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EFFECT OF PLANT POPULATION AND SOWING DATES ON GROWTH AND YIELDOF DRY BEAN (*Phaseolus vulgaris*,L) 1- PLANT GROWTH AND YIELD

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ABSTRACT

Two field experiments were carried out during summer seasons of 2010 and 2011 at the Experimental Farm at El-Kassaien, Hort. Res. Station Ismalia Governorate, Egypt, to study the effect of sowing dates and plant density on vegetative growth, dry seed yield and its components as well as chemical constituents of dry seed for snap bean plants cv. Nebrasica grown in the newly reclaimed sandy soil. This experiment included 12 treatments, which were the combinations between three sowing dates (February 1st , March 1st and April 1st) and four plant density (56 plants/m^2, 40 plants/m^2 , 28 plants/m^2 and 20 plants/m^2). Planting of snap been on March 1st gave the maximum values of Vegetative characters, dry weight of different plant organs at different stages of samples, seed yield /m^2 and total seed yield /fed. in the two seasons. Plant density at 20 plants / m^2 had significant effect on vegetative characters, total dry weight / plant at 45 and 60 days after planting in both seasons as well as 100 seeds weight , seed yield/ plant. On other hand, yield of seeds per m^2 and per fed. were significantly increased by planting at 56 plants/m^2 in both seasons. The interaction between sowing date on March 1st and plant density at 20 plants/m^2 significantly increased total dry weight/ plant at 45 and 60 days and exhibited the highest values of 100 seeds weight and seed yield/ plant. On the other hand, the highest values of total dry seed yield per square meter and per feddan were recorded with the interaction between planting on 1st March and planting at 56 plants/ m^2.

INTRODUCTION

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

Sowing date is one of the important factors which affects productivity through growing the timing and duration of the vegetative and reproductive stages, since, environmental factors such as temperature and light duration differ with varying sowing date. Many investigators reported that suitable sowing dates increased plant height, number of branches and leaves per plant, dry weight of branches and leaves per plant and yield and its components as mentioned by Amer (2004), Abd El-Latif *et al.* (2009), Abou El-Yazied (2011), Abdel-Hakim *et al.* (2012)on snap been. Many investigators concluded that increasing plant density decreased the vegetative growth and yield and its components as mentioned by Arisha and Bardisi (1999), Pawar *et al.* (2007) , Kazemi *et al*.(2012) on snapbeen and Amer *et al.* (2001) on pea

MATERIALS AND METHODS

Two field experiments were carried out during the summer seasons of 2010 and 2011 at the Experimental Farm at El-Kassasin, Hort. Res. Station Ismalia Governorate, Egypt, to study the effect of sowing dates and plant density on vegetative growth characteristics and dry seed yield and its components of bean (cv. Nebrasica) grown in the newly reclaimed sandy soil.

The physical and chemical analysis of the experimental soil is presented in Table 1 according to Chapman and Pratt (1982).

Table 1: The physical and chemical properties of soil during 2010 and 2011 seasons

Physical properties			**Chemical properties**		
	2010	**2011**		**2010**	**2011**
Sand (%)	90.5	95.6	Organic matter (%)	0.03	0.08
Silt (%)	4.7	1.6	Available K (ppm)	55	66
Clay	4.8	2.8	Available P (ppm)	5.7	6.8
Field capacity	6.8	7.2	Available N (%)	5.9	6.3
Wilting point	2.5	2.6	Calcium carbonate (%)	0.28	0.26
Available water	4.5	4.5	PH	8.1	8.1
Water holding capacity	13.9	14.6			

Sample of the soil was obtained from 25 cm soil surface.

The local meteorological data during 2010 and 2011 prevailing at El-Kassasin region are given in Table 2

Table (2): Local meteorological data at El-Kassasin region during 2010 and 2011 seasons

Month	**2010 season**				**2011 season**			
	Temperature (c º)		**Relative humidity%**		**Temperature (c º)**		**Relative humidity%**	
	Max.	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**
Jan.	20.30	13.19	88.19	57.83	19.22	12.70	93.02	58.54
Feb.	21.03	13.60	87.57	49.17	19.39	13.53	89.21	53.57
Mar.	22.06	15.64	84.64	56.0	19.80	14.19	87.16	57.70
April	23.62	17.03	82.86	53.20	23.00	16.36	84.53	54.60
May	26.03	19.93	81.16	55.32	25.29	19.38	85.96	56.32
June	29.65	23.34	81.93	53.75	28.33	22.56	86.6	58.76
Joule	30.2	25.23	86.16	61.26	30.67	25.09	88.61	60.25
Aug.	31.93	26.86	89.00	64.26	31.12	25.38	86.41	57.77

This experiment included 12 treatments, which were the combinations between three sowing dates and four plant populations as follows:

Sowing dates

1- February 1st

2- March 1st

3- April 1st

Plant populations

1- 56 plants/m^2 one plant/hill at 5 cm apart on two sides of the irrigation line.
2- 40 plants/m2 one plant/hill at 7 cm apart on two sides of the irrigation line.
3- 28 plants/m2 one plant/hill at10cm apart on two sides of the irrigation line.
4- 20 plants/m2 one plant/hill at14cm apart on two sides of the irrigation line.

These treatments were arranged in a split plot design with three replicaties. Sowing dates were assigned at random in the main plots, while, sub plots were devoted to plant populations.

The experimental unit area was 12.8 m^2 and it contained three drippers lines with 6 m length for each and 71 cm width, and the distance between drippers was 25cm. The middle dripper line was used for data collection and others were used for yield determination.

All plots received equal amounts of nitrogen, phosphorus and potassium added in the form of ammonium sulphate (20.5 % N), calcium superphosphate (15.5 % P_2O_5) and potassium sulphate (48 % K_2O) at the rates of 80 kg N, 37 kg P_2O_5 and 50 kg K_2O, respectively. One third of all fertilizers were added at the time of soil preparation with 20 m^3/fed. FYM and the rest were divided into three equal portions and added to the soil at 10 days intervals after emergence.

The other normal agricultural treatments for growing bean plants were practiced.

Data Recorded

Two random samples of ten plants from every experimental unit were taken after 45 and 60 days from sowing and the following data were recorded:

1. Plant growth

a. Morphological characters

1. Plant height.
2. Number of leaves /plant.
3. Number of branches/plant.

b. Dry weight

Different plant parts were oven dried at 70 ^oC till constant weight, and the following data were recorded:

1. Dry weight of branches.
2. Dry weight of leaves.
3. Total dry weight (branches +leaves).

2. Yield and its components

Dry pods of each plot were harvested at maturity stage, then counted and weighed in each harvest and the following parameters were calculated:

1- Yield of seeds/plant
2- Weight of 100 seeds
3- Total seeds yield/feddan.

Statistical analysis:

The data of these experiments were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1980) and the differences among treatments were compared using LSD at 0.05 level.

RESULTS AND DISCUSSION

4Plant growth
Vegetative characters
Effect of sowing dates

Data in Table 3 show the effect of three sowing dates (February 1st ., March 1st and April 1st) on vegetative growth characters of snap bean plants, expressed as plant height, number of branches and leaves/plant at 45 and 60 days after sowing in both seasons.

It is obvious from such data that sowing dates had a significant effect on all measured vegetative growth parameters during both seasons of study. In this respect, the best sowing date that gave the highest values of vegetative growth was on March 1st, while sowing of snap been seeds in the first of April recorded the lowest values of all plant vegetative growth traits.

Such increments in studied morphological characters during mid and early sowing dates may be due to the suitable and prevalent metrological factors specially temperature (Table 2) which affect positively and increased the vegetative growth phase of plants. Also, the suitable prevalent temperature which causes an increase in photosynthetic assimilation rate and also increase in duration of the period of plant growth. Such results may be due to the suitable temperature during germination and during vegetative growth, stage which resulted in increasing plant growth (Abou El-Yazied 2011).

Table (3): Effect of sowing dates on plant height, number of branches and leaves of snap bean plants during2010and2011 seasons in newly reclaimed sandy soil

Characters	Plant height (cm)		Number of branches/ plant		Number of leaves/ plant	
	Days after sowing					
Treatments	45	60	45	60	45	60
	2010 season					
February 1st	15.74	50.84	4.20	4.85	18.66	24.82
March 1st	18.91	61.11	4.82	6.16	22.51	29.79
April 1st	12.40	41.31	3.56	3.64	14.83	19.75
LSD at 0.05 level	0.80	1.24	NS	1.29	3.06	2.10
	2011 season					
February 1st	14.12	45.88	3.83	4.58	16.16	21.91
March 1st	16.96	54.38	5.20	5.50	20.00	25.60
April 1st	10.99	36.38	3.25	3.32	13.31	17.85
LSD at 0.05 level	1.27	0.18	NS	1.33	1.39	1.27

In this respect, Abd-Alla (2006) referred that plant length, number of leaves and branches/plant were significantly increased with early sowing on 1st of March**.**

Obtained results are in harmony with those reported by Mahmoud (2008) ,Abd El-Latif *et al.* (2009) , Ewas (2010) , Abou El-Yazied (2011) and Abdel-Hakim *et al*. (2012).

Effect of plant density

Data in Table 4 reveale that plant density had significant effect on plant height, number of branches and leaves/plant .

Planting seeds of snap bean at 56 plants /m^2 significantly increased plant height of snap been in both seasons without significant differences between 40 plants / m^2 in the second season only at 45 and 60 days after planting .

Concerning number of branches and leaves, data also show that , planting of snap bean at 28 or 20 plants/ m^2 recorded the maximum values of number of branches and leaves in both seasons at 45 and 60 days after sowing , except number of branches at 60 day in the 2nd season .

The stimulative effect of low plant density on morphological characters, other than plant height, may be due to more exposing to solar radiation , meanwhile , prevent stem etiolating and consequently gave more branching and higher number of leaves/ plant due to large amounts of nutrients available to each plant.

Table (4): Effect of plant density on plant height, number of branches and leaves of snap bean plants during 2010 and 2011 seasons in newly reclaimed sandy soil

Characters / Treatments	Plant height (cm)		Number of branches/ plant		Number of leaves/ plant	
	Days after sowing					
	45	60	45	60	45	60
	2010 season					
56 plants/m^2	16.81	52.92	3.16	3.95	17.73	23.92
40plants/m^2	16.73	52.04	4.02	4.64	18.37	24.27
28 plants/m^2	15.15	50.29	4.80	5.30	19.79	25.61
20 plants/m^2	14.02	49.09	4.78	5.63	18.78	25.33
LSD at 0.05 level	0.78	0.46	0.79	0.76	0.89	0.99
	2011 season					
56 plants/m^2	15.20	46.91	3.52	4.01	15.43	20.66
40plants/m^2	15.01	46.34	4.01	4.19	16.23	21.95
28 plants/m^2	13.32	44.97	4.63	4.80	17.16	22.15
20 plants/m^2	12.58	43.98	4.22	4.87	17.13	22.38
LSD at 0.05 level	0.38	0.74	0.71	NS	1.06	1.27

Obtained results are in agreement with those reported by Arisha and Bardisi (1999), Amer *et al.* (2001), Pawar *et al.* (2007) , , Abd El-Latif *et al.* (2009) , Moniruzzaman *et al*. (2009) , and Kazemi *et al*.(2012)

Effect of the interaction between sowing dates and plant density

Data in Table 5 show the interaction between sowing dates (February 1st, March 1st and April 1st) and plant density (56, 40, 28 and 20 plants/m^2) on plant height, both number of branches and leaves/plant under new reclaimed soil in both seasons.

The interaction between sowing dates and plant density had significant effect on plant height, number of branches/plant and number of leaves/plant at two different stages (45 and 60 day after sowing in both seasons.

As for plant height , the interaction between sowing date on March 1st and plant density at 56 plants/m^2 recorded the tallest plants without significant differences between sowing date on the same date and plant density at 40 plants/m^2 in the 2nd season, whereas planting of snap bean on April 1st and 20 plants / m^2 gave the shortest plants at the two sampling dates in both seasons.

Concerning number of branches , the interaction between sowing date on March 1st and plant density at 20 plants/m^2 recorded the maximum values of number of branches , whereas planting of snap bean on April 1st and 56 plants / m^2 recorded the minimum values of number of branches at 45 and 60 days after sowing in both seasons.

Table (5): Effect of interaction between sowing dates and plant density on plant height, number of branches and leaves of snap bean plants during 2010 and 2011 seasons in newly reclaimed sandy soil

Characters / Treatments		Plant height (cm)		Number of branches/ plant		Number of leaves/ plant	
		Days after sowing					
Sowing dates	Plant density	45	60	45	60	45	60
		2010 season					
February 1st	56 plants/m^2	17.06	52.64	3.36	4.10	17.54	24.26
	40 plants/m^2	16.87	51.59	4.10	4.48	18.29	23.89
	28 plants/m^2	14.93	49.99	4.48	5.97	19.78	25.76
	20 plants/m^2	14.07	49.12	4.85	4.85	19.04	25.38
March 1st	56 plants/m^2	20.29	63.53	3.58	4.93	21.06	29.12
	40 plants/m^2	19.76	62.27	4.48	6.27	22.85	29.57
	28 plants/m^2	18.46	60.30	5.82	5.82	23.74	30.46
	20 plants/m^2	17.11	58.33	5.38	7.62	22.40	30.02
April 1st	56 plants/m^2	13.07	42.58	2.53	2.86	14.59	18.40
	40 plants/m^2	13.59	42.24	3.48	3.17	13.96	19.35
	28 plants/m^2	12.06	40.59	4.12	4.12	15.86	20.62
	20 plants/m^2	10.89	39.83	4.12	4.44	14.91	20.62
LSD at 0.05 level		1.13	0.83	1.38	1.32	1.56	1.76
		2011 season					
February 1st	56 plants/m^2	15.43	47.66	3.33	3.33	15.33	21.00
	40 plants/m^2	15.30	46.30	4.00	4.66	15.66	22.00
	28 plants/m^2	13.23	45.16	4.33	5.00	17.33	23.00
	20 plants/m^2	12.53	44.40	3.66	5.33	16.33	21.66
March 1st	56 plants/m^2	18.12	55.60	4.40	5.60	18.80	24.00
	40 plants/m^2	18.16	55.88	5.20	4.80	20.00	26.00
	28 plants/m^2	16.28	53.68	5.60	6.00	20.00	25.60
	20 plants/m^2	15.28	52.36	5.60	5.60	21.20	26.80
April 1st	56 plants/m^2	12.04	37.46	2.83	3.11	12.18	17.00
	40 plants/m^2	11.56	36.83	2.83	3.11	13.03	17.85
	28 plants/m^2	10.45	36.07	3.96	3.40	14.16	17.85
	20 plants/m^2	9.92	35.19	3.40	3.68	13.88	18.70
LSD at 0.05 level		0.71	1.30	1.24	1.63	1.87	2.22

Regarding number of leaves , the same data in Table 5 show that , the highest number of leaves/plant of snap bean was obtained by the interaction between sowing date on March 1st and plant density at 20 plants/m^2 without significant differences between the same date of sowing and plant density at 25 plants/ m^2 at 45 and 60 days after sowing in both seasons. On the other hand, the lowest number of leaves was obtained by the interaction between sowing date on April 1st and plant density at 56 plants/m^2

Dry weight

Effect of sowing dates

Data in Table 6 show the effect of sowing dates (February 1st, March 1st and April 1st) on dry weight of branches, leaves, and total dry weight / plant at different stages in both seasons of study.

Sowing dates of snap bean plants had a significant effect on dry weight of branches, leaves and total dry weight / plant at 45 and 60 days after sowing in 2010 and 2011 seasons

Planting of snap bean on March 1st gave the maximum values of dry weight of different organs at different stages of samples in both seasons, while the minimum values of these traits were obtained with the late sowing (April 1st). On the other hand, planting on February 1st gave intermediate values between them.

Table (6): Effect of sowing dates on dry weight of different organs of snap bea plants during 2010 and 2011 seasons in newly reclaimed sandy soil

Characters	Dry weight of branches (g)		Dry weight of leaves (g)		Total dry weight (g)	
	Days after sowing					
Treatments	45	60	45	60	45	60
	2010 season					
February 1st	5.51	8.34	8.28	10.93	13.79	19.27
March 1st	6.89	10.30	9.07	13.24	15.96	23.53
April 1st	4.51	6.71	6.50	8.20	11.01	14.92
LSD at 0.05 level	0.40	0.47	0.88	0.36	1.15	0.40
	2011 season					
February 1st	5.04	8.28	7.68	9.97	12.72	18.25
March 1st	6.65	10.10	10.01	12.60	16.66	22.70
April 1st	4.01	5.90	6.18	8.37	10.19	14.27
LSD at 0.05 level	0.42	0.18	0.20	1.76	0.74	1.82

The increase in total dry weight/ plant were about 15.73 , 30.97 % and 22.10 and 24.38 % for planting date on 1st March companied with planting date on 1st Feb. and 44.95, 63.49 and 57.70 , 59.07 % companied with planting date on 1st April at 45 and 60 days after sowing in 1st and 2nd seasons, respectively.

The previously-mentioned results indicate, in general, that the plants grown during the mid sowing date (1st March) were the most vigorous (expressed as plant height, leaf number and dry weight of plants), compared to the other investigated sowing dates. Whereas, the late sowing date (1st April) resulted in the lowest values of plant growth. This may be attributed to

the favorable effect of prevalent temperature, (Table 2) and humidity during the growth season.

Similar results were also reported by Mahmoud (2008), Abd El-Latif *et al.* (2009), Ewas (2010) , Abou El-Yazied (2011) and Abdel-Hakim *et al*. (2012).

Effect of plant density

Data given in Table 7 indicate the effect of plant density (56, 40, 28 and 20 plants/m^2) on dry weight of branches, leaves and total dry weight / plant in both seasons of growth under sandy soil conditions. In this connection, plant density of snap bean had a significant effect on dry weight of branches, leaves and total dry weight / plant at 45 and 60 days after planting in 2010 and 2011 seasons. In addition, low density of snap bean (20 plants / m^2) gave the highest values of snap bean dry weight organs without significant differences between 20 and 28 plants /m^2 with respect dry weight of branches at 60 days after sowing in both seasons. On the contrary, the lowest values of different dry weight organs of snap bean were recorded with the high density (56 plants/m^2) in both seasons.

Table (7): Effect of plant density on dry weight of different organs of snap bean plants during 2010 and 2011 seasons in new reclaimed sandy soil

Characters	Dry weight of branches (g)		Dry weight of leaves (g)		Total dry weight (g)	
	Days after sowing					
	45	60	45	60	45	60
Treatments	2010 season					
56 plants/m^2	4.91	7.52	7.33	9.65	12.24	17.17
40 plants/m^2	5.12	7.72	7.48	9.91	12.59	17.63
28 plants/m^2	5.89	9.23	8.20	11.55	14.09	20.78
20 plants/m^2	6.61	9.33	8.80	12.04	15.41	21.36
LSD at 0.05 level	0.35	0.26	0.58	0.48	0.63	0.53
	2011 season					
56 plants/m^2	4.46	6.77	6.66	8.77	11.11	15.54
40 plants/m^2	4.68	6.98	6.82	8.98	11.50	15.95
28 plants/m^2	5.70	8.94	8.38	11.25	14.07	20.19
20 plants/m^2	6.09	9.70	9.97	12.24	16.07	21.93
LSD at 0.05 level	0.32	0.20	0.20	1.03	0.41	1.06

The increases in total dry weight / plant were about 25.89, 44.64 % and 24.40, 41.11 % for plant density at 20 plants/m^2 than plant density at 56 plants/m^2 at 45 and 60 days after sowing in 1st and 2nd seasons, respectively. From the above mentioned results it could be concluded that, the plants grown under wider spaces received more nutrients, light and moisture around each plant surrounding compared to plants in closer spaces which is probably the cause of better performance of total dry weight of individual snap bean in wider spaces. The stimulative effect of low plant density on dry weight of plant may be due to that wide spacing make a marked increase in vegetative growth, which in turn reflected on the content of plant dry weight.

The obtained results are in accordance with those reported by Arisha and Bardisi (1999), Ismail (2004) and Abd El-Latif *et al.* (2009)

Effect of the interaction between sowing dates and plant density

Data presented in Table 8 show the effect of the interaction between sowing dates (February 1st, March 1st and April 1st) and plant density **(**56, 40, 28 and 20 plants/m^2) on dry weight of branches, leaves and total dry weight/ plant.

Table (8): Effect of the interaction between sowing dates and plant density on dry weight of different organs of snap bean plants during 2010 and 2011 seasons in newly reclaimed sandy soil

Characters / Treatments		Dry weight of branches (g)		Dry weight of leaves (g)		Total dry weight (g)	
		Days after sowing					
Sowing dates	**Plant density**	**45**	**60**	**45**	**60**	**45**	**60**
		2010 season					
February 1st	**56 plants/m^2**	**4.77**	**7.49**	**7.37**	**9.58**	**12.14**	**17.07**
	40 plants/m^2	4.96	7.66	7.49	9.86	12.45	17.52
	28 plants/m^2	5.57	9.03	8.58	11.66	14.15	20.69
	20 plants/m^2	6.72	9.17	9.69	12.61	16.41	21.78
March 1st	56 plants/m^2	6.03	8.93	8.49	11.50	14.52	20.43
	40 plants/m^2	6.28	9.16	8.85	11.82	15.13	20.98
	28 plants/m^2	7.14	11.52	9.31	14.13	16.45	25.65
	20 plants/m^2	8.10	11.57	9.64	15.49	17.74	27.06
April 1st	56 plants/m^2	3.94	6.15	6.13	7.87	10.07	14.02
	40 plants/m^2	4.11	6.33	6.09	8.06	10.2	14.39
	28 plants/m^2	4.97	7.13	6.70	8.87	11.67	16.00
	20 plants/m^2	5.01	7.24	7.07	8.01	12.08	15.25
LSD at 0.05 level		0.63	0.49	1.03	0.73	1.01	0.96
		2011 season					
February 1st	56 plants/m^2	4.27	6.67	6.68	8.60	10.95	15.27
	40 plants/m^2	4.41	6.85	6.75	8.72	11.16	15.57
	28 plants/m^2	5.72	8.76	7.47	10.53	13.19	19.29
	20 plants/m^2	5.74	10.84	9.82	12.02	15.56	22.86
March 1st	56 plants/m^2	5.54	8.04	7.92	10.50	13.46	18.54
	40 plants/m^2	5.69	8.28	8.14	10.70	13.83	18.98
	28 plants/m^2	7.12	11.98	10.93	13.94	18.05	25.92
	20 plants/m^2	8.24	12.11	13.06	15.24	21.3	27.35
April 1st	56 plants/m^2	3.56	5.60	5.37	7.22	8.93	12.82
	40 plants/m^2	3.93	5.80	5.58	7.51	9.51	13.31
	28 plants/m^2	4.25	6.07	6.73	9.28	10.98	15.35
	20 plants/m^2	4.30	6.14	7.04	9.45	11.34	15.59
LSD at 0.05 level		0.56	0.38	0.35	1.78	0.74	1.84

Data show that the interaction between treatments had significant effects on dry weight of branches, leaves and total dry weight / plant at 45 and 60 days after sowing in two seasons.

The interaction between sowing dates on March 1st and plant density at 20 plants/m^2 significantly increased dry weight of branches, leaves and total/ plant at 45 and 60 days after sowing in both seasons without significant differences between plant density at 20 and 28 plants/ m^2 for dry weight of branches at 60 days in both seasons and dry weight of leaves at 45 days in th1st season.

Yield and its components

Effect of sowing dates

The effect of sowing dates (February 1st, March 1st and April 1st) on 100 seeds weight , dry seed yield / plant, dry seed yield /m^2 and total dry seed weight /fed are shown in Table 9.

It is obvious from the data that sowing dates had significant effects on 100 seeds weight, seed yield/ plant and total seed weight /fed in both seasons.

The highest values of 100 seeds weight (36.45 and 34.62 g), seed yield/ plant (8.23 and 7.93 g) and total seed weight /fed. (1045.40 and 993.04 kg) were obtained with planting snap bean

Table (9): Effect of sowing dates on yield and its components of snap bean plants during2010 and 2011 seasons in new reclaimed sandy soil

Characters / Treatments	100 seed weight (g)	Seed yield (g/ plant)	Seed yield (kg/fed)
	2010 season		
February 1st	33.19	7.05	877.63
March 1st	36.45	8.23	1025.40
April 1st	18.29	4.37	543.33
LSD at 0.05 level	1.13	0.43	63.67
	2011 season		
February 1st	30.92	6.73	842.37
March 1st	34.62	7.93	993.04
April 1st	17.69	4.23	528.73
LSD at 0.05 level	1.23	0.45	72.51

on March 1st in the 1st and 2nd seasons, respectively, followed by planting on February 1st . While planting on April 1st recorded the lowest values in this respect.

The increases in total yield/fed. were about 16.83 , 17.88 % for planting on 1st March than planting on 1st Feb. and 88.72 , 87.81 than 1st April in the 1st season and 2nd seasons , respectively.

The increments in total yield during mid sowing date may be due to the suitable prevalent metrological factors specially temperature (Table 2) which affected positively and increased the vegetative growth phase of plant. Also, such suitable metrological factors increased the photosynthetic pigments concentration (Table 12) as well as macronutrients absorption (Table 18) and in turn increased total yield per fed. In contrite the late sowing date on 1st April , resulted in the reduction in all tested morphological characters that it may be due to the highest prevailing temperature during

the vegetative growth period which increased the use of assimilated materials in respiration and consequently reduced the anabolic rate of new plant parts and in turn reduced plant growth.

These results are in agreement with those reported by Mahmoud (2008) , Abd El-Latif *et al.* (2009) , Ewas (2010), Abou El-Yazied (2011) and Abdel-Hakim *et al.* (2012).

Effect of plant density

The effect of plant density (56, 40, 28 and 20 plants/m^2) on 100 seeds weight, seed yield/ plant, and total seed yield /fed. are shown in Table 10.

Obtained data show that plant density at 20 plants/m^2 significantly increased 100 seeds weight (33.74 and 31.53g) and seed yield/ plant (8.48 and 8.15g) without significant differences between 28 plants/ m^2 with respect to 100 seed weight in the 1st and 2nd seasons, respectively. On the other hand, yield of seeds per fed. (975.62 and 957.82 kg) significantly increased by planting at 56 plants/m^2 in the 1st and 2nd seasons, respectively. It seems that seed yield/ kg/ fed. would be depended upon the increase in number of plants/ unit area (fed.).

The increases in total yield/fed. were about 61.06 and 64.47% for plant density at 56 plants/m^2 than plant density at 20 plans/m^2 in the 1st season and 2nd seasons , respectively.

At low plant density, greater nutrients uptake and improved light environment and water at lower plant density, hence the competition was low which would increase branching, flowers and pods yield/ plant.

These results are in harmony with many investigators Arisha and Bardisi (1999) , Amer *et al.* (2001) , Pawar *et al.* (2007) , Mahmoud (2008) , Abd El-Latif *et al.* (2009) , Moniruzzaman *et al*. (2009) and Abbas (2011) .

Table (10): Effect of plant density on yield and its components of snap bean plants during 2010 and 2011 seasons in new reclaimed sandy soil

Characters / Treatments	100 seed weight (g)	Seed yield (g/ plant)	Seed yield (kg/fed)
	2010 season		
56 plants/m^2	24.91	4.22	975.62
40 plants/m^2	25.78	5.22	811.72
28 plants/m^2	32.81	8.27	868.75
20 plants/m^2	33.74	8.48	605.73
LSD at 0.05 level	1.01	0.17	29.71
	2011 season		
56 plants/m^2	23.32	4.14	957.88
40 plants/m^2	24.73	5.11	794.44
28 plants/m^2	31.40	7.78	817.48
20 plants/m^2	31.53	8.15	582.38
LSD at 0.05 level	1.06	0.35	62.39

In this regard, Kazemi *et al*.(2012) studied the effect of three plant densities (13, 16 and 22 plant/m^2) on snap been. They showed that plant density had significant effect on number of pods per plant, grain yield, biological yield and harvest index. The plant density of 13 plants per m^2 had

the highest number of pods per plant (42.1 pods), grain yield (2393 kg /ha), biological yield (5761 kg/ ha) and harvest index (41.6%).

Effect of the interaction between sowing dates and plant density

Data in Table 11 show the effect of the interaction between sowing dates and plant density on yield and its components, i.e., 100 seeds weight, seed yield/ plant, total seed weight /fed. in both seasons.

Planting of snap bean on 1st March at 20 or 28 plants /m^2 had significant effect on 100 seeds weight, seed yield/ plant and recorded the highest values in this respect. While the lowest values were obtained with the interaction between planting on 1st April and planting at 56 or 40 plants/ m^2 in both seasons.

As for total yield/fed., the highest values were recorded with the interaction between planting on 1st March and planting at 56 plants/ m^2 ,1249.53 kg/fed. and,1243.55 kg/ fed.) in the 1st and 2nd seasons, respectively. On the other hand, the lowest seed yield /fed. was obtained with the interaction between planting on 1st April and planting at 20 plants/ m^2 (409.70 kg/fed. and 401.74 kg/ fed.) in the 1st and 2nd seasons, respectively.

Table (11): Effect of the interaction between sowing dates and plant density on yield and its components of snap bean plants during 2010 and 2011 seasons in new reclaimed sandy soil

Sowing dates	Plant density	100 seed weight (g)	Seed yield (g/ plant)	Seed yield (kg/fed)
		2010 season		
February 1st	56 plants/m^2	28.22	4.60	1064.24
	40 plants/m^2	29.20	5.44	845.58
	28 plants/m^2	36.65	9.05	950.50
	20 plants/m^2	38.70	9.11	650.13
March 1st	56 plants/m^2	32.12	5.41	1249.53
	40 plants/m^2	32.36	6.36	988.34
	28 plants/m^2	40.62	10.54	1106.32
	20 plants/m^2	40.74	10.60	757.34
April 1st	56 plants/m^2	14.42	2.65	612.97
	40 plants/m^2	15.78	3.87	601.24
	28 plants/m^2	21.15	5.23	549.45
	20 plants/m^2	21.79	5.73	409.70
LSD at 0.05 level		1.78	0.32	51.46
		2011 season		
February 1st	56 plants/m^2	26.33	4.42	1021.02
	40 plants/m^2	27.56	5.43	844.86
	28 plants/m^2	34.87	8.48	890.75
	20 plants/m^2	34.93	8.58	612.85
March 1st	56 plants/m^2	29.86	5.38	1243.55
	40 plants/m^2	31.00	6.08	945.35
	28 plants/m^2	38.86	10.00	1050.70
	20 plants/m^2	38.76	10.20	732.56
April 1st	56 plants/m^2	13.76	2.63	609.07
	40 plants/m^2	15.65	3.81	593.11
	28 plants/m^2	20.47	4.86	511.00
	20 plants/m^2	20.91	5.62	401.74
LSD at 0.05 level		1.84	0.62	108.18

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تأثير مواعيد الزراعه والكثافه النباتيه علي النمو والمحصول الجاف في الفلصوليا 1 - نمو النبات والمحصول

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أجريت تجربتان حقليتان خلال الموسم الصيفى لعامى 2010،2011م فى مزرعة التجارب البحثية بمحطة بحوث البساتين بالقصاصين – الاسماعيلية – مصر ، لدراسة تأثير مواعيد الزراعة (1 فبراير – 1 مارس – 1 إبريل) والكثافة النباتية (56نبات/م^2 – 40نبات/م^2 – 28نبات/م^2 – 20نبات/م^2) على النمو الخضرى والمحصول ومكوناته لنباتات الفاصوليا صنف (نبراسكا) النامية تحت ظروف الأرض الرملية المستصلحه حديثاً. اشتملت التجربة على 12 معاملة عبارة عن التفاعل بين ثلاثة مواعيد للزراعة (1 فبراير ، 1 مارس ، 1 إبريل) مع أربع كثافات نباتية (56نبات/م^2 – 40نبات/م^2 – 28نبات/م^2 – 20نبات/م^2) وقد تم توزيع هذه المعاملات فى تصميم قطع منشقة مرة واحدة فى ثلاث مكررات، حيث تم توزيع مواعيد الزراعة فى القطع الرئيسية والكثافة النباتية فى القطع تحت الرئيسية .

أعطت معاملة الزراعة فى أول مارس أعلى القيم بالنسبة للوزن الجاف. وكذلك محصول البذور/ فدان بالنسبة لكلا موسمى الزراعة . أعطت الكثافة النباتية بمعدل 20نبات/م^2 زيادة معنوية للوزن الجاف للنبات بعد 45 و 60 يوم من الزراعة فى كلا الموسمين وكذلك وزن 100 بذرة والمحصول الكلى للفدان . بينما أعطت الكثافة النباتية بمعدل 56نبات/م^2 زيادة معنوية فى المحصول الكلى للفدان بالنسبة لكلا موسمى الزراعة .

معاملة التفاعل بين ميعاد الزراعة فى 1 مارس والكثافة النباتية بمعدل 20نبات/م^2 أعطت زيادة معنوية بالنسبة للوزن الجاف للنبات بعد 45 و 60 يوم من الزراعة . كما أعطت أعلى القيم لوزن 100 بذرة ومحصول البذور/نبات . وزاد المحصول الكلى للفدان بالتفاعل بين ميعاد الزراعة فى 1 مارس والكثافة النباتية بمعدل 55نبات/م^2 .