5 + 24 kg K_2O / fed.) + Rhiz. + Phos. compared with the control treatment during both season of this study. Moreover, the treatment 20 kg N as biogas manure + Rhiz. + Phos. + half dose of mineral fertilizer / fed gave the highest values of crude protein, reducing, non -reducing, and total sugars and lowest values of fiber percentage in pods during both season compared with the other treatments and control Genrally, it may be stated that the promoting effect of nitrogen fertilizer in bulding cell and accumulation of proteins and sugars may be due to it's effect in increasing the proteins synthesis and activity of carbohydrates hydrolyzing enzymes. Moreover, it may be due to the promoting effect of phosphorus fertilizer in energy production for biosynthesis to building and accumulation proteins and carbohydrates. In addition, it is known that potassium promotes the absorption of N and P as well as its role doing a balance in plant tissues (***Edmond et al., 1981***).

Concerning the effect of mineral fertilizers on organic chemical constituents in pod of snap bean, these results corroborate

those of ***Borisonik et al. (1978), El-Abedeen et al. (1983), Fekry (1994)*** and ***El-Shamma (2000)*** all working on common bean, they found that application of 30 kg N + 96 Kg $P_2 O_5$ / fed. led to a significant increases in reducing, non-reducing and total sugars as well as protein percentage in dry seeds.

4-1-6- Nodules formation:-

Data presented in Table (7) show the effect of bio-fertilizer, organic manure and mineral fertilizer on nodules formation expressed as number and dry weight of nodules per plant as well as plant fresh weight of snap bean cv. Bronco in pot experiment. The result clearly indicated that, number and dry weight of nodules per plant and plant fresh weight were significantly increased when plants were fertilized with bio-fertilizer, organic manure or mineral fertilizer compared with the control treatment during the two seasons of this study.

With respect to the effect of bio-fertilizer, the same data in Table (7) revealed that, application of bio-fertilizer either in a single or in combination form gave a significant positive effect on number and dry weight of nodules and plant fresh weight compared with the control treatment. In this regard, Rhizobacterine + Phosphorine treatment gave the highest values of number of nodules and plant fresh weight, while, Rhizobactrerine treatment gave the highest value of nodules dry weight during both seasons compared with Phosphorine or control treatments. Obtained results are in agreement with those reported by ***Ruschel and Saito (1977), Semu et al. (1982), Mckenzie et al.(1996), Wange et al.(1996), Abd El-Fattah*** and ***Arisha (2000)*** and ***Singer et al. (2000)*** all working on

Table (7): Effect of bio-fertilizers, organic manure and mineral fertilizers on nodules formation of snap bean plants cv. Bronco in pot experiment.

Seasons / treatments	2001			2002		
	Nodules / plant		Plant fresh weight (g)	Nodules / plant		Plant fresh weight (g)
	Number	Dry weight (mg)		Number	Dry weight(mg)	
Control	5.0	24.0	4.57	0.0	0.0	4.87
Rhizobacterin	35.5	106.8	7.79	25.5	87.8	7.29
Phosphorine	14.9	44.3	7.55	11.0	32.0	7.24
Rhiz.+Phos.	38.8	93.4	7.95	32.3	68.4	9.06
Biogas manure (40 kg N/fed)	18.5	62.8	8.31	18.0	59.1	8.94
Biogas manure (20 kg N/fed) + Rhiz.+Phos.	21.8	47.5	8.24	39.0	97.8	7.9
Biogas manure (40 kg N/fed) + Rhiz.+Phos.	25.0	101.8	8.52	25.5	84.3	9.91
*Full dose of NPK	5.5	47.8	8.19	5.2	12.5	8.12
**Half dose of NPK +Rhiz.+Phos.	15.3	55.8	9.37	23.0	60.0	8.75
*Full dose of NPK +Rhiz.+Phos	14.9	86.3	10.0	20.0	71.8	9.16
Biogas manure (20 kg N/fed) + Rhiz. + Phos. + **Half dose of NPK	19.5	60.0	10.69	20.0	57.1	10.2
LSD at 0.05	10.3	33.07	0.71	13.66	19.25	0.53

Full dose = 40Kg N+ 48 Kg P_2O_5 + 48 K_2O/fed

****Half dose = 20Kg N+ 24 Kg P_2O_5 +24 K_2O/fed**

common bean. They found that seed inoculation with Rhizobium significantly increased the nodule number and nodule dry weight.

On the other hand, ***Tau et al. (1984)*** and ***Andrade et al. (1998)*** on common bean found that inoculation of (*Phaseolus vulgaris)* did not increase nodulation. Regarding the effect of organic manure on number and dry weight of nodules per plant and plant fresh weight, data presented in Table (7) clear that application of biogas manure in single or in combination form with bio- or mineral fertilizes significantly increase number and dry weight of nodules per plant and plant fresh weight compared with the control treatment. Moreover, fertilizing common bean plants with biogas manure at the high used rate (40 kg N /fed) + Rhiz. + Phos. gave the highest values for nodule number and dry weight in the first season. While biogas manure at the lower used rate (20 kg N /fed) + Rhiz. + Phos. gave the highest values in the second season. Meanwhile, Biogas manure (20 kg N /fed) + Rhiz. + Phos.+ half dose of mineral fertilizers treatment gave the highest value for plant fresh weight, during both seasons.

Concerning the effect of mineral fertilizers on nodules formation, data presented in Table (7) show that plants which were fertilized with recommended dose of mineral fertilizers (40 kg N + 48 kg P_2O_5 + 48 kg K_2O /fed.) alone gave the lowest values for nodules number and dry weight of nodules per plant compared with other treatments. Meanwhile, mineral fertilizers at full-recommended dose + Rhiz. + Phos. Treatment significantly increased nodules dry weight per plant in both seasons. Moreover, biogas manure (20 kg N /fed) + Rhiz. + Phos. + mineral fertilizers at

half recommended dose treatment significantly increased fresh weight per plant with highest values in both seasons.

The results concerning the effect of mineral fertilizers on nodules formation, agree with those reported by ***Ssali and Keya (1980), Sundstrom et al. (1982), Muller et al.(1993)*** and ***Andrad et al. (1998)*** all working on common bean, they found that nodule dry weight per plant was decreased at the highest N rate.

4-2-Second experiment:

Effect of cultivars, phosphorus, bio-fertilizers and their interaction on:

4-2-1- Vegetative growth characteristics:-

a- Effect of cultivars:-

Data presented in Table (8) clarify that, there were significant differences between the used cultivars, i.e. Bronco and Paulista in all studied vegetative growth characteristics expressed as plant height, number of branches and leaves per plant, leaf area as well as fresh weight per plant, during both seasons of the experiment, except that for number of branches in the first season and plant dry weight in both seasons which where not significantly affected. In this respect, plants of Bronco cultivar's recorded the highest values in plant height, average leaf area and fresh weight per plant while plant of Paulista cultivar's recorded the high number of leaves and branches per plant. Obtained results were true during both seasons of the study. Meanwhile, there were no significant differences on plant dry weight between the used cultivars during

Table (8): Effect of cultivars, phosphorus and bio-fertilizers on vegetative growth characteristics of snap bean.

Treatments / Season		2001						2002					
cultivars	Fertilization	Plant height (cm)	Number		Leaf area (cm^2)	Plant weight (g)		Plant height (cm)	Number		Leaf area (cm^2)	Plant weight (g)	
			Branches	Leaves		Fresh	Dry		Branches	Leaves		Fresh	Dry
Bronco		36.3	5.2	14.2	500.46	42.47	5.41	34.0	5.2	12.3	476.59	38.96	5.20
Paulista		29.5	5.1	14.9	361.79	37.89	5.40	28.6	5.5	13.0	348.48	36.39	5.20
LSD at 0.05		0.19	N.S.	0.39	13.80	1.16	N.S.	0.11	0.19	0.03	1.74	1.55	N.S.
	Control	27.0	3.4	11.0	283.95	28.98	3.59	25.8	3.6	10.2	270.90	27.69	3.51
	48 kg P_2O_5/fed.	32.0	4.7	14.0	418.69	40.47	5.38	30.0	4.5	12.1	380.53	37.21	4.79
	VAM	30.3	4.2	13.4	336.69	36.17	4.45	30.4	5.0	11.9	365.25	35.84	4.34
	Phos.	32.3	4.4	13.7	367.75	36.36	4.81	31.1	4.8	11.8	359.10	36.41	4.65
	VAM+ Phos.	33.3	5.2	15.2	453.50	39.73	5.19	31.8	5.7	12.9	422.60	37.99	5.29
	VAM+ 24 kg P_2O_5/fed.	33.3	5.2	14.6	443.75	40.38	5.51	31.7	5.9	12.9	438.40	39.11	5.50
	VAM+ 48 kg P_2O_5/fed.	33.1	5.2	14.2	440.64	41.85	5.51	31.4	5.6	12.7	423.99	38.01	5.42
	Phos. + 24 kg P_2O_5/fed.	33.8	5.5	14.6	461.46	42.44	5.70	31.5	5.7	12.9	432.14	38.60	5.51
	Phos. +48kg P_2O_5/fed.	36.5	6.3	17.2	539.30	46.45	6.73	34.9	6.4	14.6	502.80	41.88	6.30
	VAM+ Phos.+24 kg P_2O_5/fed	35.5	6.1	16.5	509.10	45.30	6.38	33.5	6.3	13.8	485.91	41.38	6.05
	VAM+ Phos.+48 kg P_2O_5/fed	34.6	6.0	16.1	487.56	43.88	6.22	32.4	6.0	13.3	456.25	4032	5.87
	LSD at 0.05	0.67	0.24	0.42	25.81	1.71	0.18	0.26	0.19	0.29	8.96	1.04	0.28

VAM = Vesicular arbuscular mycorrhizal fungi
Phos. = phosphorine

both seasons of study. The different behavior observed in these characters might reflect the differential expressively of certain genes during ontogenetic processes. In this respect, obtained results are in agreement with those reported by ***Helal (1995) Hafez et al. (1997), Hanna and El-Gizy (1999), Ali (2002)*** and ***Amer et al. (2002)*** all working on common bean.

b- Effect of fertilization treatments:-

With respect to the effect of phosphorus, Phosphorine and vesicular arbuscular mycorrhizal on vegetative growth of snap plants, the same data at Table (8) show clearly that the studied growth characteristics, i.e. plant height, number of branches and leaves, leaf area as well as fresh and dry weight per plant were positively affected due to the application of all tested treatments compared with the control treatment. In this regard, the application of Phosphorine + 48 kg P_2O_5 / fed led to a significant increase in all the measured growth aspect of snap bean plants in comparison with the other treatment and that of control, followed by (VAM $\pm$ Phos. + 24 kg P_2O_5 / fed.), (VAM $\pm$ Phos. + 48 kg P_2O_5 /fed.), (Phos. + 24 kg P_2O_5 /fed.), (VAM + 48 kg P_2O_5 /fed.) and Phosphorine alone at 1 kg /fed., respectively. Obtained results are true during both seasons of study. Such increments in growth of snap bean plant due to the application of phosphorus, Phosphorine and VAM may be attributed to the main role of phosphorus in most metabolic process of plant. Increasing the vegetative growth of plants as a result of Phosphorine and VAM application may be due to the active bacteria and fungi, respectively, in bio-fertilizers which is capable to transform the tri-calcium phosphate to mono-calcium phosphate in addition to the ability to dissolve soil complex in organic and

inorganic phosphate and the role of phosphate bio-fertilizers in increasing availability of soil immobilized phosphorus and consequently increased the content of such element in plant (Table, 9). Furthermore, phosphorus is a part of molecular structure of several vitally important compounds notably nucleic acids (DNA and the two forms of RNA). Moreover, VAM increased the roots absorbing surface for growing plants and consequently increased the nutrients absorption, which affect plant growth.

The results regarding the effect of bio-fertilizers on vegetative growth characteristics are in a agreement with those of ***El-Shamma (2000)*** and ***Ali (2002)*** on common bean, who indicated that phosphate dissolving bacteria increased vegetative growth. Moreover, ***AbouEl-Salehein*** and ***Ahmed (1998)*** on bean and ***Mansour (2000)*** on pea, found that VA mycorrhiza inoculation increased number of branches per plant as well as dry matter per plant.

c- Effect of the interaction:-

According to the effect of the interaction between cultivars and fertilization treatments, it is obvious from such data in Table (9) that there were significant differences between all treatments in all studied growth parameters during both seasons of the experiment. In general, application of Phosphorine fertilizer at 1 kg /fed combined with 48 kg P_2O_5 /fed to both cultivars under study resulted in the maximum values of plant growth aspects. Plants of cv. Paulista produced the greatest number of branches and leaves per plant when plants fertilized with Phosphorine at 1 kg /fed combined with 48 kg P_2O_5 /fed. Meanwhile, those of Bronco showed the highest values of

Table (9): Effect of interaction between cultivars, phosphorus and bio-fertilizers on vegetative growth characteristics of snap bean.

Treatments / Season		2001						2002					
Cultivars	Fertilization	Plant height (cm)	Number		Leaf area (cm^2)	Plant weight (g)		Plant height (cm)	Number		Leaf area (cm^2)	Plant weight (g)	
			Branches	Leaves		Fresh	Dry		Branches	Leaves		Fresh	Dry
Bronco	Control	28.7	3.6	10.4	324.10	30.78	3.78	26.1	3.8	9.5	313.43	28.98	3.65
	48 kg P_2O_5/fed.	36.1	4.7	14.2	490.28	43.04	5.47	33.3	4.3	12.1	459.80	38.76	4.58
	VAM	34.3	4.1	13.6	405.10	38.18	4.31	33.1	4.5	11.3	396.38	36.98	4.42
	Phos.	37	4.3	14.0	423.40	40.05	4.75	34.6	4.5	11.5	402.50	38.36	4.42
	VAM+ Phos.	35.6	5.0	14.3	500.80	39.35	4.54	34.4	5.3	12.4	472.10	37.29	4.91
	VAM+24kg P_2O_5/fed.	36.5	5.2	14.4	504.73	40.83	5.40	34.8	5.5	12.8	510.00	40.72	5.55
	VAM+ 48 kg P_2O_5/fed.	37.7	5.5	14.5	520.63	44.88	5.66	34.7	5.5	12.5	499.00	39.29	5.43
	Phos. + 24 kg P_2O_5/fed.	38	5.7	14.9	550.28	45.51	5.94	34.9	5.7	13.0	518.00	40.80	5.80
	Phos. + 48 kg P_2O_5/fed.	38.6	6.3	15.8	639.58	49.83	6.87	37.6	6.3	13.6	583.73	43.24	6.37
	VAM+ Phos.+24 kg P_2O_5/fed	38.4	6.1	15.5	588.30	48.06	6.55	35.6	6.3	13.2	566.53	42.54	6.13
	VAM+ Phos.+ 48kg P_2O_5/fed	38.1	6.1	15.2	557.88	46.72	6.25	35.2	5.9	13.0	521.00	41.65	5.95
Paulista	Control	25.3	3.3	11.6	243.80	27.18	3.41	25.5	3.3	10.9	228.38	26.39	3.37
	48 kg P_2O_5/fed.	27.9	4.8	13.7	347.10	37.91	5.28	26.8	4.7	12.1	301.25	35.66	5.00
	VAM	26.2	4.4	13.1	268.28	34.17	4.59	27.8	5.5	12.4	334.13	34.70	4.26
	Phos.	27.5	4.5	13.4	312.10	32.68	4.87	27.5	5.0	12.2	315.70	34.45	4.88
	VAM+ Phos.	31.1	5.4	16.0	406.20	40.10	5.84	29.2	6.0	13.3	373.10	38.70	5.66
	VAM+ 24kg P_2O_5/fed.	30.1	5.2	14.8	382.78	39.93	5.61	28.6	6.2	13.1	366.80	37.50	5.45
	VAM+ 48kg P_2O_5/fed.	28.5	4.9	13.8	360.65	38.83	5.37	28.1	5.8	12.9	348.98	36.73	5.41
	Phos. + 24 kg P_2O_5/fed.	29.6	5.2	14.3	372.65	39.37	5.46	28.1	5.6	12.8	346.28	36.40	5.22
	Phos. + 48 kg P_2O_5/fed.	34.4	6.3	18.6	439.03	43.08	6.59	32.3	6.4	15.6	421.88	40.52	6.23
	VAM+ Phos.+24 kg P_2O_5/fed	32.6	6.0	17.6	429.90	42.53	6.20	31.5	6.2	14.5	405.30	40.22	5.97
	VAM + Phos.+ 48 kg P_2O_5/fed	31.1	5.8	17.0	417.25	41.03	6.14	29.6	6.2	13.5	391.50	39.00	5.78
LSD at 0.05		0.94	0.33	0.60	36.50	2.42	0.25	0.36	0.27	0.40	12.67	1.47	0.29

plant height, leaf area as well as fresh and dry weight per plant compared with Paulista plants during both seasons of this study. Similar results are in accordance with those reported by ***Emara (1985), Hungiria*** and ***Neves (1987), Helal (1995)*** and ***Ewais (2003)*** on common bean.

4-2-2- Chemical composition of plant foliage:-

a- Effect of cultivars:-

Data in Table (10) showed the effect of cultivars, phosphorus and bio-fertilizer on chemical composition for plant foliage of snap bean expressed as chlorophyll a, b, total carotenoids as well as N, P and K percentage. The results clearly indicated that there were significant differences between the tested cultivars, i.e., Bronco and Paulista, in chlorophyll a, b, total carotenoids, N and K in the first season and chlorophyll a only in the second one. Paulista cultivar gave the highest values of chlorophyll a, b total carotenoids, and K content in first season and total N and K in second season. Meanwhile, cv. Bronco gave the highest values of total N and P in the first season and chlorophyll a, b, total carotenoids as well as phosphorus on the second one. These differences among the studied cultivars may be due to the differences in genetic potentiality of such cultivars. With respect to the effect of cultivars on chemical composition of plant foliage, obtained results are similar to those reported by ***Helal (1995), Ahlawat (1996), Hernandez et al. (1990), Hanna*** and ***El-Gizy (1999), Ali (2002) and Amer et al.(2002)*** on snap bean.

Table (10): Effect of cultivars, phosphorus and bio-fertilizers on chemical composition of plant foliage of snap bean plants.

Treatments / Season		2001					2002					
		Chlorophyll (mg/100g F. W.)		Total carotenoids (mg/100g F. W.)	N %	P %	K %	Chlorophyll (mg/100g F. W.)		Total carotenoids (mg/100g F. W)	N %	P %	K %
cultivar	Fertilization	a	b					a	b				
Bronco		208.7	74.5	145.0	2.68	0.553	3.39	210.2	78.5	149.6	2.65	0.533	3.46
Paulisa		220.1	78.2	151.8	2.63	0.549	3.51	201.8	78.2	149.3	2.67	0.524	3.54
LSD at 0.05		3.99	2.59	3.68	0.03	N.S	0.06	2.28	N.S.	N.S.	N.S.	N.S.	N.S.
	Control	165.2	56.2	104.6	1.81	0.354	2.72	163.6	54.7	98.1	1.79	0.356	2.70
	48 kg P_2O_5/fed.	200.6	70.8	146.8	2.68	0.560	3.55	196.6	74.8	143.0	2.66	0.555	3.59
	VAM	176.8	62.4	137.2	2.46	0.460	3.15	178.4	64.3	134.	2.50	0.460	3.34
	Phos.	187.3	63.0	140.6	2.54	0.490	3.22	188.0	69.9	145.8	2.58	0.480	3.41
	VAM+ Phos.	225.3	79.7	155.7	2.76	0.515	3.36	210.5	80.8	155.8	2.76	0.496	3.46
	VAM+ 24 kg P_2O_5/fed.	218.5	76.2	153.2	2.71	0.534	3.43	213.7	82.2	156.3	2.77	0.515	3.52
	VAM+ 48 kg P_2O_5/fed.	217.5	76.2	150.1	2.73	0.610	3.66	206.8	77.4	153.1	2.71	0.575	3.68
	Phos. + 24 kg P_2O_5/fed.	223.0	80.2	152.8	2.77	0.581	3.52	212.4	79.4	155.8	2.78	0.540	3.56
	Phos. +48kg P_2O_5/fed.	260.8	196.7	168.7	2.98	0.649	3.74	238.5	96.8	171.6	2.94	0.616	3.77
	VAM+ Phos.+24 kg P_2O_5/fed	245.8	90.9	163.0	2.91	0.636	3.73	231.4	93.1	167.0	2.88	0.585	3.72
	VAM+ Phos.+48 kg P_2O_5/fed	237.9	87.4	160.1	2.85	0.675	3.83	226.2	88.6	163.1	2.86	0.634	3.80
	LSD at 0.05	9.58	6.02	7.36	0.08	0.055	0.20	5.71	3.95	4.26	0.06	0.06	0.16

VAM = Vesicular arbuscular mycorrhizal fungi Phos. = phosphorine

b- Effect of fertilization treatments:-

Concerning the effect of phosphorus, Phosphorine and VAM (vesicular arbuscular mycorrhiza) on chemical composition of plant foliage, the same data at Table (10) showed clearly that chlorophyll a, b, total carotenoide as well as N, P and K percentage were positively affected due to the application of all fertilization treatments compared with the control treatment. In this regard, the application of Posphorine + 48 kg P_2O_5 /fed led to a significant increase in chlorophyll a, b, total carotenoids and total N content in comparison with the other treatments and control, Meanwhile, treatment with VAM + Phos. + 48 kg P_2O_5 /fed gave the best values for total P and K. These results are true during both seasons of study. Such increment in all estimated macro-elements was connected with increase in vegetative growth parameters (Table,3) as a result of phosphorus application. Obtained results may be due to the role of phosphorus and Phosphorine fertilizer on proliferation of roots and consequently increased the absorption ability of bean plants. Also, a strongly positive correlation pf % root colonization by VAM fungi and plants P concentration and accumulation was observed which suggests that the observed inoculation responses were a result of improved P acquisition by the mycorrhiza roots ***Ibijbijen et al. (1996).*** Such result is similar to those obtained by ***Ali (2002)*** on common bean, ***Kerlous et al. (1998)*** on cowpea, they found that total nitrogen; phosphorus and potassium content of plant foliage were significantly increased with application of Phosphorine at rate of 1 kg + 60 kg P_2O_5 /fed.

c- Effect of the interaction:-

According to the effect of the interaction between cultivars and fertilization treatments it is obvious from data in Table (11) that there were significant differences between all tested treatments in chlorophyll a, b, total carotenoids as well as N, P and K percentage of plant foliage of snap bean during both seasons of the experiment. In general, application of Phosphorine fertilizer at rate of 1 kg /fed combined with 48 kg P_2O_5 /fed or VAM + Phos. + 24 kg P_2O_5 /fed. to both cultivars under study (Bronco and Paulista) resulted in the highest values of chemical composition of plant foliage, during both seasons of the experiment, except that for P and K percentage in both seasons where the application of VAM + Phos. + 48 kg P_2O_5 /fed. gave the highest values. Moreover, Paulista gave the highest values for chlorophyll a, b and total carotenoides when plants fertilized with Phosphorine at rate of 1 kg + 48 kg P_2O_5 /fed. and VAM + Phos. + 48 kg P_2O_5 /fed. for P and K percentage in the first season. Where as, Bronco cultivar gave the highest values for chlorophyll a, b, and carotenoides when plants fertilized with Phos. + 48 kg P_2O_5 /fed. and VAM + Phos. + 48 kg P_2O_5 /fed. for P and K percentage in the second season. These results agree with ***Ali (2002)*** who revealed that the interaction effect between cultivars and phosphatic fertilizer had a significantly effect on total nitrogen and potassium content. On the other hand, ***Helal (1995)*** found that there were no significant effect on total nitrogen, phosphorus and potassium as the results of the effect of interaction between common bean cultivars and NPK fertilization.

Table (11): Effect of interaction between cultivars, phosphorus and bio-fertilizers on chemical composition of plant foliage of snap bean plants

Treatments / Season		2001						2002					
		Chlorophyll (mg/100g F. W.)		Total carotenoids (mg/100g F.W.)	N %	P %	K %	Chlorophyll (mg/100g F. W.)		Total carotenoids (mg/100g F.W.)	N %	P %	K %
cultivars	Fertilization	a	b					a	b				
Bronco	Control	161.5	52.3	106.8	1.89	0.347	2.69	167.3	53.9	95.6	1.78	0.370	2.75
	48 kg P_2O_5/fed.	196.5	71.4	145.3	2.72	0.540	3.47	199.4	75.6	139.1	2.63	0.560	3.51
	VAM	177.1	60.9	136.	2.48	0.470	3.05	178.5	65.0	132.4	2.52	0.460	3.29
	Phos.	181.8	58.2	137.9	2.55	0.500	3.11	186.4	70.2	149.2	2.57	0.480	3.35
	VAM+ Phos.	211.8	74.1	147.6	2.71	0.510	3.30	207.3	76.3	152.2	2.68	0.500	3.38
	VAM+ 24 kg P_2O_5/fed.	203.9	71.8	146.6	2.67	0.530	3.39	219.3	81.9	155.1	2.76	0.510	3.42
	VAM+ 48 kg P_2O_5/fed.	220.5	79.2	148.5	2.78	0.610	3.63	212.9	77.3	153.7	2.72	0.580	3.64
	Phos. + 24 kg P_2O_5/fed.	223.2	82.9	150.5	2.83	0.602	3.46	226.2	84.3	160.7	2.81	0.543	3.46
	Phos. +48kg P_2O_5/fed.	248.9	95.0	164.8	3.01	0.660	3.68	244.4	97.3	173.1	2.92	0.620	3.78
	VAM+ Phos.+24 kg P_2O_5/fed	236.7	88.6	157.6	2.93	0.642	3.71	239.6	92.7	169.1	2.88	0.600	3.70
	VAM+ Phos.+48 kg P_2O_5/fed	234.3	85.0	153.7	2.87	0.673	3.80	231.5	89.1	164.8	2.87	0.640	3.81
Paulista	Control	168.9	60.2	102.4	1.72	0.360	2.76	159.9	55.4	100.5	1.80	0.342	2.65
	48 kg P_2O_5/fed.	204.7	70.3	148.3	2.63	0.580	3.63	193.9	74.0	146.9	2.68	0.550	3.67
	VAM	176.4	64.0	138.5	2.44	0.450	3.24	178.3	63.6	135.6	2.49	0.460	3.39
	Phos.	192.8	67.8	143.2	2.52	0.480	3.34	189.7	69.6	142.4	2.59	0.480	3.47
	VAM+ Phos.	238.8	85.3	163.8	2.81	0.520	3.42	213.7	85.4	159.5	2.84	0.492	3.54
	VAM+ 24 kg P_2O_5/fed.	233.0	80.6	159.8	2.76	0.537	3.48	208.2	82.6	157.5	2.79	0.520	3.61
	VAM+ 48 kg P_2O_5/fed.	214.5	73.2	151.7	2.68	0.610	3.68	200.7	77.6	152.4	2.71	0.570	3.71
	Phos. + 24 kg P_2O_5/fed.	222.7	77.6	155.2	2.71	0.560	3.59	198.7	74.5	150.8	2.75	0.538	3.65
	Phos. +48kg P_2O_5/fed.	272.8	98.4	172.6	2.95	0.638	3.81	232.6	96.2	170.0	2.97	0.613	3.75
	VAM+ Phos.+24 kg P_2O_5/fed	255.	93.2	168.4	2.89	0.630	3.75	223.1	93.6	165.0	2.88	0.570	3.73
	VAM+ Phos.+48 kg P_2O_5/fed	241.5	89.8	166.6	2.83	0.677	3.86	220.9	88.0	161.3	2.85	0.627	3.79
LSD at 0.05		13.55	8.51	10.41	0.11	0.078	0.28	8.07	5.59	6.03	0.09	0.078	0.23

VAM = Vesicular arbuscular mycorrhizal fungi Phos. = phosphorine

4-2-3- Green pods yield and its components:-

a- Effect of cultivars:-

The results reported in Table (12) show the effect of cultivars, phosphorus and bio-fertilizer on green pods yield and its components expressed as pod length, pod diameter, pod fresh weight, yield per plot and total green pods yield per feddan as well as dry matter percentage in pods. The results clearly indicate that there were significant differences between the used cultivars, i.e. Bronco and Paulista in green pods yield and its components. Moreover, cv. Bronco recorded the highest values of pod length, pod diameter, pod weight, yield per plot and total green pods per feddan than those of Paulista during both seasons of study. Meanwhile, Paulista gave the highest values of dry matter percentage in pod than those of Bronco these results were true in both growing seasons. The differences among cultivars might be attributed to the different genetic potentiality of every cultivar. The higher potentiality of bean variety was the function of the higher vegetative growth as indicated in (Table 8). In the same line ***Faris et al. (1991*** and ***1992), Hewedy*** and ***Mohamed (1994), Helal (1995), Hafez et al. (1997), Hanna*** and ***El-Gizy (1999), Roy*** and ***Parthasarathy (1999), Ali (2002)*** and ***Amer et al. (2002)*** on snap bean.

b- Effect of fertilization treatments:-

With respect to the effect of phosphorus, Phosphorin and VAM (vesicular arbuscular mycorrhizal) on green pods yield and its components, the same data at Table (12) showed clearly that green pods yield and its components expressed as pod length, pod diameter, pod fresh weight, yield per plot and total green pods yield

Table (12): Effect of cultivars, phosphorus and bio-fertilizers on green pods yield and its components of snap bean plants

Treatments / Seasons		2001						2002					
		Pod			Yield		Dry matter %in pod	Pod			Yield		Dry matter %in pod
cultivars	Fertilization	Length (cm.)	Diameter (cm.)	Fresh weight (g)	Plot (Kg)	Feddan (ton)		Length (cm.)	Diameter (cm.)	Fresh weight (g)	Plot (Kg)	Feddan (ton)	
Bronco		11.03	0.63	4.04	8.08	3.434	7.51	11.40	0.65	4.90	9.35	4.015	6.43
Paulista		11.89	0.62	3.27	6.49	2.779	8.92	10.89	0.53	3.45	6.71	2.876	7.72
LSD at 0.05		0.06	0.02	0.03	0.61	0.022	0.03	0.02	0.02	0.02	0.55	0.120	0.10
	Control	10.56	0.59	2.99	3.60	1.540	6.31	10.52	0.54	3.39	3.96	1.695	5.98
	48 kg P_2O_5/fed.	10.85	0.62	3.62	7.01	3.003	7.96	10.87	0.57	3.88	7.22	3.095	6.75
	VAM	10.56	0.62	3.54	5.65	2.422	7.83	10.98	0.57	3.94	7.52	3.224	6.89
	Phos.	10.88	0.63	3.68	6.75	2.892	8.21	10.97	0.58	3.97	7.81	3.346	6.84
	VAM+ Phos.	10.97	0.63	3.66	7.14	3.060	8.15	11.19	0.59	4.14	8.33	3.568	7.13
	VAM+ 24 kg P_2O_5/fed.	11.03	0.64	3.67	7.75	3.163	8.31	11.26	0.59	4.28	8.77	3.366	7.20
	VAM+ 48 kg P_2O_5/fed.	10.95	0.63	3.70	7.67	3.286	8.25	11.21	0.59	4.23	8.37	3.585	7.15
	Phos. + 24 kg P_2O_5/fed.	11.18	0.63	3.76	7.80	3.342	8.85	11.18	0.59	4.25	8.59	3.680	7.16
	Phos. + 48 kg P_2O_5/fed.	11.28	0.66	3.95	9.44	4.043	9.33	11.58	0.62	4.68	9.59	4.111	7.70
	VAM+ Phos.+24 kg P_2O_5/fed	11.17	0.64	3.86	8.80	3.770	8.58	11.44	0.61	4.63	9.13	3.914	7.60
	VAM+ Phos.+48 kg P_2O_5/fed	11.13	0.64	3.83	8.52	3.651	8.61	11.39	0.60	4.53	9.09	3.895	7.44
	LSD at 0.05	0.12	0.05	0.06	1.14	0.032	0.14	0.06	0.03	0.05	1.14	0.187	0.13

VAM = Vesicular arbuscular mycorrhizal fungi Phos. = Phosphorine

per feddan as well as dry matter percentage in pods were positively affected due to the application of all fertilization treatments compared with the control one. In this respect, the application of Phosphorine + 48 kg P_2O_5 /fed. led to a significant increase in green pod yield and its components of snap bean in comparison with the other treatment and control, followed by VAM ± Phosohorine + 24 kg P_2O_5 /fed, VAM ± Phosphorine + 48 kg P_2O_5 /fed, Phosohorine + 24 kg P_2O_5 /fed, VAM + 24 kg P_2O_5 /fed and Phosohorine at 1 kg /fed., respectively. These results were true in both growing seasons. The increase in total yield owe directly to the increase in vegetative growth (Table, 8) and chemical composition of plant foliage (Table, 10). These results coincided with those reported by ***Abou El-Salehein*** and ***Ahmed (1998)*** on bean, and ***Mansour (2000)*** on pea; they mentioned that inoculation with mycorrhiza significantly increased the total green pods yield and its components. Moreover, ***Ali (2002)*** on common bean found that green pod yields expressed as pods yield /plant and total pods yield / fed. as well as average pod length, diameter and weight significantly increased with inoculation of seeds with Phosphorine.

c- Effect of the interaction:-

Concerning the interaction between snap bean cultivars and fertilization treatments, it is obvious from data in Table (13) that there were significant differences between all treatments in green pods yield and its components during both seasons of the experiment. In general, application of Phosphorine fertilizer at 1 kg /fed combined with 48 kg P_2O_5 /fed. to both cultivars under study resulted in the highest values of pod length, pod diameter, pod weight, yield per plant and total green pods yield per feddan as well

Table (13): Effect of interaction between cultivars, phosphorus and bio-fertilizers on green pods yield and its components of snap bean plants

Treatments / Seasons		2001						2002					
		Pod			Yield		Dry matter %in pod	Pod			Yield		Dry matter %in pod
cultivars	Fertilization	Length (cm.)	Diameter (cm.)	Fresh weight (g)	Plot (Kg)	Feddan (ton)		Length (cm.)	Diameter (cm.)	Fresh weight (g)	Plot (Kg)	Feddan (ton)	
Bronco	Control	10.64	0.60	3.44	3.99	1.710	6.15	10.81	0.59	4.17	4.17	1.787	5.65
	48 kg P_2O_5/fed.	10.95	0.63	3.95	8.03	3.440	7.43	11.26	0.64	4.61	8.68	3.722	6.23
	VAM	10.82	0.62	3.88	6.52	2.792	7.30	11.21	0.63	4.57	8.55	3.663	6.20
	Phos.	11.04	0.64	4.13	8.37	3.586	7.60	11.33	0.64	4.67	9.36	4.012	6.28
	VAM+ Phos.	10.90	0.63	3.94	6.66	2.854	7.40	11.28	0.64	4.61	9.24	3.959	6.25
	VAM+ 24 kg P_2O_5/fed.	11.02	0.63	3.99	7.28	3.119	7.53	11.46	0.65	4.99	10.26	4.397	6.55
	VAM+ 48 kg P_2O_5/fed.	11.07	0.64	4.10	8.97	3.845	7.63	11.39	0.65	4.97	9.66	4.140	6.50
	Phos. + 24 kg P_2O_5/fed.	11.16	0.64	4.20	9.06	3.884	7.70	11.52	0.65	5.07	10.33	4.425	6.60
	Phos. +48kg P_2O_5/fed.	11.37	0.67	4.32	10.18	4.364	8.18	11.85	0.69	5.47	11.36	4.867	6.93
	VAM+ Phos.+24 kg P_2O_5/fed	11.20	.065	4.28	9.70	4.156	7.85	11.67	0.67	5.43	10.64	4.558	6.90
	VAM+ Phos.+48 kg P_2O_5/fed	11.18	0.64	4.25	9.39	4.023	7.90	11.62	0.66	5.35	10.59	4.537	6.63
Paulista	Control	10.48	0.58	2.53	3.20	1.371	6.48	10.23	0.49	2.62	3.74	1.603	6.30
	48 kg P_2O_5/fed.	10.74	0.62	3.28	5.99	2.567	8.50	10.48	0.50	3.15	5.76	2.468	7.28
	VAM	10.30	0.61	3.20	4.79	2.051	8.35	10.74	0.52	3.31	6.52	2.785	7.58
	Phos.	10.72	0.61	3.22	5.13	2.197	8.83	10.61	0.52	3.26	6.25	2.680	7.40
	VAM+ Phos.	11.03	0.63	3.38	7.62	3.267	8.90	11.09	0.54	3.68	7.42	3.178	8.00
	VAM+ 24 kg P_2O_5/fed.	11.04	0.63	3.35	7.49	3.206	9.10	11.06	0.54	3.56	7.20	2.334	7.85
	VAM+ 48 kg P_2O_5/fed.	10.83	0.62	3.29	6.36	2.727	8.88	11.03	0.53	3.49	7.70	3.030	7.80
	Phos. + 24 kg P_2O_5/fed.	11.20	0.62	3.32	6.53	2.800	10.00	10.84	0.53	3.43	6.85	2.934	7.73
	Phos. +48kg P_2O_5/fed.	11.19	0.64	3.58	8.69	3.722	10.48	11.31	0.56	3.89	7.83	3.355	8.48
	VAM+ Phos.+24 kg P_2O_5/fed	11.14	0.63	3.44	7.90	3.383	9.30	11.21	0.54	3.83	7.63	3.269	8.30
	VAM+ Phos.+48 kg P_2O_5/fed	11.07	0.63	3.41	7.65	3.280	9.33	11.15	0.54	3.71	7.59	3.253	8.25
LSD at 0.05		0.17	0.06	0.09	0.16	0.447	0.20	0.08	0.05	0.06	1.61	0.265	0.18

VAM = Vesicular arbuscular mycorrhizal fungi Phos. = Phosphorine

as dry matter percentage in pods. Moreover, cv. Bronco recorded the highest values of these characters except dry matter percentage compared with cv. Paulista. Meanwhile, Paulista recorded the highest values of dry matter percentage in pod compared with Bronco. These results were true in both seasons of this study. Similar results were reported by ***Hewedy*** and ***Mohamed (1994)*** and ***Helal (1995)*** on snap bean.

4-2-4-Mineral composition of green pods:-

a- Effect of cultivars:-

The results in Table (14) show the effect of cultivars, phosphorus and bio-fertilizer (Phosphorine and vesicular arbuscular mycorrhiza) on N, P and K percentage in pods of snap bean. The results indicated that there were no significant difference on P percentage in green pods between the used cultivars (Bronco and Paulista) during both seasons and on N percentage during the first season. Respecting K percentage, there was significant difference between used cultivars in both seasons. Bronco cultivar gave the highest values of N percentage in the first season and P percentage in the second one. Meanwhile, cv. Paulista gave the highest values for P and K percentages in the first season and N and K percentage in the second one. Many investigators worked in this respect among them, ***Helal (1995), Singer et al. (1996)*** and ***Ali (2002)*** all working on common bean.

b- Effect of fertilization treatments:-

Concerning the effect of phosphorus, Phosphorine and vesicular arbuscular mycorrhiza (VAM) fungi on N, P and K percentage in green pods, the same data at Table (14) show clearly

Table (14): Effect of cultivars, phosphorus and bio-fertilizers on pod chemical composition of snap bean.

Treatments / season		2001			2002		
cultivars	Fertilization	N %	P %	K %	N %	P %	K %
Bronco		2.79	0.652	3.39	2.77	0.659	3.50
Paulista		2.78	0.655	3.54	2.80	0.658	3.56
LSD at 0.05		N.S.	N.S	0.04	0.13	N.S	0.05
	Control	1.90	0.410	2.58	1.88	0.407	2.62
	48 kg P_2O_5/fed.	2.78	0.684	3.49	2.77	0.692	3.65
	VAM	2.60	0.613	3.22	2.62	0.627	3.37
	Phos.	2.69	0.626	3.35	2.71	0.643	3.40
	VAM+Phos.	2.91	0.640	3.38	2.88	0.657	3.49
	VAM+24 kg P_2O_5/fed.	2.86	0.666	3.46	2.90	0.671	3.57
	VAM+48kg P_2O_5/fed.	2.87	0.706	3.69	2.83	0.703	3.72
	Phos. + 24 kg P_2O_5/fed.	2.92	0.676	3.59	2.91	0.685	3.62
	Phos. +48 kg P_2O_5/fed.	3.11	0.724	3.77	3.12	0.719	3.80
	VAM+Phos.+24 kg P_2O_5/fed	3.02	0.716	3.74	3.03	0.712	3.76
	VAM+Phos.+48 kg P_2O_5/fed	2.97	0.735	3.82	2.99	0.728	3.84
LSD at 0.05		0.08	0.09	0.44	0.43	0.055	0.36

VAM = Vesicular arbuscular mycorrhizal fungi Phos. = phosphorine

that N, P and K percentage were positively affected due to the application of all fertilization treatments compared with the control treatment. In this regard, the application of Phosphorine + 48 kg P_2O_5 /fed. led to a significant increase in N percentage in comparison with the other treatments and control. Meanwhile, treatment with VAM + Phos. + 48 kg P_2O_5 /fed. gave the highest values for P and K percentages. These results are true during both seasons of study. Obtained results may due to the synergistic effect of phosphorus in increasing the absorption of nitrogen and potassium elements by plant. Such results are similar to those obtained by ***Ali (2002)*** on bean who found that the application of 1 kg Phosphorine +60 P_2O_5 /fed. led to the highest values of total nitrogen, phosphorus and potassium. In this respect, ***Abou El-Salehein*** and ***Ahmed (1998)*** on bean, and ***Mansour (2000)*** on pea, they found that VAM inoculation increased N and P content of seed.

c- Effect of the interaction:-

According to the effect of the interaction between cultivars and fertilization treatments, it is obvious from data at Table (15) reveal that there were significant differences between all treatments in N, P and K percentages in green pods during both seasons of the study. Application of Phosphorine at rate of 1 kg /fed. combined with 48 kg P_2O_5 /fed. or VAM+ Phos. + 48 kg P_2O_5 /fed. to both cultivars under study (Bronco and Paulista) resulted in the highest values for N, P and K percentage. In this regard, Paulista cultivar gave the highest values of nitrogen percentage when plants fertilized with Phosphorine at rate of 1 kg /fed. + 48 kg P_2O_5 /fed. compared with Bronco cultivar at the same treatment in both seasons. Meanwhile, Bronco gave the highest values for P percentage on first season and K percentage in the second one when

Table (15): Effect of interaction between cultivars, phosphorus and bio-fertilizers on pod chemical composition of snap bean.

Treatments / season		2001			2002		
Cultivars	Fertilization	N %	P %	K %	N %	P %	K %
Bronco	Control	1.95	0.404	252	1.83	0.411	2.66
	48 kg P_2O_5/fed.	2.80	0.675	3.31	2.76	0.695	3.60
	VAM	2.58	0.615	3.11	2.61	0.631	3.30
	Phos.	2.66	0.621	3.21	2.68	0.648	3.32
	VAM+ Phos.	2.88	0.635	3.25	2.81	0.661	3.41
	VAM+ 24 kg P_2O_5/fed.	2.85	0.658	3.34	2.90	0.669	3.49
	VAM+ 48 kg P_2O_5/fed.	2.91	0.703	3.68	2.86	0.695	3.72
	Phos. + 24 kg P_2O_5/fed.	2.94	0.681	3.54	2.96	0.684	3.56
	Phos. + 48kg P_2O_5/fed.	3.10	0.721	3.77	3.05	0.718	3.81
	VAM+ Phos.+24 kg P_2O_5/fed	3.00	0.715	3.75	3.01	0.708	3.77
	VAM+ Phos.+48 kg P_2O_5/fed	2.97	0.738	3.79	2.98	0.724	3.86
paulista	Control	1.85	0.415	2.64	1.92	0.403	2.58
	48 kg P_2O_5/fed.	2.75	0.692	3.66	2.78	0.689	3.70
	VAM	2.61	0.611	3.33	2.62	0.622	3.44
	Phos.	2.71	0.630	3.49	2.74	0.638	3.48
	VAM+ Phos.	2.94	0.645	3.51	2.95	0.652	3.56
	VAM+24 kg P_2O_5/fed.	2.87	0.662	3.58	2.90	0.673	3.65
	VAM+48 kg P_2O_5/fed.	2.82	0.708	3.70	2.80	0.710	3.72
	Phos. + 24 kg P_2O_5/fed.	2.90	0.671	3.64	2.86	0.686	3.67
	Phos. + 48 kg P_2O_5/fed.	3.12	0.726	3.77	3.18	0.719	3.78
	VAM+ Phos.+24 kg P_2O_5/fed	3.04	0.717	3.72	3.05	0.716	3.74
	VAM+ Phos.+ 48 kg P_2O_5/fed	2.96	0.732	3.84	3.01	0.731	3.81
LSD at 0.05		0.11	0.127	0.63	0.61	0.078	0.51

VAM = Vesicular arbuscular mycorrhizal fungi Phos. = Phosphorine

plants fertilized with VAM+ Phos. + 48 kg P_2O_5 /fed. compared with Paulista at the same treatment. While, Paulista gave the highest values of K percentage in the first season and P percentage in the second one compared with Bronco at the same treatment. These results agree with those reported by ***Ali (2002)*** on common bean.

4-2-5-Organic chemical constituents in pods:-

a- Effect of cultivars:-

The results reported at Table (16) clarify that there were significant differences between the used cultivars, i. e. Bronco and Paulista on organic chemical constituents in pods expressed as crude protein, reducing, non-reducing and total sugars as well as fiber percentage during both seasons of the experiment, except that crude protein and non-reducing sugars in the first season which was not significantly affected. Bronco cultivar gave the highest values for reducing and total sugars in both seasons and non-reducing sugars in the second one than cv. Paulista. With respect to the crude protein percentage, Bronco gave the highest value in the first season than Paulista without significant difference, while Paulista gave the highest value of crude protein percentage in the second season. Respecting the fiber percentage cv. Paulista gave the lowest values for fiber percentage during both seasons. These differences between the studied cultivars may be due to the differences in genetic potentiality of such cultivar. These results were in agreement with those reported by ***Beltran et al. (1983), Kunwar et al. (1984), Helal (1995), Singer et al. (1996), Ali (2002)*** and ***Ewais (2003)*** all working on common bean.

Table (16): Effect of cultivars, phosphorus and bio-fertilizers on organic constituents of pod for snap bean.

Treatments / season		2001					2002				
		Protein %	Sugars %			Fiber %	Protein %	Sugars %			Fiber %
cultivars	Fertilization		reducing	Non-reducing	Total			reducing	Non-reducing	Total	
Bronco		17.41	10.43	2.70	13.13	9.66	17.30	10.48	2.84	13.19	10.26
Paulista		17.37	10.06	2.72	12.79	9.54	17.50	9.91	2.68	12.59	9.81
LSD at 0.05		N.S.	0.34	N.S.	0.24	N.S.	0.20	0.30	0.14	0.26	0.20
	Control	11.88	8.16	2.18	10.34	10.30	11.72	8.00	1.98	9.98	10.79
	48 kg P_2O_5/fed.	17.34	10.28	2.55	12.82	9.80	17.31	10.20	2.58	12.77	10.25
	VAM	16.22	9.34	2.39	12.34	10.01	16.34	9.59	2.29	11.88	10.45
	Phos.	16.78	10.06	2.53	12.59	9.95	16.94	9.81	2.48	12.29	10.36
	VAM+Phos.	18.19	10.39	2.59	12.98	9.62	18.00	10.45	2.83	13.28	10.18
	VAM+24kg P_2O_5/fed.	17.88	10.40	2.57	12.97	9.69	18.13	10.52	2.89	12.85	9.89
	VAM+48kg P_2O_5/fed.	17.91	10.56	2.74	13.30	9.52	17.69	10.37	2.77	13.14	9.98
	Phos.+24kg P_2O_5/fed.	18.25	10.59	2.84	13.43	9.44	18.19	10.49	2.91	13.40	9.81
	Phos. +48kg P_2O_5/fed.	19.44	11.07	3.26	14.33	8.92	19.47	11.13	3.28	14.40	9.45
	VAM+Phos.+24kg P_2O_5/fed	18.88	10.70	3.17	13.87	9.06	18.94	10.85	3.17	14.02	9.55
	VAM+Phos.+48kg P_2O_5/fed	18.53	10.58	2.98	13.56	9.27	18.70	10.71	3.09	13.80	9.66
LSD at 0.05		0.63	0.42	0.54	0.63	0.63	0.80	0.48	0.45	0.57	0.43

VAM = Vesicular arbuscular mycorrhizal fungi
Phos. = Phosphorine

b- Effect of fertilization treatments:-

With respect to the effect of phosphorus, Phosphorine and vesicular arbuscular mycorrhizal (VAM) fungi on organic chemical constituents in green pods of snap bean, the same data at Table (16) showed that crude protein, reducing, non-reducing and total sugars as well as fiber percentages were positively affected due to the application of all fertilization treatments compared with the control one. In this regard, the application of Phosphorine + 48 kg P_2O_5 /fed. led to a significant increase in crude protein, reducing, non-reducing and total sugars as well as fiber percentage in comparison with the other treatments and that of control, followed by (VAM + Phos. +24 kg P_2O_5 /fed.), (VAM + Phos. + 48 kg P_2O_5 /fed.) , (Phos. + 24 kg P_2O_5 /fed.), (VAM + 24 kg P_2O_5 /fed.) and Phosphorine at rate of 1 kg /fed., respectively. Obtained results are true during both seasons of study. Such results may be due to the main role of phosphorus in carbohydrates deposition and plant metabolism. The results regarding the effect of bio-fertilizer on organic chemical constituents in green pods of snap bean are in agreement with those of ***Ali (2002)*** on bean that found who application of 1 kg Phosphorine + 60 kg P_2O_5 / fed. led to the highest values of soluble, non-soluble and total sugars content of produced dry seed.

c- Effect of the interaction:-

According to the effect of the interaction between cultivars and fertilization treatments, it is obvious from such data in Table (17) that there were significant differences between all the studied treatments in protein, reducing, non-reducing and total sugars as well as fiber percentage during both seasons of the experiment. In general, application of Phosphorine fertilizer at rate of 1 kg /fed.

Table (17): Effect of interaction between cultivars, phosphorus and bio-fertilizers on organic constituents of pod for snap bean.

Treatments / season		2001					2002				
cultivars	Fertilization	Protein %	Sugars %			Fiber %	Protein %	Sugars %			Fiber %
			reducing	Non-reducing	Total			reducing	Non-reducing	Total	
Bronco	Control	12.19	8.38	2.29	10.67	10.37	11.44	8.13	1.91	10.04	10.95
	48 kg P_2O_5/fed.	17.50	10.59	2.43	13.02	9.84	17.25	10.57	2.56	13.13	10.42
	VAM	16.13	10.04	2.45	12.49	10.04	16.31	9.66	2.44	12.10	10.62
	Phos.	16.63	10.18	2.53	12.71	10.01	16.75	9.91	2.48	12.39	10.55
	VAM+ Phos.	18.00	10.65	2.60	13.24	9.68	17.57	10.68	2.78	13.46	10.39
	VAM+ 24kg P_2O_5/fed.	17.81	10.55	2.54	13.09	9.72	18.13	10.88	3.01	13.79	10.15
	VAM+ 48kg P_2O_5/fed.	18.19	10.76	2.66	13.42	9.57	17.88	10.76	2.84	13.60	10.21
	Phos. + 24 kg P_2O_5/fed.	18.38	10.79	2.79	13.58	9.48	18.50	10.90	3.08	13.98	10.08
	Phos. + 48 kg P_2O_5/fed.	19.38	11.24	3.30	14.54	9.05	19.06	11.46	3.42	14.88	9.74
	VAM+ Phos.+ 24 kg P_2O_5/fed	18.75	10.84	3.18	14.02	9.15	18.81	11.19	3.29	14.48	9.82
	VAM+ Phos.+ 48kg P_2O_5/fed	18.56	10.73	2.91	13.63	9.33	18.63	11.08	3.18	14.26	9.91
Paulista	Control	11.57	7.95	2.07	10.02	10.24	12.00	7.88	2.04	9.92	10.63
	48 kg P_2O_5/fed.	17.19	9.97	2.66	12.63	9.76	17.38	9.82	2.60	12.42	10.08
	VAM	16.31	9.84	2.36	12.20	9.98	16.38	9.52	2.15	11.67	10.29
	Phos.	16.94	9.94	2.52	12.46	9.89	17.12	9.71	2.48	12.18	10.17
	VAM + Phos.	18.38	10.13	2.58	12.71	9.55	18.44	10.22	2.88	13.10	9.96
	VAM+ 24 kg P_2O_5/fed.	17.94	10.25	2.74	12.85	9.66	18.13	10.15	2.76	12.91	9.62
	VAM+ 48kg P_2O_5/fed.	17.63	10.36	2.83	13.19	9.46	17.50	9.98	2.70	12.68	9.75
	Phos. + 24 kg P_2O_5/fed.	18.13	10.38	2.89	13.27	9.39	17.88	10.09	2.74	12.83	9.54
	Phos. +48 kg P_2O_5/fed.	19.50	10.89	3.23	14.12	8.79	19.88	10.79	3.14	13.93	9.16
	VAM+ Phos.+ 24 kg P_2O_5/fed	19.00	10.56	3.16	13.72	8.97	19.06	10.52	3.04	13.56	9.28
	VAM+ Phos.+ 48kg P_2O_5/fed	18.50	10.44	3.06	13.50	9.21	18.78	10.34	2.99	13.33	9.40
LSD at 0.05		0.88	0.59	0.76	0.89	0.59	1.13	0.67	0.64	0.81	0.61

VAM = Vesicular arbuscular mycorrhizal fungi Phos. = phosphorine

combined with 48 kg P_2O_5 /fed. to both cultivars under study resulted in the maximum values of protein, reducing, non-reducing and total sugars percentage and the lowest value for fiber percentage during both seasons. Bronco cultivar gave the highest values of reducing, non-reducing and total sugars when the plants fertilized with Phosphorin at rate of 1 kg + 48 kg P_2O_5 /fed. or VAM + Phos. + 24 or 48 kg P_2O_5 /fed. compared with Paulista cultivar under the same fertilizer treatments. Meanwhile, Paulista cultivar gave the highest value of protein percentage and lowest value of fiber percentage compared with Bronco cultivar with the same treatments. Obtained results are true during both seasons of study. These results agree with those reported by ***Ali (2002)*** and ***Ewais (2003)*** both working on common bean.

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