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Effect of sowing dates and plant cultivar, on growth, development and pod production of snap bean (*Phaseouls vulgaris* L.) during summer season

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Abstract : Two field experiments were carried out in the experimental farm of the faculty of Agriculture, Moshtohor, Benha University during two successive summer season; to study the effect of sowing dates March 1st referred as early sowing date, April 1st as medium sowing date and May 1st as late sowing date. Four cultivars were tested in the experiment namely Paulista, Samantha, Narina and Bronco. The data for vegetative growth and chemical composition was taken at 75 day. Flower behavior as well as quantity and quality of green pods were determined.
1. All vegetative aspects i.e plant length, number of leaves and branches per plant as well as fresh weight of shoot were significantly increased with early sowing on the 1st of March. Cv. Bronco reflected the highest value of these vegetative criteria. On the other hand, the dry matter percentage of the shoots was increased with delaying seed sowing from March 1st to May 1st.
2. Early sowing (1st March) led to significant increases in all assayed photosynthetic pigments (chl. (a), (b) and carotenoids) as well as mineral constituent (N, P, K). Cv. Paulista followed by cv. Bronco reflected the highest values. Early sowing (1st march) exhibited the maximum increase in reducing, non-reducing and total sugars as well as nucleic acids (RNA& DNA). Cv. Paulista reflected the highest level for all these parameters.
3. Flowering behavior showed that early sowing date (1st March) exhibited the highest values of both number of flowers, pods per plant and fruit set percentage. Plants of cv. Bronco possessed the superiority in this respect followed by cv. Paulista.
4. Sowing snap bean seed in early planting (1st March) significantly increased green pod yield per plant as well as feddan followed by cv. Bronco, cv. Paulista then cv. Narina. Meanwhile cv. Samantha produced the lowest yield. Worth to be mention that cv. Paulista improved pod quality in all measured physical and chemical parameters of pods.
It can be concluded that cv. Bronco can be recommended on the early sowing date (1st March) to obtain high green pod yield .For better quality of pods cv. Paulista at early sowing (1st March) could be recommended.
Keywords: sowing dates, plant cultivar, pod, snap bean, *Phaseouls vulgaris* L.,

Introduction

Snap bean (*Phaseouls vulgaris* L.) is one of the most important vegetable crops grown in Egypt for local markets and exportation. Their pods are a good source of vitamins A and C and calcium as well as protein. This crop is widely used as protein source with highly nutritive value in human nutrition in the world[1].

Increasing crop production can be achieved through the proper agriculture practice as using high yielding ability cultivars and selecting the suitable plant date[2,3,4]. Changing in planting date leads to exposure of *Phaseouls vulgaris* L plants different degrees of temperature, which affect the plant growth and development[5].Therefore, this field experiment was conducted to study growth, development, chemical constituents, quantity and quality of yield for four cultivars sown at three sowing dates to find out the suitable variety and optimum date of planting to raise its potential as a profitable horticultural crop.

Material and methods

The experimental plant used was snap bean *Phaseouls vulgaris* L. and four cultivars named Paulista, Samantha, Narina and Bronco. The plants were sown for two successive seasons at three sowing dates March 1st, April 1st, May 1st referred as early, medium and late sowing dates, respectively. The maximum and minimum temperatures are represented in Table (1)

Table (1): Maximum and minimum temperature (°C) during the two seasons of study.

Seasons	1st season		2nd season	
Month	**Max**	**Min**	**Max**	**Min**
March	21.40	13.17	22.31	13.51
April	26.63	14.21	27.32	14.60
May	32.56	17.15	33.72	18.10
June	33.62	21.72	34.10	22.12
July	34.80	22.71	35.64	23.18

A split plot design with four replicates was adopted. The sowing date treatments were distributed on main plots whereas the cultivar treatments were randomly arranged in the sub-plots. Each experimental plot included four ridges of 3.5m length and 60cm width with an area of 8.4m^2. Mineral fertilization with ammonium sulphate at 200 kg, superphosphate at 300 kg and potassium sulphate at 150 kg per fed were used and the amount of fertilizers were divided into three equal doses added after complete germination, at flowering and at fruit setting.

Samples were collected at 50 days from sowing. Twelve plants from each experiment plot were taken for vegetative growth characters and chemical analysis. Photosynthetic pigments (chl(a), chl(b) and carotenoids) were determined in fresh leaves by the method recommended by Metzner *et al.*[6].

Nucleic acid RNA and DNA were estimated in fresh shoots by the method of Siprin[7]. Total nitrogen was determined according to the conventional micro-kieldahl method Pirie[8]. Reducing, non reducing and total sugars content as described by Dubios *et al.*[9]. Phosphorus content was estimated according to the method of Chapman and Pratt[10]. Potassium was determined by using flame photometer according to Brown and Lilleland [11].

Yield of green pods:

At harvest 60 to 56 days after sowing, green pods in each experimental plot was picked, weight and pod yield per plant as well as pod yield per feddan was recorded.

For pod quality, a random sample of 50 pod for each plot was taken and the physical properties were recorded including pod length, pod diameter and pod weight. In addition total carbohydrate percentage was determined as described by Dubios *et al.* [9]. Protein content as well as fiber percentage were evaluated according to the method of A.O.A.C.[12] . All data were subjected to statistical analysis according to the method of Gomez and Gomez [13].

Table (2): Effect of sowing date and cultivar as well as their interaction on vegetative growth characters of bean plants during the two experimental seasons .

		1st season					2nd season				
Sowing date	**Cultivars**	**Plant length (cm)**	**No. of branches/ plant**	**No. of leaves/ plant**	**Fresh weight/ plant (g)**	**Dry matter of plant of foliage (%)**	**Plant length (cm)**	**No. of branches/ plant**	**No. of leaves/ plant**	**Fresh weight/ plant (g)**	**Dry matter of plant of foliage (%)**
March 1st		33.9	5.2	13.9	55.6	13.6	32.8	4.6	12.9	53.3	13.7
April 1st		30.2	4.3	11.6	41.2	14.9	28.7	3.6	11.4	40.5	15.1
May 1st		25.6	2.9	9.7	34.9	16.8	24.35	2.7	8.9	33.4	17.0
L.S.D at 0.05		0.9	0.6	0.5	0.9	0.2	0.7	0.3	0.6	0.6	0.2
	Paulista	29.7	4.9	12.4	44.9	14.9	27.6	3.3	11.5	43.3	15.0
	Samantha	24.2	3.3	10.1	40.5	14.5	27.5	2.7	9.2	39.2	14.7
	Nainar	32.6	4.3	11.4	42.8	15.7	31.2	4.2	10.6	41.9	15.9
	Bronco	33.1	4.9	13.0	47.4	15.3	32.3	4.3	13.2	45.1	15.5
	L.S.D at 0.05	0.8	0.4	0.6	1.4	0.2	0.7	0.3	0.6	0.9	0.2
March 1st	Paulista	33.7	4.9	12.4	44.9	14.9	27.6	3.3	11.5	43.3	15.0
	Samantha	27.2	4.3	11.4	49.5	13.1	26.2	3.5	10.4	47.3	13.2
	Nainar	36.2	6.2	13.5	53.3	14.5	35.2	5.2	12.3	52.3	14.6
	Bronco	38.3	6.3	16.3	61.2	13.5	37.3	5.4	15.5	58.5	13.7
April 1st	Paulista	29.2	4.3	12.3	39.3	14.5	26.2	3.3	11.4	39.1	14.7
	Samantha	24.2	3.4	10.6	40.4	14.2	24.2	2.4	9.3	40.2	14.3
	Narina	33.2	4.3	11.4	42.0	15.7	32.2	4.2	11.3	41.3	15.8
	Bronco	34.2	5.3	12.2	43.3	15.1	32.2	4.3	13.5	41.3	15.3
May 1st	Paulista	26.2	3.4	10.5	37.2	16.8	24.4	2.3	9.4	35.7	16.9
	Samantha	21.3	2.3	8.4	31.6	16.3	20.2	2.2	7.3	30.2	16.5
	Narina	28.6	2.4	9.4	33.1	17.0	26.3	3.1	8.2	32.3	17.2
	Bronco	26.7	3.1	10.6	37.6	17.2	27.2	3.3	10.6	35.5	17.4
L.S.D at 0.05		1.4	0.6	1.0	2.4	0.3	1.3	0.6	1.1	1.6	0.6

Results and Discussions:

Vegetative growth:

Data represented in Table (2) show the effect of sowing date, cultivar and their interaction on vegetative growth characteristics of bean plants during the two seasons of study.

The results revealed that the early sowing on 1st of March showed the highest significant values for plant length, number of branches and leaves as well as fresh weight during the two seasons of study. These results lend more support to the finding of other investigators who found increase in vegetative growth of *Phaseouls vulgaris* L. at the early sowing dates of such legume [14,15,16,17,18].

Vegetative growth of snap bean cultivated on the 1st of March may be attributed to the favorable prevailing temperature (Table, 1) at the early planting date which encourage the increase of photosynthetic pigments content Table (3) and nutrients accumulation (Table, 4) that in turn increased the vegetative growth of plants. On the other hand, increase of dry weight percentage of plant foliage was reported at the latter sowing date (1st May). This increase may be attributed to the reduction of water content of the plant due to the high temperature prevailing during their vegetative growth as maximum temperature reached 32-35^{O}C (Table 1) [19].

Data of the two seasons revealed that all studied parameters of vegetative growth were significantly affected due the different genotypes (Table 2). C.v Bronco possessed the high values in all traits i.e plant length, number of leaves and branches per plant as well as the fresh and dry matter percentage followed by cv. Narina in case of plant length and cv. Paulista for number of leaves, branches and the fresh weight of plant, meanwhile cv. Narina showed the highest dry matter percentage. On the other hand cv. Samantha exhibited the lowest values in all studied growth parameters. In this respect, other investigators mentioned that there were significant differences among the tested common bean cultivars in growth parameters for different used genotypes [20, 21].

The results in Tables (2a&b) showed significant effects on all the studied growth parameters due to the interaction between the tested sowing dates and the used genotypes. It is clear that early sowing (1st of March) for cv. Bronco reflected the highest values in most measured growth aspects (plant length, number of leaves and branches as well as fresh weight of plants) compared to other treatments. The superiority of the studied growth criteria for cv. Bronco may be attributed to the suitable temperature and the adaptation of cv. Bronco for growth under the prevailing environmental condition than the other tested cultivars.

Photosynthetic pigments:

Data recorded in Table (3) show the effect of sowing date, cultivar and their interaction on photosynthetic pigments of leaves of snap bean (chl.a, chl.b, chla+b and carotenoids). It is obvious that the first sowing date (March 1st) has the highest concentration of the studied pigments. Whereas, these photosynthetic pigments were decreased in a descending order as bean seeds were sown on 1st March, 1st April and 1st May, respectively. Other investigators reported also decrease in chlorophylls of *Phaseouls vulgaris* L. leaves due to the prevailing high temperature [22]. Karas *et al.* [17] studied the effect of two sowing dates (the last week of January and late sowing on the third week of February) on chlorophyll content of snap bean cultivars. They found that the highest level of chlorophylls exhibited in leaves of late sowing.

Table (3): Effect of sowing date and cultivar as well as their interaction on photosynthetic pigments (mg/100g. F.W) of the leaves during the two experimental seasons.

Seasos		1st season				2nd season			
Sowing date	Cultivars	Chlorophyll				Chlorophyll			
		(a)	(b)	(a+b)	Carot.*	(a)	(b)	(a+b)	Carot.*
March 1st		193.1	133.3	326.4	136.4	172.9	124.4	297.3	117.2
April 1st		180.4	94.1	274.4	116.4	161.6	78.4	240.0	96.6
May 1st		141.7	71.2	212.8	81.3	122.9	59.4	182.4	65.9
L.S.D at 0.05		1.3	0.8	2.0	1.5	1.0	3.4	4.0	2.4
	Paulista	174.8	102.5	277.3	115.1	156.0	90.6	246.6	96.8
	Samantha	169.7	96.1	265.8	111.6	149.5	83.3	232.7	90.1
	Narina	170.7	98.6	269.2	110.4	151.5	87.1	238.5	91.8
	Bronco	171.7	100.8	272.5	111.6	153.1	88.7	241.7	94.3
L.S.D at 0.05		1.1	1.8	2.7	1.7	0.9	2.6	2.7	1.5
March 1st	Paulista	196.9	136.2	333.7	140.9	176.0	126.6	302.5	120.6
	Samantha	190.8	129.5	32.3	133.3	169.7	121.7	291.4	114.5
	Narina	191.9	131.7	323.5	135.3	172.3	124.0	296.3	115.6
	Bronco	192.8	135.2	328.0	136.0	173.7	125.3	299.0	118.4
April 1st	Paulista	183.3	96.7	279.9	119.8	165.2	83.3	248.6	100.6
	Samantha	178.3	91.6	269.9	113.7	157.9	71.5	229.3	92.3
	Narina	179.5	93.1	272.5	115.2	160.5	78.2	238.7	95.2
	Bronco	180.4	49.9	275.3	117.1	162.9	80.6	243.5	98.4
May 1st	Paulista	144.3	74.0	218.3	84.4	126.8	62.0	188.8	69.3
	Samantha	139.8	67.3	207.1	78.1	120.8	56.7	177.5	63.1
	Narina	140.7	71.1	211.6	80.7	121.6	59.0	180.6	64.8
	Bronco	141.9	72.4	214.3	81.8	122.5	60.1	182.6	66.2
L.S.D at 0.05		2.0	3.1	4.7	3.0	1.6	4.5	4.6	2.6

The high level of photosynthetic pigments content of early sowing date in the present work may be attributed to the suitable temperature prevailing during growth of snap bean. On the contrary, plants sown on the late sowing date (1st of May) showed the lowest values of photosynthetic pigment (chl a, b, and carotenoids). Worth to be mention, that the temperature prevailing during May and June ranged from (32-34°C) and this level of temperature was unsuitable for this stage of plant growth. Moreover, the results of the present study indicated substantial decrease of carotenoids content in plants sown at 1st of May. This would be a further support to explain their low level of chlorophylls content, since the carotenoids act as a protective agent from photo-oxidation [23] and as important antioxidant for eliminating singlet oxygen[24].

With regard to cultivars, the results reveal that cv. Paulista possessed the highest values in photosynthetic pigments content i.e: chlorophyll a, b and (a +b) as well as carotenoids, followed by cv. Bronco and cv. Narina, meanwhile cv. Samantha exhibited the least values in all assayed photosynthetic pigments in both seasons of the study. Such differences among the tested cultivars may be due to the genetic potential for such genotype. Other researchers working on bean plants reported that there were significant differences in photosynthetic pigments content among the tested cultivars[17, 25].

Data in Table (3) indicate that there is a significant effect on the photosynthetic pigments due to the interaction between the tested sowing dates and the used cultivars. It is clear that, early sowing (1st of March) for cv. Paulista reflected the highest values during both seasons of study. On the other hand cv. Samantha at late sowing on of 1st May exhibited the lowest values in this respect.

Mineral constituents:

The present investigation showed that N, P and K content decreased significantly by delaying sowing date from 1st March to 1st May during the two seasons (Table 4). In this connection Ibrahim *et al.*[19] found that the early sowing at 1st March increased the content of N, P, K of cv. Paulista compared to the late sowing date of 1st May. Such increase may be attributed to the suitable temperature during plant growth.

Table (4): Effect of sowing date and cultivar as well as their interaction on N, P and K content of plant foliage (mg/100g D.W.) during the two experimental seasons.

Season		1st season			2nd season		
Sowing date	**Cultivars**	**N**	**P**	**K**	**N**	**P**	**K**
March 1st		3253	122	5192	2662	115	4208
April 1st		2997	110	4882	2512	89	4047
May 1st		2757	100	3890	2212	81	3074
L.S.D at 0.05		78	6	77	105	7	65
	Paulista	3303	122	4941	2709	101	4012
	Samantha	2829	116	4445	2308	89	3666
	Narina	2915	109	4611	2395	93	378
	Bronco	2829	97	4621	2435	97	3648
L.S.D at 0.05		68	9	126	59	8	81
March 1st	Paulista	3443	135	5417	2802	120	4404
	Samantha	3063	102	5045	2522	111	4096
	Narina	3263	123	5200	2642	114	4208
	Bronco	3263	129	5107	2682	117	4124
April 1st	Paulista	3323	120	5169	2722	96	4264
	Samantha	2862	99	4673	2362	81	3900
	Narina	3242	108	4828	2462	87	4068
	Bronco	2922	114	4859	2502	90	3956
May 1st	Paulista	3143	111	4239	2602	87	3368
	Samantha	2562	90	3619	2042	75	3004
	Narina	2622	96	3805	2082	78	3060
	Bronco	2702	105	3898	2122	84	2864
L.S.D at 0.05		119	15	219	103	14	137

As to the response of snap bean cultivars, the results show clearly significant difference among the different cultivars in the total N, P and K content. Cultivars Paulista exhibited the highest values in the estimated macro elements compared to the other tested cultivars. These results are in agreement with those reported by other investigators [21,26].

The results also indicate significant effect due to the interaction between the tested sowing dates and the used cultivars. It is obvious that early sowing (1st March) for cv. Paulista reflected the highest values of N, P and K in plant shoots compared to the other treatments.

Carbohydrate constituents:

The present study showed that reducing sugars, non reducing sugars and total sugars content were significantly affected by sowing date (Table 5). The early sowing date followed by medium one (March 1st and April 1st) showed significant increase in reducing sugars as well as total sugars compared to the late sowing

(1st of May). The high level of carbohydrate at the early sowing date may be due to the favorable prevailing temperature that induced the photosynthetic pigments formation which in turn encourage sugar assimilation in plant. Similar results were reported by other investigators El-Sayed [27] and Cowling and Sage [22].

Table (5): Effect of sowing date and cultivar as well as their interaction on sugar percentage of plant foliage and nucleic acid of leaves (μg/g) during the two experimental season.

Seasons		1st season					2nd season				
Sowing date	**Cultivars**	**RS***	**Non-RS**	**Total Sugar**	**RNA**	**DNA**	**RS***	**Non-RS**	**Total Sugar**	**RNA**	**DNA**
March 1st		0.945	1.180	2.126	210.2	202.2	0.887	1.133	2.021	205.1	197.3
April 1st		0.828	1.092	1.921	194.5	187.1	0.775	1.051	1.827	190.2	182.9
May 1st		0.652	1.033	1.686	124.3	119.6	0.546	0.981	1.527	119.9	115.7
L.S.D at 0.05		0.117	0.089	0.079	0.4	0.4	0.083	0.148	0.811	2.4	1.5
	Paulista	0.893	1.175	2.060	182.0	175.0	0.815	1.112	1.920	179.0	172.2
	Samantha	0.736	1.041	1.770	168.1	161.7	0.658	0.994	1.650	163.6	157.8
	Narina	0.822	1.112	1.930	178.8	172.0	0.759	1.073	1.830	175.8	169.1
	Bronco	0.783	1.081	1.860	176.4	169.7	0.713	1.042	1.750	168.5	162.1
L.S.D at 0.05		0.068	0.070	0.082	1.9	1.8	0.055	0.082	0.367	2.9	2.7
March 1st	Paulista	1.081	1.222	2.300	218.8	210.5	0.987	1.175	2.160	215.5	207.4
	Samantha	0.869	1.128	1.990	195.5	188.1	0.799	1.081	1.880	192.3	184.9
	Narina	0.940	1.198	2.130	214.4	206.2	0.916	1.151	2.060	211.1	203.0
	Bronco	0.893	1.177	2.070	212.1	204.1	0.846	1.128	1.970	201.6	194.0
April 1st	Paulista	0.893	1.175	2.060	198.3	190.8	0.846	1.280	1.970	195.6	188.1
	Samantha	0.775	1.034	1.800	188.9	181.7	0.704	0.963	1.070	183.4	176.4
	Narina	0.846	1.081	1.920	196.1	188.7	0.799	1.810	1.880	194.8	187.4
	Bronco	0.799	1.081	1.880	194.5	187.1	0.752	1.034	1.780	186.8	179.6
May 1st	Paulista	0.705	1.128	1.830	128.7	123.8	0.611	1.034	1.640	126.0	121.2
	Samantha	0.564	0.963	1.520	119.9	115.3	0.470	0.940	1.410	115.0	112.8
	Narina	0.681	1.057	1.730	126.0	121.2	0.564	0.986	1.550	121.5	116.8
	Bronco	0.658	0.987	1.640	122.6	118.0	0.540	0.963	1.500	117.1	112.6
L.S.D at 0.05		0.118	0.121	0.142	3.3	3.2	0.069	0.142	0.636	5.0	4.2

*RS= Reducing sugars

Different cultivars revealed significant difference in reducing, non-reducing and total sugar content during the two seasons of growth. In this respect cv. Paulista showed the highest values followed by cvs Narina and Bronco, meanwhile Cv. Samantha exhibited the lowest value of all carbohydrate constituents.

The interaction between the sowing date and the tested cultivars revealed that Cv. Paulista at the early sowing date (1st March) showed the highest level of the mentioned carbohydrate fractions during both seasons of growth compared to the same cultivar as well as other cultivars at later sowing dates. Whereas, Cv. Samantha at the latest sowing date (1st of May) exhibited the least values in this connection.

Nucleic acids:

Data in Table (5) indicate that there was gradual significant decrease in nucleic content by delaying sowing date till the (1st of May) compared to the other two sowing dates. The same trend was obtained during both seasons of growth. Worth to be mention, that the plants sown at the delayed day (1st May) were exhibited to high level of temperature over the suitable level of their growth and development. So, plants suffered from high temperature. This result are in agreement with Khalil *et al.*[28] and Sadak and Orabi [29] They revealed that exposure of wheat seedlings to high temperature resulted in decreased of DNA and attributed this reduction to the statement of Papadakis and Roubelakis –Angelakis[30] who reported that high temperature stress has a role in releasing of activated reactive oxygen species which accompanied with the induction of DNase activity, enhanced DNA fragmentation and methylation. In this respect, other investigators reported that salinity stress decreased DNA content Garg [31] on soybean and Bekheta and El-Bassiouny [32] on wheat plant.

Regarding cultivars cv. Paulista exhibited the highest level of RNA and DNA, however cv. Samantha showed the lowest values of nucleic acids.

Flowering behavior:

The present investigation indicated that early planting (1st March) increased number of flowers and pod/plant as well as fruit set percentage as compared to medium and late planting date during both reasons of growth.

The enhancing effect of early sowing on vegetative growth and different assayed chemical constituents may induced flowering and fruit set of snap bean. The obtained results are confirmed by previous reports of Ismail *et al.*[16], Karas *et al.*[17] and MaMta *et al.*[33] (Table 6).

Table (6): Effect of sowing date and cultivar as well as their interaction on plant flowering behaviour, fruit set percentage and number of pods/ plant during, the two experimental seasons.

Season		1st season			2nd season		
Sowing date	**Cultivars**	**No.of flowers /plant**	**No. of pods/ plant**	**Fruit set.%**	**No.of flowers /plant**	**No. of pods/ plant**	**Fruit set.%**
March 1st		19.4	17.2	88.2	18.1	15.9	87.4
April 1st		15.8	11.5	75.5	14.4	10.2	70.4
May 1st		13.4	7.9	58.9	12.1	6.7	54.7
L.S.D at 0.05		0.17	0.68	1.88	0.6	0.6	1.4
	Paulista	15.8	12.2	75.4	14.8	11.1	72.8
	Samantha	13.8	9.8	69.0	12.8	8.8	66.2
	Narina	14.9	11.2	73.5	13.8	10.1	71.0
	Bronco	20.2	15.6	75.9	18.2	13.6	73.2
L.S.D at 0.05		0.87	0.88	2.58	0.7	0.7	2.0
March 1st	Paulista	19.1	17.1	89.5	18.1	16.1	88.9
	Samantha	17.2	14.2	82.5	16.2	13.2	81.4
	Narina	18.0	15.1	89.4	17.0	15.1	88.8
	Bronco	23.3	21.4	91.6	21.2	19.2	90.5
April 1st	Paulista	15.3	11.3	73.8	14.3	10.2	71.3
	Samantha	13.2	9.2	69.6	12.1	8.1	66.6
	Narina	14.4	10.3	71.5	13.2	9.2	69.6
	Bronco	20.3	15.3	75.2	18.1	13.4	74.0
May 1st	Paulista	13.1	8.1	61.8	12.0	7.0	58.3
	Samantha	11.1	6.1	54.9	10.1	5.1	50.4
	Narina	12.2	7.3	59.8	11.3	6.2	54.8
	Bronco	17.0	10.1	59.4	15.2	8.4	55.3
L.S.D at 0.05		1.5	1.5	4.5	1.3	1.3	3.4

The cultivars also showed significant differences in these studied parameters, cv. Bronco was the superior followed in descending order by cv. Paulista, Narina and Samantha respectively. The results was previously recorded by other investigators Youssef [25], Feleafel *et al.* [34], and Perez-Barbeito *et al.* [35] on snap bean.

The interaction between the tested sowing date and cultivars showed that cv. Bronco at the first sowing date reflected the highest value of number of flowers and pods as well as fruit setting percentage.

Yield of green pods:

It is clear from the results (Table 7) that there was a continuous decrease per feddan with delaying sowing date till 1st of May compared to 1st April and 1st March. Such increments during the early sowing date (1st March) may be attributed to the favorable prevailing temperature that encourage the vegetative growth

(Table 2a, b) and fruit setting percentage (Table 6) which in turn increased the number of pods per plant and consequently yield productivity. However, the high temperature during growth and production at late sowing date (1st May) (Temp 33-35°C) decreased photosynthate production and their translocation to the reproductive organs; this reduction leads to abscission of flowers and pods[4].

Table (7): Effect of sowing date and cultivar as well as their interaction on pod length, diameter, weight as well as yield during the two experimental seasons.

Seasos		1st season					2nd season				
Sowing date	**Cultivars**	**Pod length (cm)**	**Pod diameter (cm)**	**Pod weight (g)**	**Weight of pods /plant (g)**	**Total yield/ fed. (kg)**	**Pod length (cm)**	**Pod diameter (cm)**	**Pod weight (g)**	**Weight of pods /plant (g)**	**Total yield/ fed. (kg**
March 1st		11.3	0.71	3.88	66.48	4920	11.75	0.69	4.02	63.56	4570
April 1st		10.0	0.64	3.48	39.37	2620	10.25	0.64	3.56	35.82	2320
May 1st		9.0	0.58	2.79	21.63	11.60	8.90	0.58	3.18	20.45	1050
L.S.D at 0.05		0.31	0.06	0.22	2.62	141.46	0.25	0.04	0.20	1.78	82.51
	Paulista	11.2	0.63	3.11	43.30	2933	10.80	0.63	3.34	41.32	2720
	Samantha	10.20	0.55	3.08	30.79	1973	9.20	0.55	3.30	29.24	1813
	Narina	10.0	0.68	3.74	38.25	2560	10.20	0.67	3.94	37.00	2373
	Bronco	9.0	0.70	3.62	57.56	4133	10.00	0.68	3.77	52.18	3680
L.S.D at 0.05		0.50	0.06	0.37	2.76	139.61	0.40	0.06	0.35	1.67	104.01
March 1st	Paulista	12.50	0.70	3.58	69.46	5120	12.20	0.70	3.69	66.63	4720
	Samantha	10.00	0.60	3.44	48.21	3360	10.10	0.60	3.62	47.02	3160
	Narina	11.00	0.75	4.35	60.93	4560	11.00	0.70	4.44	58.98	4320
	Bronco	11.50	0.80	4.17	87.34	6640	11.00	0.75	4.32	81.63	6080
April 1st	Paulista	11.00	0.60	3.03	39.07	2480	11.30	0.60	3.23	35.81	2320
	Samantha	9.00	0.55	3.18	28.53	1760	9.20	0.55	3.17	25.33	1520
	Narina	10.00	0.70	3.91	33.25	2160	10.50	0.70	4.00	32.20	1920
	Bronco	10.00	0.70	3.81	56.64	4080	10.00	0.70	3.86	49.95	3520
May 1st	Paulista	10.00	0.60	2.71	21.63	1200	9.10	0.60	3.10	21.52	1120
	Samantha	8.00	0.50	2.60	15.62	800	8.30	0.50	3.11	15.37	760
	Narina	9.00	0.60	2.97	20.59	960	9.20	0.60	3.39	19.95	880
	Bronco	9.00	0.60	2.89	28.70	1680	9.00	0.60	3.15	24.97	1440
L.S.D at 0.05		0.82	0.11	0.64	4.78	241.81	0.70	0.11	0.61	2.90	180.14

With regard to cultivars, cv. Bronco produced the highest yield followed by Paulista, Narina and Samantha. Such results could be explained on the basis that the two cultivars (Bronco and Paulista) produced higher number of flowers, pods and high percentage of fruit setting compared to other cultivars (Table 6). Other investigators stated that varieties differ in their response [3,35].

Early sowing (1st of March) of cv. Bronco reflected the highest values in weight of pods and total yield per feddan compared to other treatments, meanwhile plants of cv. Samantha produced the least values especially when grown at late sowing time (1st of May).

Green pod quality:

Green pods produced from sowing date on (1st March) (Table 7) showed the superior effect on average pod length, diameter and weight compared to other tested sowing dates. The favorable effects of early sowing date on pod characters could be related to the positive effect of such sowing date on vegetative growth (Table 2)

which in turn affect the quality of produced green pods. These results coincide with the founding of other researchers El-Sefi *et al*.[15] and Reichel[36] on French bean.

Snap bean cultivars differ to their response to the three sowing dates, cv. Paulista reflected the highest values with respect to average pod length, meanwhile cv. Bronco possessed the highest values of pod diameter. On the contrary, cv. Samantha recorded the lowest value of all studied criteria.

Chemical constituents of green pods:

(Table 8) showed the high level of protein and carbohydrate at early sowing date (1st March) compared to the later sowing dates at 1st April) or (1st May). On the other hand, fiber percentage increased by delaying sowing date at 1st April (10.7%) 1st May (12.95%) compared to the first sowing date at 1st March (9.1%). Decreasing of protein and carbohydrate concomitants to increase of fiber percentage in green pods sown at the delayed sowing date (1st of May) may be due to the higher prevailing temperature which in turn may enhance the rate of respiration comparing to photosynthesis leading to deleterious effect on protein and carbohydrate metabolism and on sequent affect their contents in plant tissues[2].

Table (8): Effect of sowing date and cultivar as well as their interaction on protein (mg/100g. D.W), carbohydrate and fibers percentage of green pods during two experimental seasons.

Season		1st season			2nd season		
Sowing date	**Cultivars**	**Protein mg/100 k.D.W**	**Carbohydrate %**	**Fiber %**	**Protein mg/100 k.D.W**	**Carbohydrate %**	**Fiber %**
March 1st		1936.7	7.02	8.9	1582.5	6.20	9.3
April 1st		1817.5	6.36	10.5	1498.0	5.52	10.9
May 1st		1708.3	5.37	12.7	1424.2	4.80	13.2
L.S.D at 0.05		53.4	0.39	0.4	21.0	0.22	0.5
	Paulista	1963.3	7.45	10.5	1602.2	6.70	10.9
	Samantha	1728.9	5.57	10.0	1413.3	4.65	10.3
	Narina	1776.7	6.28	11.3	1483.3	5.89	11.7
	Bronco	1814.4	5.69	10.9	1507.8	4.79	11.4
L.S.D at 0.05		44.3	0.4	0.3	18.8	0.31	0.2
March 1st	Paulista	2050	8.26	8.8	1650	7.71	9.1
	Samantha	1826	6.19	8.5	1500	5.16	8.5
	Narina	1910	7.30	9.4	1570	6.65	9.9
	Bronco	1960	6.33	9.1	1610	5.30	9.5
April 1st	Paulista	1950	7.57	10.2	1600	6.61	10.7
	Samantha	1740	5.78	9.8	1400	4.68	10.3
	Narina	1770	6.19	11.2	1490	5.97	11.4
	Bronco	1810	5.92	10.7	1503	4.82	11.0
May 1st	Paulista	1890	6.54	12.5	1557	5.78	13.0
	Samantha	1620	4.75	11.8	1340	4.12	12.1
	Narina	1650	5.37	13.3	1390	5.04	13.9
	Bronco	1673	4.81	13.1	1410	4.25	13.7
L.S.D at 0.05		76.8	0.7	0.5	32.5	0.53	0.4

With respect to cultivars response, cv. Paulista possessed the highest values of total protein and carbohydrate contents of green pods followed by cvs. Bronco and Narina, meanwhile cv. Samantha showed the least values in this respect. Regarding fiber percentage cv. Samantha showed the minimum percentage of fiber content, however, cv. Bronco contains the highest percentage. Thus, the green pods of cv. Paulista showed the superior chemical constituents hence, they contain the highest values of protein and carbohydrate accompanied with low percentage of fibers. Such differences in chemical constituent content of produced pods for the studied snap bean cultivars may be due to the differences in genotype potential [21, 37].

In conclusion, cv. Bronco on early sowing date showed the highest green yield. Meanwhile, cv. Paulista sown on (1st March) produced the best quality of pods.

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