Effect of Some New Genotypes and Plant Population Per Hill on Yield and Storability of Broad Bean

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Abstract:

The present experiment was carried out in the Vegetable Research farm, Faculty of Agriculture, Assiut University, Assiut, during two seasons of 2011/2012 and 2012/2013 to estimate mainly the yield of six new broad bean genotypes (Roomy 3, Roomy 5, Roomy 12, Roomy 13, Roomy 80 and Roomy 101) grown under three planting population per hill (one, two and three seeds per hill). Roomy 5 genotype produced higher weights of green pods and green seeds per plant and supported the highest total fresh yield. High plant density (three seeds/ hill) gave the tallest plants and the highest total green yield. On the other hand, low planting density (one seed/ hill) increased the number of tillers per plant and decreased the total green yield per feddan. Results of storage experiment showed that differences in the weight loss percentage among all broad bean genotypes were observed at period of storage.

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Introduction:

Broad bean (*Vicia faba* L., major), large flat-seeded, is known, in Egypt, as "Fool Roomy ". Its green immature seeds (fool akhdar) are eaten as fresh and, also, cooked as a vegetable. No statistically information is available on the cultivated area or productivity of broad bean in Egypt. This may be attributed to:

a) the number of cultivated cultivars of broad bean is very limited, and characterized with very low yields, and b) the Egyptian growers usually harvest immature pods of medium-seeded (equine type) cultivars for green (fresh) market. Improving the production of broad bean in Egypt may be achieved by growing new high-yielding cultivars and improving the cultural practices (sowing date, plant density, irrigation, fertilization,....ect). The general breeding research program adopted by Department of Horticulture, Faculty of Agriculture, Assiut University, Assiut, produced many new and promising broad bean (major) genotypes. Previous studies on broad bean cultivars and lines were carried out by El-Murabaa *et al.*, (1987) ; Hanna (1995); Abdel-Gaid (1996); Salem (1996); Hassan (2006); Abdel-Rahman (2009) and Dahmardeh *et al.*, (2010). These authors reported considerable variations among broad bean cultivars and lines. The results obtained by El-Murabaa *et al.*, (1987) showed that large flat-seeded cultivars had larger green pods (longer and wider pods) but less pods and seeds per plant as well as lower fresh seed yield, compared to field cultivars (medium-seeded type). Dawwam and Abdel-Aal (1991) observed that faba bean cultivars differed significantly for all traits except branches/ plant. Equadols variety (large flat-seeded) was the best for yield, plant height, braches/ plant.

The yield and growth studies reported by Hassan (2006) revealed a wide range of variation among the used new breeding lines of broad bean. Results showed that the growers can use Roomy 5 and Roomy 13 to produce better total green pod yield. Earlier studies have shown that planting density is an important factor affecting yield of legumes. Moreover, yield and its components response to planting density of broad bean were discussed by several investigators: Badr *et al.*, (1974), Khalil *et al.*, (1993), Abdel-Aziz *et al.*, (1999), Hussein *et al.*, (1999), Mokhtar (2001), Turk andTawaha (2002), Kakiuchi and Kobata (2004), Dahmardeh *et al.* (2010) and Singh *et al.* (2013). These authors confirmed that an increase in plant density leads to a reduction in branching , pod number and number of seeds per plant. Badr *et al.* (1974) reported that higher planting density caused a decrease in number of branches and number of seeds per plant , while it increased plant height and seed yield of broad bean. Singh *et al.* (1992) concluded that increasing plant density of faba bean caused significant increase in seed yield and plant height but the number of pods and number of branches/ plant were decreased. Dahmardeh *et al.* (2010) concluded that selection of cultivars and plant density can improve the economic yield and directly influence the yield components. Pilbeamal *et al.* (1990) found that the faba bean yields generally increased as population density increased. Abdel Gaid (1996) concluded that increasing plant density increased length and width of green pods and plant height. Also, the maximum total fresh yield

was obtained when broad bean was planted on two ridges (high density).

The present investigation was done to study the two following points:

a) The effects of six new broad bean genotypes and plant population per hill on fresh yield and some other components.

b) Preliminary study on the storability of the test broad bean genotypes.

Materials and Methods:

The field experiment was carried out in a clay soil at the Experimental Farm, Faculty of Agriculture, Assiut University, Assiut, Egypt, during the two seasons of 2011/2012 and 2012/2013.

A- Field experiment

1- Six new broad bean genotypes namely, Roomy 3, Roomy 5, Roomy 12, Roomy 13, Roomy 80 and Roomy 101 were genetically produced in the general research program of Prof. Dr. E.A. Waly and Prof. Dr. S.A. Abdel-aal (Dept., of Hort., Assiut University) 2- Three planting population per hill, that is, one seed per hill (6.7 plant m2) two seeds per hill (13.4 plant m2) and three seeds per hill (20.1 plant m2).

The experiment was in a randomized complete block design in a split-plot arrangement with four replicates. Genotypes were distributed randomly in the main plots, while plant density in the sub plots. Each plot consisted of five rows, 2.5 meters long and 60 cm apart. The plot area was 7.5 sq. m. In the two seasons, sowing dates were on October 23 and 21, respectively.

Seeds were sown into every hill on one side of ridge at 25 cm apart between hills. The normal cultural practices of cultivation, irrigation, fertilization and pest control of broad bean were followed as recommended by Waly and Abdel-aal (1992). Immature (green) pods were manually picked on March 10 and 2 in the two growing seasons, respectively. At green harvest, five plants were randomly taken from each plot to record the data of the following characters:

1- Plant height, in cm.

2- Number of tillers per plant.

3- Number of green pods per plant.

4- Weight of green pods per plant, in gm.

5- Weight of green seeds per plant, in gm.

6- Total green pods yield was determined for each experimental plot and expressed as ton/fed.

The recorded data were subjected to the statistical analysis using normal F test.

The differences between means were compared using the L.S.D. test at 5% level of probability (Steel and Torrie, 1982).

B- Storage experiment

To determine the storability of the test new broad genotypes, samples of fleshy green harvested pods were sorted for uniform size and shape. These samples were stored at room temperature in the laboratory of vegetable crops. The storage period was 10 days. All samples were weighed every two days and percentages of loss weight were calculated.

Experimental Results:

A- Field experiment (Tables 1 and 2)

1- Plant height (cm)

The results indicated that plant height show significant differences between the test genotypes in both seasons. Roomy 12 was the longest, while Roomy 3 was the shortest. On other hand, changing the plant density had significant influences on plant height, which increased by decreasing plant population. The high-

est plants (152.5 and 139.6 cm in the two seasons, respectively) were obtained at planting three seeds per hill (20 plant/ m2) and the shortest plants (141.7 and 131.6 cm) were obtained in case of one seed/ hill (6.7 plants/ m2). No significant interaction was reached between broad bean genotype and plant density in the two seasons of study.

2- Number of tillers per plant

This character was influenced significantly by the two factors under study in the two seasons, except the effect of genotype in the second season. It is clear that number of tillers per plant ranged from 3.8 to 4.8 and 5.3 to 5.9 in the two seasons, respectively. Roomy 12 produced more tillers per plant compared to other genotypes, in first season only. While Roomy 101 gave the lowest values. Increasing density from planting one seed per hill up to three seeds / hill led to decrease the number of tillers/ plant (5.5 to 3.4 and 6.7 to 4.8 tiller in both seasons, respectively). Significant interaction was observed in first season only.

3- Number of green pods per plant

The results showed that this character was significantly affected by broad bean genotype, in both seasons. Of all tested genotypes, Roomy 101 ranked first (34.7 ad 31.4 pod/ plant) followed by Roomy 5. While, Roomy 12 produced the lowest

values (28.9 and 23.3 pod/ plant in both seasons, respectively). In both seasons, number of pods was significantly affected by plant density. The planting with one seed/ hill favored pod production, as compared to the other densities. The interaction of genotype and planting density was significant in second season only.

4- Weight of green pods per plant, gm

The significant differences were observed among the six broad bean genotypes with respect to weight of green pods per plant in both seasons. Roomy 5 had the highest pods weight per plant (443.5 and 348.5 gm in both seasons, respectively) compared to other genotypes. There was no significant interaction between the two factors under study.

5- Green seed weight per plant, gm

Broad bean genotypes differed significantly for this trait in both seasons and ranged from 124.8 to 166.9 and 67.1 to 174.8 gm. Roomy 5 outweighed all other genotypes under study followed by Roomy 3 and Roomy 80. While Roomy 13,

Roomy 12 and Roomy 101 gave the lowest weight of green seeds in the two seasons, respectively. The effect of plant density was significant in the first season only. Generally, planting one seed/ hill (6.7 plat/ m2) caused an increase in green seed weight, while planting three seeds/ hill (20 plant/ m2) produced the lowest values. There was significant effect for interaction on green seed weight in first season only.

6- Total green yield, Ton/fed.

The present results showed significant effect of genotype and plant density on total green (fresh) yield in both seasons. Yielding potential of the different broad bean genotypes revealed that Roomy 5 gave the highest (10.5 and 5.9 Ton/ fed.) fresh yield than the other tested genotypes, while Roomy 101 gave the lowest value (8.3 and 3.2 ton/ fed.). Total fresh yield was increased by increasing plant density from one seed/ hill (6.7 plat/ m2) up to three seeds/ hill (20 plat/ m2). It could be mentioned

that the increases were 3.6 and 2.3 tons/ fed. in both seasons, respectively. Interaction between genotype and plant density was significant in first season only.

B- Preliminary storage study

The data of storage experiment in the two seasons are presented in Table (3) and (4). Results obtained in this study showed variations between broad bean genotypes in the percentage of average loss weight at periods of storage. Weight loss percentage increased considerably and constantly throughout the storage period. In the first season, the average weight loss (after 10 days storage) ranged between 30.2 and 34.5 % (genotype Roomy 5 and genotype 101, respectively). In the second season, the range was between 42.8 and 47.1 % (genotype Roomy 3 and Roomy 101 respectively).

Table (1): The main effect of some broad bean genotypes and plant density on fresh yield and its components during 2011/ 2012.

Treatment	Plant height, cm	Number of tillers/ plant	Number of green pods/ plant	Weight of green pods/ plant, gm	Green seed weight/ plant, gm	Total green yield, ton / fed.
Genotypes						
Roomy 3	141.7	4.2	31.4	394.8	156.7	9.6
Roomy 5	154.1	4.7	32.8	443.5	166.9	10.5
Roomy 12	155.4	4.8	28.9	324.2	129.2	10.2
Roomy 13	149.1	3.9	29.4	360.9	143.6	9.2
Roomy 80	143.1	4.3	31.2	400.5	155.1	9.3
Roomy 101	144.2	3.8	34.7	320.8	124.8	8.3
L.S.D 0.05%	6.1	0.3	3.2	58.5	26.0	0.6
Plant density (pl./ m2)						
6.7	141.5	5.5	39.7	532.0	184.0	7.6
13.4	149.8	4.0	31.4	324.8	129.9	9.7
20.1	152.5	3.4	22.9	265.7	107.6	11.2
L.S.D 0.05%	4.5	0.2	3.3	58.5	18.4	0.5
L.S.D. 0.05 % for interaction	N.S.	0.4	N.S.	N.S.	15.3	0.3

Table (2): The main effect of some broad bean genotypes and plant density on fresh yield and its components during 2012/ 2013.

Treatment	Plant height, cm	Number of tillers/ plant	Number of green pods/ plant	Weight of green pods/ plant, gm	Green seed weigh/ plant, gm	Total green yield, ton / fed.
Genotypes						
Roomy 3	120.7	5.5	26.6	321.9	143.0	4.9
Roomy 5	140.3	5.9	29.7	348.5	174.8	5.9
Roomy 12	141.3	5.6	23.3	316.3	67.1	4.8
Roomy 13	139.0	5.3	26.8	339.3	104.9	4.3
Roomy 80	136.2	5.8	25.8	307.2	136.7	4.7
Roomy 101	138.8	5.3	31.4	344.6	121.4	3.2
L.S.D 0.05%	6.4	N.S	4.7	33.5	36.4	0.8
Plant density (pl./ m2)						
6.7	131.6	6.7	32.9	402.2	142.1	3.6
13.4	134.1	5.3	26.1	311.2	126.0	5.2
20.1	139.6	4.8	22.7	275.5	106.5	5.9
L.S.D 0.05%	4.8	0.6	3.4	25.8	N.S	1.1
L.S.D. 0.05 % for interaction	N.S.	N.S.	4.5	N.S.	N.S.	N.S.

Table (3): The percentage of loss weight in green pods of some new broad bean genotypes under storage in 2011/ 2012 season.

Genotypes	Storage period, day				
	2	4	6	8	10
Roomy 3	8.3	14.4	21.4	26.4	31.4
Roomy 5	7.5	13.6	19.8	23.0	30.2
Roomy 12	8.1	14.7	20.2	24.3	31.7
Roomy 13	7.9	16.6	20.3	25.3	31.6
Roomy 80	8.9	15.4	21.7	27.8	33.8
Roomy101	9.7	16.1	23.7	28.6	34.5

Table (4): The percentage of loss weight in green pods of some new broad bean genotypes under storage in 2012 / 2013 season.

Genotypes	Storage period, day				
	2	4	6	8	10
Roomy 3	13.5	22.1	26.1	34.5	42.8
Roomy 5	16.0	24.2	32.4	38.4	43.3
Roomy 12	14.6	22.4	31.2	38.4	45.2
Roomy 13	10.5	20.4	28.5	35.5	44.5
Roomy 80	9.4	19.2	23.9	34.1	46.1
Roomy101	13.8	23.6	32.4	37.0	47.1

Discussion:

Obtained results of the two seasons showed significant differences among the test broad bean genotypes for all measured traits, except number of tillers per plant in the second season. El-Murabaa *et al.*, (1987); Hanna, (1995); Salem, (1996); Turk and Tawaha, (2002); Hassan, (2006); Abdel-Rahman, (2009); Dahmardeh *et al.*, (2010) and Singh *et al.*, (2013) reported consid-

erable variation among faba and broad bean varieties and/ or genotypes in Egypt and other world. It is evident that Roomy 5 ranked second in respect of plant height and number of green pods per plant. On the other hand, it produced higher green seed weight per plant. Also, this genotype gave the highest total yield of green (fresh) pods.

Roomy 101 recorded lower total yield per feddan. Plant population per hill had significant effects on characters of broad bean genotypes under study, except green seed yield in second season. Increasing plant density from one seed/ hill (6.7 plant/ m2) up to three seeds/ hill (20.1 plant/ m2) led to increasing plant height and decreasing number of tillers per plant. Similar results were reported by Singh *et al.*, (2013) suggested that plant attains more height might be due to more who competition for resources especially sunlight. Dahmardeh *et al.* (2010) reported that increase in plant height could be

Justified on the bases of increase in the number of plants per unit area coupled with high plant-to-plant competition.

The lowest plant density (one seed/ hill) produced the maximum number and weight of green pods and green seed weight per plant, and vice versa. The decrease in these characters with increasing plant density (three seeds/ hill) could be attributed to the increased competition among plants for growth factors, which finally reduced the number of tillers per plant. These results coincide with the findings of Singh *et al.*, (1992). Increasing in total green yield (ton/ fed.) observed at three seeds/ hill (high plant population) is related to the increased number of plants per unit area and not to the increased production of pods per plant. These results are confirmed by several investigators Turk and Tawaha ,(2002) and Dahmardeh *et al.* (2010). With respect to storability of broad bean, Abou Aziz *et al.,* (1976) pointed out that faster in loss weight during storage at room temperature in broad bean is due to water losses.

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تأثير بعض التراكيب الوراثية الجديدة وعدد النباتات في الجورة علي محصول الفول الرومي

بتول أحمد راضى ، سيد عباس عبد العال ، نشأت محمود قنديل ، أيمن قطب متولى
قسم الخضر – كلية الزراعة – جامعة أسيوط – أسيوط – مصر

أجريت هذه الدراسة بمزرعة الخضر البحثية ومعامل قسم البساتين – كلية الزراعة – جامعة أسيوط – خلال موسمي ٢٠١١/٢٠١٢ ، ٢٠١٢/٢٠١٣ وذلك لدراسة تأثير التركيب الوراثي والكثافة النباتية علي محصول الفول الرومي وبالإضافة إلي ذلك أجريت دراسة مبدئية لتقييم القدرة التخزينية للتراكيب الوراثية الجديدة تحت ظروف حرارة الغرفة.

وقد اشتملت هذه الدراسة علي ستة تراكيب وراثية جديدة من الفول (رومي٣، رومي ٥، رومي ١٢، رومي ١٣، رومي ٨٠، رومي ١٠١) وثلاثة نظم من الكثافة النباتية (بذرة، بذرتين، ثلاثة بذور في الجورة) ومن الجدير بالذكر أن التراكيب الوراثية الجديدة قد تم استنباطها بواسطة أ.د/ عصمت عبد العظيم والي (رحمه الله) وأ.د/ سيد عباس عبد العال أستاذ الخضر بقسم البساتين ويمكن تلخيص نتائج هذه الدراسة في الآتي:

١- تميز التركيب الوراثي رومي ١٢ بطول نباتاته ولكنه كان اقل تفريعاً- بينما اتصف التركيب الوراثى رومي ٣ بقصر نباتاته وكثرة فروعه.

٢- أعطي التركيب الوراثى رومي ٥ اعلي إنتاجية لكل من عدد القرون الخضراء/ النبات، ووزن البذور الخضراء/ النبات، والمحصول الكلي من القرون الخضراء للفدان.

٣- اختلفت التراكيب الوراثية للفول الرومي فيما بينها من حيث الفقد في الوزن خلال فترات التخزين المختلفة.