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GROWTH AND PRODUCTIVITY OF SOME NEW DRY BEAN GENOTYPES UNDER DIFFERENT PLANT DENSITY CONDITIONS

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ABSTRACT: A filed experiment was carried out at a private farm located at Qaha District, Qalubayia governorate, Egypt, during the two successive summer seasons of 2018 and 2019 to evaluate growth and productivity of seven new dry bean genotypes (DB-2-435, DB-5-485, DB-5-486, DB-5-487, DB-5-489, DB-7-4 and DB-7-31) in additional to three commercial cultivars (Giza 3, Giza 6 and Nebraska) under different plant densities, *i.e.*, 5 cm one row, 10 cm one row, 5 cm 2 rows and 10 cm 2 rows/ridge. These treatments were arranged in a split plot in a randomized complete block design with three replications. Plant densities were randomly distributed in the main plot and genotypes were randomly arranged in the sub plot. As average two seasons, sowing seeds of genotypes DB-5-485, DB-5-487, DB-5-489 at 10 cm on one side increased number of branches/plant, leaf area/plant, dry weight/plant and total chlorophyll in leaf tissues, followed by the interaction between sowing at 10 cm on one side and Nebraska cultivar regarding total chlorophyll in both seasons. In general, the interaction between sowing at 10 cm on one side and Nebraska cultivar or genotype DB-5-485 increased number of seeds/pod, yield/plant in both seasons. Respecting total yield, the interaction between sowing at 5 or 10 cm on two sides and Nebraska cultivar or the genotype DB-5-485 gave the highest values of total yield /fed., however, the interaction between sowing at 5 cm on one row and DB-5-486 genotype gave the lowest total yield/fed. (0.781 ton/fed.) as average of two seasons.

Key words: Density, genotypes, growth, dry weight, phaseolus vulgaris, yield.

INTRODUCTION

Dry bean (*Phaseolus vulgaris* L.) considered as one of the most important vegetable crops grown in Egypt for both local consumption and exportation. It plays an important role in human nutrition as a cheap source of protein, carbohydrates, vitamins and minerals. In Egypt, in 2019, the cultivation of dry bean plants was 67734 feddans which produced 132130 tons with an average of 1.949 tones/fed. (**FAO, 2020**).

Plant density considered as one of main factor affecting bean yield. The number of plants per unit area was controlled by variation in plant spacing between and within rows. There were significant differences between plant spacing, densities or plant populations regarding growth and yield of dry seeds bean (**Arisha and Bardisi, 1999; Ismail, 2004; Pawar *et al*., 2007; Abubaker, 2008; Abd El-Latif *et al*., 2009; Moniruzzaman *et al*., 2009; Kazemi *et al*., 2012; Khairy, 2013; El-Seifi *et al*., 2014; Elhag and Hussein, 2014; Tuarira and Moses, 2014; Abu Seif *et al*., 2016; Masa *et al*., 2017; Mostafa *et al*., 2019; Kouam and Zanfack, 2020**).

One of the main issues to be considered in plant breeding programs is the evaluation of changes in yield and quality of candidate or new

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cultivars under different environments. Genotype-environment (G × E) interaction has been important and challenging issue for plant breeders in developing improved varieties. Firstly, plant breeding programs mostly focused on developing high yielding cultivars. Then, stable and sustainable yields under various environmental conditions have consistently gained importance over only increased yield. The development of cultivars, which are adapted to a wide range of diversified environments, is the ultimate aim of plant breeders in a crop improvement program. The adaptability of a genotype is usually tested by the degree of its interactions with diverse environments. A variety is considered more adaptive or stable if it has a high mean of yield with low degree of fluctuation in yield ability for growing over different locations or seasons (**Eberhart and Russell, 1966**).

Some researchers showed differences between bean cultivars for growth and productivity **(Hamed, 2012; Mandour, 2014; Beshir *et al*., 2015; Yunsheng *et al.*, 2015; Hamaiel *et al.*, 2016; Marzouk *et al*., 2016; Masa *et al*., 2017; Shafeek *et al.*, 2017; Abdallah, 2018; Rahman *et al*., 2018; Saleh *et al*., 2018; Zaky *et al*., 2020**). They showed that there were significant differences between cultivars, genotypes regarding plant growth and productivity of seeds.

Therefore, this study aim to evaluate the performance of ten dry bean genotypes for growth and yield components under different plant densities.

MATERIALS AND METHODS

A filed experiment was carried out at a private farm located at Qaha District, Qalubayia Governorate, Egypt, during the two successive summer seasons of 2018 and 2019 to evaluate growth and productivity of seven new dry bean genotypes (DB-2-435, DB-5-485, DB-5-486, DB-5-487, DB-5-489, DB-7-4 and DB-7-31) in additional to three commercial cultivars (Giza 3, Giza 6 and Nebraska) under different plant densities, *i.e.*, 5 cm one row, 10 cm one row, 5 cm 2 rows and 10 cm 2 row. Seeds of new dry bean genotypes were developed in Hort. Res. Inst., Agric. Res. Center, Egypt (Hamed 2012).

Seeds were sown in four plant densities as following:

- 5 cm one row (seeds sowing at 5 cm among seeds and one row/ridge at one side)
- 10 cm one row (seeds sowing at 10 cm among seeds and one row/ridge at one sides).
- 5 cm two rows (seeds sowing at 5 cm among seeds and two rows/ridge at two sides).
- 10 cm two rows (seeds sowing at 10 cm among seeds and two rows/ridge at two sides).

These treatments were arranged in a split plot in a randomized complete block design with three replications. Plant densities were randomly distributed in the main plot and genotypes were randomly arranged in the sub plot. In both seasons, the area of experimental plot was 10.5 m^2. Each plot consisted of 3 ridges 5 m in length and 0.7 m in width. One row was used for the samples to measure vegetative growth and the other two rows were used for yield determination. In both seasons seeds were sown in the second week of March.

Dry bean seeds were inoculated at a rate of 1 kg/fed., before being sown with nitrobein biofertilizer. The adhesive agent used was 20 percent Arabic gum. Inoculated seeds were left for one hour in a shaded position before they were sown for air-drying.

All plots received equal amounts of nitrogen, phosphorus and potassium and 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 60 kg N, 100 kg P_2O_5 and 50 kg K_2O, respectively. On third of N, K and all P fertilizers were added at the time of soil preparation with 20 m^3/fed. FYM (farmyard manure). The rest two third of N and K were added at 25 and 45 days after sowing in both seasons. The other normal agricultural treatments for growing dry bean plants were practiced.

Data Recorded

Plant growth

Ten plants were randomly chosen from the central row of each plot at 45 days after sowing in the respective two seasons to estimate plant height (cm), number of branches/plant and leaf area (cm^2) using the disc method as described by **Derieux *et al.* (1973**). Different plant parts were oven dried at 70°C till constant weight, and total dry weight/plant were recorded.

Photosynthetic pigment

Total chlorophyll content measured by Minolta Chlorophyll Meter (SPDS) Model SPAD 501 according to **Mielke *et al.* (2010**).

Yield and its Components

For each experimental plot at harvest stage from each of the two rows, the following characters were recorded: the number of pods / plant, number of seeds/pod, yield/plant and total yield of seeds (ton/fed.).

Statistical Analysis

The analysis of variance (split plot design) for data of each of the two growing seasons were carried out according to **Snedecor and Cochran (1980**), The LSD test at the 5% level of probability was used in means comparison.

RESULTS AND DISCUSSION

Plant Growth and Total Chlorophyll

Effect of plant density

Data in Tables 1 and 2 show the effect of plant density on plant growth such as plant height, number of branches/plant, leaf area and dry weight/plant as well as total chlorophyll in leaves in 2018 and 2019 seasons. Sowing dry bean seeds at 5 cm on two sides recorded the tallest plants, whereas sowing at 10 cm on one side gave the highest values of number of branches/plant, leaf area/plant, dry weight/plant as well as the concentration of total chlorophyll in leaf tissues at 45 days after sowing in both seasons. On the other hand, the lowest values of dry weight/plant and total chlorophyll in leaf tissues were obtained with sowing seeds at 5 cm on two sides in both growing seasons.

The plants grown under wider spaces received more nutrients, light and moisture around each plant surrounding compared with plants in closer spaces which is probably the cause of better performance of total dry weight of individual dry bean in wider spaces. Wider spacing allows plants to grow better through enhancing the photosynthesis process that would favor net photosynthetic products, encourage plant growth, and consequently exhibit an increase in the dry weight of plant. Also low plant density increased number of branches/ plant (Table 1) which in turn increased dry matter of dry bean plants. Plants under wider spacing had strong vegetative growth (Table 1) with active photosynthetic apparatus, and consequently had high efficiency of building photosynthetic pigments.

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 dry 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.

These results are harmony with those reported with **Arisha and Bardisi (1999), Ismail (2004), Pawar *et al.* (2007), Abubaker (2008), Abd El-Latif *et al.* (2009) and Abu Seif *et al.* (2016).**

Effect of genotypes

Data in Tables 1 and 2 indicate that there were significant differences among dry bean genotypes in plant height, number of branches/ plant, leaf area, dry weight/plant and the concentrations of total chlorophyll in leaf tissues in both seasons. As for plant height, data show that, Nebraska cv. and DB-5-485 genotype in the 1st season and Giza 3 and DB-5-489 genotypes in the 2nd season gave the tallest plants, whereas genotype DB-2-435 gave the shortest plants in both seasons. Respecting the trait number of branches/plant, data in the same table show that, the genotypes DB-5-487 and DB-5-485 gave the heist values of number of branches/plant in the 1st season, meanwhile, Giza 3, Giza 6, cultivars, genotypes DB-5-485, DB-5-487 and DB-7-31 gave the highest number of branches/plant in the 2nd season. In general, DB-5-485 genotype recorded maximum leaf area, dry weight/plant and the concentrations of total chlorophyll in leaf tissues, followed by Nebraska regarding total chlorophyll in both seasons.

Table 1. Effect of plant density, genotypes and interaction between them on plant height and number of branches/plant of dry bean during 2018 and 2019 seasons

Characters	Plant height (cm)					Number of branches/ plant				
	5 cm		10 cm		Mean (A)	5 cm		10 cm		Mean (A)
Treatments	1 row	2rows	1 row	2rows		1 row	2rows	1 row	2rows	
					First season; 2018					
Nebraska	38.11	43.88	40.09	40.09	40.54	3.80	3.53	4.46	3.33	3.78
Giza 3	40.32	45.11	34.78	36.88	39.27	3.56	3.13	4.10	3.43	3.56
Giza 6	39.09	43.67	34.89	40.78	39.61	4.20	3.30	4.13	3.10	3.68
DB-5-486	34.53	41.21	35.55	36.65	36.99	3.66	3.20	3.76	3.66	3.57
DB-5-487	37.53	46.00	34.86	38.76	39.29	3.90	3.83	4.66	4.00	4.10
DB-5-489	39.32	43.75	36.22	40.32	39.90	4.00	3.33	4.10	3.86	3.82
DB-2-435	22.50	27.30	20.90	27.20	24.48	3.00	2.33	3.20	2.86	2.85
DB-5-485	38.54	46.00	34.76	45.44	41.19	4.43	3.46	4.66	4.56	4.28
DB-7-4	37.83	39.32	36.33	38.09	37.89	3.83	2.43	4.20	3.00	3.37
DB-7-31	35.55	38.33	33.22	36.22	35.83	3.66	3.06	4.53	3.43	3.67
Mean (B)	36.33	41.46	34.16	38.04		3.80	3.16	4.18	3.52	
L.S.D at 5 %	A =0.84		B =1.04		AxB =2.09	A =0.12		B =0.16		A x B =0.32
					Second season; 2019					
Nebraska	34.90	36.86	35.55	36.42	35.93	3.30	2.66	3.33	3.06	3.09
Giza 3	39.11	38.66	32.63	39.66	37.52	3.46	2.76	3.66	3.20	3.27
Giza 6	30.32	34.86	32.98	31.00	32.29	3.43	3.13	3.26	3.40	3.31
DB-5-486	31.12	39.77	29.22	39.12	34.81	3.00	2.56	3.00	2.90	2.87
DB-5-487	31.89	37.54	30.20	34.33	33.49	3.20	3.53	3.33	3.33	3.35
DB-5-489	38.31	39.56	35.98	35.99	37.46	2.86	2.56	3.00	2.96	2.85
DB-2-435	29.63	33.23	31.80	32.76	31.86	3.10	2.76	3.66	3.10	3.16
DB-5-485	34.43	38.22	35.21	33.33	35.30	3.20	2.90	3.20	3.56	3.22
DB-7-4	31.13	37.43	31.46	32.55	33.14	3.20	2.90	3.46	3.10	3.17
DB-7-31	34.45	36.78	33.65	34.67	34.89	3.43	3.20	3.10	3.33	3.27
Mean (B)	33.53	37.29	32.87	34.98		3.22	2.90	3.30	3.19	
L.S.D at 5 %	A =0.80		B =1.01		AxB =2.02	A =0.11		B =0.16		A x B =0.32

Table 2. Effect of plant density, genotypes and interaction between them on leaf area, dry weight/plant and total chlorophyll of dry bean during 2018 and 2019 seasons

Characters	Leaf area (cm^2)					Dry weight/plant (g)					Total chlorophyll (spead)				
	5 cm		10 cm		Mean (A)	5 cm		10 cm		Mean (A)	5 cm		10 cm		Mean (A)
Treatments	1 row	2rows	1 row	2rowss		1 row	2rows	1 row	2rowss		1 row	2rowss	1 row	2rows	
							First season; 2018								
Nebraska	128.36	103.26	144.26	135.90	127.95	14.23	9.80	14.93	10.26	12.31	46.66	38.76	53.26	48.86	46.89
Giza 3	116.63	93.40	146.16	119.96	119.04	12.66	11.96	15.23	12.36	13.05	42.40	43.43	51.70	44.80	45.58
Giza 6	120.76	116.36	148.53	145.83	132.87	15.86	10.06	15.90	10.00	12.96	43.60	33.60	46.93	44.13	42.07
DB-5-486	141.53	133.10	146.10	140.66	140.35	12.30	11.23	12.43	11.53	11.87	45.73	40.43	49.73	47.00	45.72
DB-5-487	143.73	129.40	159.53	130.56	140.81	13.53	10.36	13.93	11.43	12.31	35.26	32.63	39.70	39.70	36.82
DB-5-489	178.06	86.86	191.53	135.83	148.07	16.10	9.50	17.96	12.10	13.92	45.30	43.43	49.90	47.90	46.63
DB-2-435	134.33	127.53	140.16	133.76	133.95	13.43	11.40	15.53	13.33	13.42	42.66	30.30	47.46	46.66	41.77
DB-5-485	156.73	143.40	161.33	159.70	155.29	15.30	9.50	17.60	14.43	14.21	47.43	43.50	55.10	49.20	48.81
DB-7-4	114.10	100.40	139.76	113.16	116.86	14.83	8.86	16.10	9.63	12.36	40.76	38.00	46.50	45.20	42.62
DB-7-31	135.96	113.63	165.30	133.46	137.09	11.26	9.90	16.16	11.06	12.10	43.16	36.96	47.13	47.40	43.66
Mean (B)	137.02	114.73	154.27	134.88		13.95	10.26	15.58	11.61		43.30	38.10	48.74	46.09	
L.S.D at 5%	A =4.17		B =7.00		A x B =	A =0.16		B =0.40		AxB =0.80	A =0.65		B =1.28		AxB =2.60
							Second season; 2019								
Nebraska	180.60	172.60	193.50	165.76	178.12	14.63	9.13	16.76	11.23	12.94	47.36	49.60	52.06	51.83	50.21
Giza 3	153.73	134.46	173.66	143.96	151.45	13.06	6.93	12.93	11.63	11.14	37.90	31.60	49.40	48.40	41.83
Giza 6	160.06	154.00	176.00	170.70	165.19	9.46	8.66	11.50	8.40	9.51	42.86	42.50	51.03	48.23	46.16
DB-5-486	153.26	116.23	170.36	150.93	147.70	10.63	7.26	11.86	8.43	9.55	41.60	39.16	47.06	45.23	43.26
DB-5-487	191.70	134.13	168.76	174.53	167.28	10.23	9.46	10.53	9.36	9.90	36.90	43.60	48.26	45.90	43.67
DB-5-489	177.06	149.86	191.86	158.90	169.42	11.86	8.10	16.93	10.26	11.79	39.76	36.16	42.73	42.60	40.31
DB-2-435	143.70	137.63	147.16	133.40	140.47	9.80	5.53	10.90	7.60	8.46	44.13	39.66	47.60	45.23	44.16
DB-5-485	202.79	172.60	199.43	179.83	188.66	15.70	11.16	17.30	12.16	14.08	49.80	44.36	55.80	52.06	50.51
DB-7-4	144.36	110.56	159.90	121.96	134.20	10.40	7.40	12.00	8.13	9.48	41.56	39.80	43.96	42.76	42.02
DB-7-31	160.26	147.83	168.66	174.36	162.78	11.30	7.40	11.50	10.00	10.05	39.66	34.43	45.03	44.10	40.81
Mean (B)	166.75	142.99	174.93	157.43		11.71	8.10	13.22	9.72		42.15	40.09	48.29	46.63	
LSD at 5 %	A =3.13		B =6.06		A x B =	A =0.26		B =0.48		AxB=0.97	A =0.44		B =1.14		AxB=2.28

The differences among dry bean genotypes could be attributed to the genetic differences between cultivars. Differences among dry bean genotypes for plant growth and total chlorophyll were also observed by **Hamed (2012), Mandour (2014), Beshir *et al*. (2015), Yunsheng *et al.* (2015) and Hamaiel *et al.* (2016**).

Effect of the interaction

Data in Tables 1 and 2 show that sowing seeds of Giza 3 cv. and genotypes DB-5-485 and DB-5-487 at 5 cm on two sides in the 1st season and sowing seeds of Giza 3 cultivar and genotypes DB-5-485, DB-5-486, DB-5-487 and DB-5-489 in the 2nd season gave the tallest plants. In general, as average two seasons, sowing seeds of all genotypes at 5 cm on two sides gave the tallest plants, except genotypes DB-5-485, DB-7-4 and DB-7-31. As average two seasons, sowing seeds of DB-5-485, DB-5-487, DB-5-489 genotypes at 10 cm on one side increased number of branches/plant, leaf area/ plant, dry weight/plant and total chlorophyll in leaf tissues, followed by the interaction between sowing at 10 cm on one side and Nebraska cultivar regarding total chlorophyll in both seasons. The obtained results are in agreement with those reported by **Kouam and Zanfack (2020**).

Yield and its Components

Effect of plant density

It is evident from data presented in Tables 3 and 4 that number of pods/plant, number of seeds/pod, yield/plant and total yield/feddan significantly influenced by various plant density of dry bean in both seasons. Sowing seeds of dry bean genotypes at 10 cm on one side increased number of pods/plant, number of seeds/pod and yield/plant, whereas, sowing at 5 cm or 10 cm at two sides increased total yield/feddan in both seasons. While the lowest values of these traits were recorded with sowing seeds at 5 cm on two sides in both seasons except total yield of seeds trait which gave lowest yield with sowing at 10 cm on one side.

At wider spacing, greater nutrients uptake and improved light environment and water at lower plant population, hence the competition was low which would increase branching, flowers and yield/plant. Pods number and weight as the major yield parameters reflect the plant performance during previous growth stages, which depend mainly on the vigorous of vegetative growth and flowering status. The obtained results are in agreement with those reported by **Moniruzzaman *et al*. (2009), Kazemi *et al*. (2012), Khairy (2013), El-Seifi *et al*. (2014), Elhag and Hussein (2014), Tuarira and Moses (2014), Masa *et al.* (2017)** and **Mostafa *et al*. (2019).**

Effect of genotypes

It is obvious from data in Tables 3 and 4 that number of pods/plant, number of seeds/pod, yield/plant and total yield/feddan of dry bean plants significantly influenced by genotypes. In general, the genotype DB-5-485 and Nebraska cultivar significantly had the high number of pods/plant, number of seeds/pod, yield/plant and total yield/feddan in both seasons. While Giza 6 cultivar significantly gave the lowest yield and its components parameters in both seasons. These results are in accordance with those reported by **Marzouk *et al*. (2016), Masa *et al*. (2017), Shafeek *et al.* (2017), Abdallah (2018) Rahman *et al*. (2018) Saleh *et al*. (2018) and *Zaky et al.* (2020)**. They found that there were significant differences among genotypes for yield and its components of bean.

Effect of the interaction

It is evident from data presented in Tables 3 and 4 that, number of pods/plant, number of seeds/plant, yield/plant and total yield of seeds/ fed., of dry bean significantly influenced by the interaction between plant density and genotypes in both seasons.

The interaction between sowing at 10 cm on one side and DB-5-487 and DB-5-489 genotypes increased number of pods/plant. In general, the interaction between sowing at 10 cm on one side and Nebraska cultivar or genotype DB-5-485 increased number of seeds/pod and yield/plant in both seasons. respecting total yield, the interaction between sowing at 5 or 10 cm on two sides and Nebraska cultivar or the genotype DB-5-485 gave the highest values of total yield/fed., however, the interaction between sowing at 5 cm on one row and DB-5-486 genotype gave the lowest total yield/fed., (0.781 ton/fad.) as average of two seasons.

Obtained results are in harmony with those reported by **Yeasmin *et al*. (2016)** on mungbean plants.

Table 3. Effect of plant density, genotypes and interaction between them on No. pods/plant and No. seeds/pod of dry bean during 2018 and 2019 seasons

Characters / Treatments	No. pods/plant 5 cm 1 row	No. pods/plant 5 cm 2rows	No. pods/plant 10 cm 1 row	No. pods/plant 10 cm 2rows	No. pods/plant Mean (A)	No. seeds/pod 5 cm 1 row	No. seeds/pod 5 cm 2rows	No. seeds/pod 10 cm 1 row	No. seeds/pod 10 cm 2rows	No. seeds/pod Mean (A)
First season; 2018										
Nebraska	12.53	6.23	14.56	10.90	11.06	3.70	2.93	4.63	4.03	3.82
Giza 3	13.50	8.56	17.63	6.00	11.42	2.96	2.83	3.80	2.00	2.90
Giza 6	10.23	5.10	11.50	10.16	9.25	2.76	2.20	2.90	2.36	2.56
DB-5-486	11.10	6.33	15.56	7.13	10.03	3.63	2.83	3.70	2.80	3.24
DB-5-487	18.63	6.46	24.10	13.56	15.69	3.33	1.96	3.49	2.36	2.79
DB-5-489	22.53	6.80	23.23	10.86	15.86	4.43	3.86	4.00	3.63	3.98
DB-2-435	12.90	6.53	21.33	9.53	12.57	3.70	2.70	4.53	3.60	3.63
DB-5-485	13.23	10.33	20.43	14.00	14.50	4.40	3.43	4.60	4.10	4.13
DB-7-4	12.23	9.00	14.43	11.90	11.89	3.73	2.40	3.66	2.96	3.19
DB-7-31	12.00	8.56	19.23	11.90	12.92	3.80	2.80	3.96	2.83	3.35
Mean (B)	13.89	7.39	18.20	10.59		3.64	2.79	3.93	3.07	
LSD at 5%	A =1.09		B =1.14		AxB=2.28	A =0.10		B =0.17		AxB =0.34
Second season; 2019										
Nebraska	16.80	11.66	17.56	11.66	14.42	4.46	4.30	5.06	4.70	4.63
Giza 3	10.03	9.43	15.90	10.16	11.38	4.13	3.53	4.06	3.83	3.89
Giza 6	12.00	10.80	12.43	10.76	11.50	4.73	4.03	4.26	3.96	4.25
DB-5-486	11.56	5.43	11.23	9.73	9.49	4.40	3.73	4.46	4.70	4.32
DB-5-487	16.10	7.10	18.00	12.43	13.41	3.90	3.70	4.63	3.66	3.97
DB-5-489	20.43	13.66	21.86	16.43	18.10	4.53	4.53	4.70	4.46	4.56
DB-2-435	10.00	9.00	12.23	9.66	10.22	3.66	4.80	4.86	3.70	4.26
DB-5-485	16.70	12.46	12.43	14.53	14.03	4.96	3.60	5.26	4.83	4.66
DB-7-4	10.66	9.00	18.40	9.90	11.99	4.26	4.00	4.76	4.20	4.31
DB-7-31	13.23	9.10	18.86	11.10	13.07	4.30	3.60	4.50	4.06	4.12
Mean (B)	13.75	9.76	15.89	11.64		4.33	3.98	4.66	4.21	
LSD at 5%	A =0.93		B =1.18		AxB =2.37	A =0.15		B =0.17		AxB =0.34

Table 4. Effect of plant density, genotypes and interaction between them on yield/plant and total yield (ton/fed.) of dry bean during 2018 and 2019 seasons

Characters / Treatments	Yield/plant (g)					Total yield (ton/fed.)				
	5 cm		10 cm		Mean (A)	5 cm		10 cm		Mean (A)
	1 row	2rows	1 row	2rows		1 row	2rows	1 row	2rows	
					First season; 2018					
Nebraska	14.68	8.14	23.58	17.83	16.06	1.761	1.954	1.415	2.139	1.817
Giza 3	7.74	5.40	15.97	12.24	10.34	0.929	1.297	0.958	1.469	1.163
Giza 6	7.12	5.08	16.35	10.66	9.80	0.854	1.219	0.981	1.279	1.083
DB-5-486	6.78	5.33	18.72	12.93	10.94	0.814	1.280	1.123	1.551	1.192
DB-5-487	8.19	5.71	20.75	13.61	12.07	0.983	1.370	1.245	1.633	1.308
DB-5-489	12.56	7.35	22.98	15.23	14.53	1.507	1.765	1.379	1.827	1.620
DB-2-435	10.39	6.45	18.68	14.91	12.61	1.247	1.549	1.121	1.789	1.427
DB-5-485	15.76	9.24	24.73	19.23	17.24	1.891	2.218	1.484	2.307	1.975
DB-7-4	11.46	8.36	19.08	16.33	13.81	1.375	2.007	1.145	1.960	1.622
DB-7-31	8.97	7.54	19.12	13.95	12.40	1.076	1.809	1.147	1.674	1.427
Mean (B)	10.37	6.86	20.00	14.69		1.244	1.647	1.200	1.763	
LSD at 5 %	A =2.86		2.91		AxB =5.83	A =0.096		B =0.090		AxB =0.180
					Second season; 2019					
Nebraska	12.95	8.53	23.35	16.67	15.38	1.554	2.047	1.401	2.000	1.751
Giza 3	6.38	5.85	15.00	10.83	9.52	0.766	1.404	0.900	1.300	1.093
Giza 6	5.89	5.31	15.00	10.00	9.05	0.707	1.275	0.900	1.200	1.021
DB-5-486	7.18	5.50	18.33	11.67	10.67	0.862	1.319	1.100	1.400	1.170
DB-5-487	7.26	6.08	20.00	13.33	11.67	0.871	1.460	1.200	1.600	1.283
DB-5-489	11.94	8.33	21.67	18.39	15.08	1.433	2.000	1.300	2.207	1.735
DB-2-435	9.03	6.44	19.82	15.12	12.60	1.084	1.545	1.189	1.814	1.408
DB-5-485	14.78	8.94	25.42	17.16	16.58	1.773	2.145	1.525	2.059	1.876
DB-7-4	8.93	8.39	17.98	16.13	12.86	1.071	2.013	1.079	1.935	1.525
DB-7-31	10.93	7.45	18.53	13.60	12.63	1.311	1.787	1.112	1.632	1.461
Mean (B)	9.53	7.08	19.51	14.29		1.143	1.700	1.171	1.715	
LSD at 5%	A =1.38		B =1.20		AxB =2.43	A =0.084		B =0.107		A x B =.214

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نمو وإنتاجية بعض التراكيب الوراثية الجديده من الفاصوليا الجافة تحت ظروف كثافات نباتية مختلفة

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تم اجراء تجربه حقلية فى مزرعه خاصه بمركز قها محافظه القليوبيه بمصر خلال موسمين صيفيين متتالين لعامى 2018، 2019 وذلك لتقييم سبعة سلالات جديدة من الفاصوليا الجافة (DB-2-435 ، DB-5-485 ، DB-5-486 ، DB-5-487،DB-5-489، DB-7-4، DB-7-31) بالاضافة لثلاثة أصناف تجارية (Nebraska، Giza 6، Giza 3) تحت ظروف كثافات نباتية مختلفة (5 سم بين النباتات على جهة واحدة من الخط ، 10 سم بين النباتات على جهة واحدة من الخط، 5 سم بين النباتات على جانبى الخط ، 10 سم بين النباتات على جانبى الخط) ودراسة تلك المعاملات على النمو والمحصول وجودة البذور فى الفاصوليا الجافة. تم تصميم التجربة بنظام القطع المنشقة فى قطاعات كاملة العشوائية فى ثلاث مكررات. أوضحت النتائج أن زراعة الطرز الوراثية DB-5-485, DB-5-487, DB-5-489 على مسافه 10 سم من جهة واحدة من الخط أدت إلى زيادة معنوية في صفات عدد الأفرع/النبات والوزن الجاف للنبات والكلوروفيل الكلي في أنسجة الأوراق في كلا الموسمين. كما أكدت النتائج أن الطرازين الوراثيين DB-2-485 ، Nebraska أعطا أعلى قيم فى عدد البذور/القرن ، والمحصول/النبات عند زراعتهما على مسافة 10 سم من جهة واحدة من الخط. كما أوضحت النتائج أن زراعة الطرازين الوراثيين DB-2-485، Nebraska على مسافة 5 سم أو 10 سم على جانبى الخط أعطت أعلى محصول كلى/الفدان، فى حين أعطى الصنف DB-2-486 أقل محصول كلى/الفدان عند زراعته على مسافة 5 سم من جهة واحدة من الخط.

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