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PATH ANALYSIS AS STATISTICAL MODEL FOR SCREENING NEW LINES OF SNAP BEAN (*Phaseolus vulgaris* L.)

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By
R.M.Galal, W.W.M.Shefei*and S. A. Farag*

*Vegetable Research Department, Horticulture Research Institute, and *The Central Laboratory for Design and Statistical Analysis Research, Agricultural Research Center, Giza, Egypt*

ABSTRACT

Four field experiments were conducted at Sids Horticulture Research Station, Beni-Sueif Governorate, Horticulture Research Institute, Agriculture Research Center, during fall 2011, summer 2012, fall 2012 and summer 2013 seasons on snap bean (*Phaseolus vulgaris* L.). Sixteen genotypes (ten new lines and six cultivars) were evaluated for their yield and growth characteristics. Plant height, the number of branches/plant, snap pod length , snap pod thickness, snap pod width, snap pod weight , the number of snap pods/plant, the number of dry seeds/pod, 100-dry seeds weight and early and total snap pods yield were studied. Also, the path analysis was studied. The results showed that Lines 20 and 24 produced the highest snap pod yield/feddan in the four seasons. Results of path analysis showed that early yield, pod weight, the number of pods per plant and the number of branches per plant were the most important contributing traits to the total yield. It is concluded that these results are important for designing selection criteria index in our snap bean breeding program.

***Key words**: path coefficient analysis, phaseolus vulgaris L., snap bean, yield, yield components.*

1. INTRODUCTION

Snap bean (*Phaseolus vulgaris* L.) is one of *Fabaceae* family. It is also known as common, snap, kidney, French or haricot beans **(**Singh 1999). It is one of the most important food crops in Egypt and consumed as a cooked vegetable either as dry seeds or green pods.

Many investigators reported that the vegetative growth and the total and exportable yield as well as pod quality of snap bean are greatly affected by the genotypes (Nassar 1986, El-Sayed 1990, 1996, Mohamed 1997, Dahiya *et al.* 2000, Mohamed 2004 and Araujo *et al.*2012).

El-Sayed (1990) found a significant difference in pod length, pod thickness, the number of seeds/pod and the the number of snap pods/plant among the different cultivars. Escribano *et al.* (1994) found that pod width differed significantly among genotypes. Singh *et al.* (1994) found that the number of snap pods/plant and pod weight were significantly affected by the tested cultivars. Zhiwei *et al.* (1995) found significant differences and variation among the cultivars for pod weight. El-Sayed (1996) found significant differences for plant height among different bean genotypes. Mohamed (1997) reported that the six evaluated snap bean cultivars exhibited similarity in the length of the main stem and found significant differences for the number of the developed primary branches, pod length, pod width and 100-seeds weight among the different cultivars. Dilana and Tema cultivars produced the greatest early and total yield. Dahiya *et al.* (2000) found significant differences for plant height and primary branches/plant among the different bean genotypes. Also, Mohamed (2004) found significant differences for plant height, the number of branches/plant, the the number of seeds/pod, 100-seeds weight and snap pods/plant among the different bean genotypes. Atilla (2007) found a significant difference in pod length, pod width, pod weight, the number of seeds/pod, 100-seeds weight, snap pods/plant, early and total yield among the different cultivars. Sofi *et al.* (2011) found that plant height, the number of seeds/pod, 100-seeds weight and the number of snap pods/plant were significantly different among the tested cultivars.

Yield is a complex dependent character and it is contributed by several component characters. Direct selection for seed yield is often not very effective and thus indirect selection for some of the associated component traits may be useful.

Path analysis, a method proposed by Wright (1921), permits the partitioning of the correlation coefficients into direct and indirect effects of various traits on variables whose estimates are obtained by multiple regression equations where the variables are previously standardized. Dewey and Lu (1959) described the advantage of path analysis. It permits the partitioning of the correlation coefficient into its components that measure the direct effect of a predictor variable upon it`s response variable. The second component is to measure the direct effects of a predictor variable on the response variable through other predictor variables. Path coefficient analysis is a statistical technique to evaluate the relation among traits.

In this study, the categorization of most effective traits on snap bean yield production was investigated. The path analysis can contribute knowledge on the changes caused by the environment in the inter-relationships between traits of importance in common bean breeding (Coimbra *et al*., 1998 and 1999, Kurek *et al*., 2001).

Gravois and Helmes (1992) reported that path analysis has been applied in crop breeding. Although correlation coefficients among traits are frequently present, they are not incorporated into a path analysis to investigate the relative direct and indirect influence of each trait on yield. According to Board *et al.* (1997), path coefficient is a standardized partial regression coefficient that has been used to organize and present the casual relationships between predictor and response variables through a path diagram that is based on experimental results. Ribeiro *et al.* (2003) reported that path analysis showed that the correlation between yield and its components was modified by the genotype by year interaction. Their results suggested that more years of evaluation are necessary to obtain more reliable and useful estimates. Mehra and Singh (2012) reported that the relative importance of the number of primary branches per plant and the number of pods per plant can not be ignored when selection is practiced for improving the pod yield in French bean. For effective selection, greater emphasis should be laid on the number of pods per plant, the number of pods per cluster and the number of primary branches per plant.

The first objective of this study was to evaluate ten new lines and six cultivars of snap bean for growth and green pod yield and its components under Middle Egypt growing conditions. Also, this study aimed to confirm the nature of inter-relationship as well as the direct and indirect effects of yield components in the sixteen evaluated genotypes.

2. MATERIALS AND METHODS

Four field experiments were conducted at Sids Horticulture Research Station, Beni-Sueif Governorate, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt.

Seeds of sixteen snap bean (*Phaseolus vulgaris* L.) genotypes (ten new lines and six commercial cultivars) were sown in the growing seasons of fall 2011(September 9th), summer 2012(March 1st), fall 2012 (September 10th) and summer 2013(March 5st). (Table 1). Cultivar names are Tema, Paulista, Xera, Bronco, Giza 3 and Baslem.

The lines were selected by Galal (2004) in his breeding program. Lines 18, 20, 24, 27, 38, 143, and Line 156 were produced by hybridization between Bronco x BARC-RR-3 genotypes, while, Line 5-2, Line 18-2, Line 41-2 were produced by hybridization between Aurora x Olathe. These lines and cultivars were produced in Sids Horticulture Research Station.

In each season, sixteen genotypes were arranged in a randomized complete block design (RCBD) with three replicates. Seeds of each genotype were planted in hills, 5 cm apart on rows 4 m in length and 60 cm in width. Each experimental unit consisted of six rows (three rows producd snap pods and three rows produced dry seed yield). The soil of the experiment was clay loam. Also, different agricutltural production practices *i.e*. irrigation, fertilization and pest management were applied as recomonded by Egyptian Ministry of Agriculture.

Table (1): Monthly means of day temperatures during the fall and summer seasons of 2011, 2012 and 2013 at Beni-Suief Governorate, Egypt.

Temperature °C				
	Fall season 2011		Fall season 2012	
Month	Maximum	Minimum	Maximum	Minimum
September	32.2	19.3	33.8	20.3
October	31.4	18.1	31.5	18.6
November	24.7	11.2	24.7	12.9
December	20.4	8.5	21.3	8.7
	Summer season2012		Summer season2013	
March	29.2	13.4	28.8	13.2
April	31.1	14.8	29.7	15.3
Mayo	35.6	20.5	35.0	21.2
June	37.5	23.8	37.4	24.9

Ten plants chosen at random from each plot after 60 days (beginning of pod formation) from planting were used for recording plant height and the number of branches/plant.

Twenty marketable pods were taken at random from each experimental plot to determine pod length, pod thickness, pod width (the width of pod was measured as the distance from side wall to side wall at the largest section of the pod), and pod weight.

Number of snap pods/plant was recorded on five plants labeled at random from each experimental plot, and their the number of snap pods was counted in each harvest, then the total the number was divided by five.

Thirty dry pods were taken at random from each plot to determine the number of dry seeds/pod and 100- dry seed weight.

Early snap pod yield, in each experimental plot was harvested twice both seasons and their early snap pod yield (Ton\feddan) was estimated.

Total snap pod yield, in each experimental plot was harvested five times at one week intervals in both seasons and their snap pod weight was used to estimate the total yield as (Ton\feddan).

2.1. Statistical analysis

The statistical analysis was conducted by using the computer program MSTAT-C. Means were compared using Duncan's multiple range test Duncan (1955).

Path analysis was made on the basis of phenotypic correlation coefficients taking the total snap pod yield as effect and the remaining estimated characters as cause. Direct and indirect effects of component characters on snap pods yield were examined using path coefficient analysis as outlined by Dewey and Lu (l959).

3. RESULTS AND DISCUSSION

3.1. Vegetative growth and yield components

3.1.1. Plant height

Data presented in Table (2) indicated that Line 18, 20, 38, 156 and Paulista genotypes gave tallest plants in the four seasons followed by Line 27 and Tema genotypes. These results are in agreement with those obtained by El-Sayed (1996), Dahiya *et al.* (2000), Mohamed (2004) and Sofi *et al.* (2011) who found significant differences for plant height among different bean genotypes.Whereas, Mohamed (1997) reported that the six evaluated snap bean cultivars exhibited similarity in length of the main stem. Also, Araujo *et al.* (2012) found no significant difference in plant height of the different cultivars under their experimental conditions.

3.1.2. The number of branches/plant

Data presented in Table (2) indicated that Tema, Bronco and Giza 3 genotypes gave high values for the number of branches/plant in the four seasons followed by Lines 18, 20, 24 and 27. Mohamed (1997) reported that the evaluated six genotypes, however, differed in the the number of

Table (2): Mean values of plant height,number of branches/plant,snap pod length and snap pod thickness of 16 bean genotypes evaluated in fall and summer seasons of 2011, 2012 and 2013.

Genotype	Plant height (cm)				Number of branches/plant			
	Fall 2011	Summer 2012	Fall 2012	Summer 2013	Fall 2011	Summer 2012	Fall 2012	Summer 2013
Line 18	44.7 a	42.9 a	42.6 ab	44.7 ab	3.2 bcd	3.8 a	3.3 abc	3.7 ab
Line 20	43.5 ab	42.2 ab	40.6 abc	41.8 abcd	3.2 abc	3.3 abcd	3.0 bc	3.1 def
Line 24	41.4 abcde	39.8 abcd	38.3 bcd	39.6 cde	3.5 ab	3.0 cde	3.4 ab	3.3 bcde
Line 27	42.9 ab	41.0 abcd	41.2 abc	40.4 cd	3.0 bcd	3.5 abc	3.3 abc	3.1 def
Line 38	41.8 abcd	41.0 abcd	40.3 abcd	41.4 abcd	3.4 abc	2.7 e	2.9 bc	2.7 f
Line 143	39.1 cde	38.7 abcd	38.7 bcd	40.6 cd	3.3 abc	3.0 cde	3.0 bc	3.1 def
Line 156	42.5 abc	41.6 abc	41.6 abc	43.6 abc	3.4 abc	3.7 ab	3.0 bc	3.0 ef
Line 5-2	40.8 bcde	38.0 bcd	43.3 a	41.8 abcd	3.0 bcd	3.2 abcde	3.0 bc	3.0 ef
Line 18-2	40.4 bcde	36.9 cd	41.8 abc	40.6 cd	2.6 d	2.7 e	2.7 c	3.0 ef
Line 41-2	38.1 e	39.0 abcd	37.7 cd	38.6 de	3.0 bcd	2.9 cde	3.0 bc	2.9 ef
Tema	40.35 bcde	41.5 abc	42.6 ab	44.8 a	3.8 a	3.8 a	3.9 a	3.5 abcd
Paulista	41.50 abcde	40.8 abcd	42.7 ab	42.6 abcd	3.2 bcd	3.1 bcde	3.8 a	3.3 bcde
Xera	38.90 cde	39.4 abcd	39.5 abcd	40.8 bcd	2.9 cd	2.7 de	2.8 c	3.2 cde
Bronco	38.23 de	38.7 abcd	39.5 abcd	40.0 cd	3.6 ab	3.5 abc	3.6 a	3.6 abc
Giza3	40.23 bcde	40.7 abcd	42.6 ab	40.5 cd	3.2 abc	3.5 abc	3.3 abc	3.8 a
Baslim	34.50 f	36.6 d	35.9 d	36.0 e	2.9 bcd	3.2 bcde	3.0 bc	3.0 ef
Genotype	**Snap pod length (cm)**				**Snap pod thickness (mm)**			
	Fall 2011	**Summer 2012**	**Fall 2012**	**Summer 2013**	**Fall 2011**	**Summer 2012**	**Fall 2012**	**Summer 2013**
Line 18	13.2 a	11.6 a	13.5 a	12.0 ab	7.1 bcde	6.6 ab	6.9 cd	6.7 cde
Line 20	13.1 a	11.6 a	13.0 a	11.8 abc	6.4 efg	6.7 ab	5.7 f	6.8 cde
Line 24	11.3 c	10.7 ab	11.8 c	10.8 cdef	6.8 def	6.8 ab	6.8 cde	7.0 cde
Line 27	12.0 b	9.6 abc	12.2 b	9.8 fg	7.2 bcd	7.2 ab	7.4 bc	7.0 cde
Line 38	12.4 b	9.9 abc	13.0 a	10.0 efg	7.8 b	7.7 ab	7.4 bc	7.7 bc
Line 143	13.2 a	10.5 ab	13.0 a	10.8 cdef	6.9 cdef	7.1 ab	7.0 bcd	7.2 cd
Line 156	12.5 b	10.2 ab	12.8 ab	10.3 defg	7.4 bcd	7.3 ab	6.8 cde	7.3 cd
Line 5-2	8.8 f	8.9 bc	9.2 f	8.8 hi	8.9 a	7.2 ab	8.8 a	9.3 a
Line 18-2	10.1 e	5.9 d	10.5 de	9.6 gh	8.8 a	8.8 a	8.9 a	8.6 ab
Line 41-2	10.4 de	7.7 cd	11.0 d	8.0 i	8.8 a	8.5 a	8.8 a	8.9 a
Tema	13.3 a	11.8 a	13.0 a	12.5 a	6.1 fg	6.0 b	6.3 def	6.3 de
Paulista	10.7 d	11.0 ab	11.0 cd	11.8 abc	6.1 fg	6.1 b	6.0 ef	6.0 e
Xera	10.4 de	10.9 ab	11.2 c	11.0 cde	5.7 g	5.9 b	5.9 f	5.9 e
Bronco	10.2 de	10.9 ab	10.5 de	11.0 cde	7.2 bcd	7.2 ab	7.8 b	6.7 cde
Giza3	12.2 b	11.2 ab	10.5 de	11.1 bcd	6.9 cdef	6.8 ab	7.0 bcd	6.7 cde
Baslim	10.5 de	10.6 ab	10.8 de	10.8 cdef	7.7 bc	7.2 ab	7.0 bcd	6.9 cde

Means followed by the same letters within each column do not differ significantly according to Duncan's Multiple Range test at the 5% level.

the developed primary branches. The cv. Giza 3 distinctively had the least the number of primary branches (4.1) while, cv. Bronco had (4.6) and cv. Tema had (4.9) branches/plant. Dahiya *et al.* (2000) found significant differences for primary branches/plant. In snap bean, Mohamed (2004) found that the number of branches/plant was significantly different among the ten genotypes.

3.1.3. Snap pod length

Data presented in Table (2) indicated that Lines 18, 20 and Tema genotypes produced the tallest pods in the four seasons followed by Line 143. El-Sayed (1990), Mohamed (1997), Atilla (2007) and Araujo *et al.* (2012) found a significant difference in pod length among the different cultivars.

3.1.4. Snap pod thickness

Data presented in Table 2 indicated that Line 20, Paulista, Tema and Xera genotypes produced the thinnest pods in the four seasons followed by Lines 18, 24 and Line 27. El-Sayed (1990) and Mohamed (1997) found significant differences in pod thickness due to cultivar differences.

3.1.5. Snap pod width

Data presented in Table (3) indicated that Lines 27, 5-2, and Line 18-2 produced the widthest pods in the four seasons followed by Baslim genotypes. Escribano *et al.* (1994) and Atilla (2007) found that pod width differed significantly among genotypes.

3.1.6. Snap pod weight

Data presented in Table (3) indicated that Line 20 and Line 24 produced the highest weight of pods in the four seasons. Singh *et al*. (1994), Zhiwei *et al*. (1995), Atilla (2007) and Araujo *et al.* (2012) found significant differences and variation among the cultivars for pod weight.

3.1.7. The number of dry seeds/pod

Data presented in Table (3) indicated that Lines 20, 143, 24, 27, 18-2 and Line 5-2 produced the highest number of seeds/pod in the four seasons followed by Lines 18, 38, and Line 18-2, Tema, Paulista, Bronco, Xera and Giza 3 genotypes**.** El-Sayed (1990), Mohamed (2004), Atilla (2007), Sofi *et al.* (2011) and Araujo *et al.* (2012) found that the the number of seeds/pod was significantly different among the tested cultivars.

3.1.8. 100- dry seed weight

Data presented in Table (3) indicated that Giza 3 cv. produced the highest 100- dry seed weight in the four seasons followed by Bronco, Tema, Lines 27, 38 and Line 156. On the other side, Lines 18, 20, 18-2, and Line 18-2, Paulista, Xera and Balsim genotypes produced the lightest 100- dry seeds weight in all seasons. Mohamed (1997), Mohamed (2004), Atilla (2007) and Sofi *et al.* (2011) found that 100-seed weight differed significantly among the studied genotypes. Whereas, Araujo *et al.* (2012) found that the 100-seed weight was significantly affected by the tested cultivars.

3.1.9. Number of snap pods/plant

Data presented in Table (4) indicated that Line 20 produced the highest the number of snap pods/plant in the four seasons followed by Line 24, Tema and Paulista genotypes. . El-Sayed (1990), Singh *et al*. (1994), Mohamed (2004), Atilla (2007), Sofi *et al.* (2011) and Araujo *et al.* (2012) found that the the number of snap pods/plant was significantly affected by the tested cultivars.

3.1.10. Early snap pod yield

Data presented in Table (4) for early yield indicated that Line 20 produced the highest value for all seasons followed by Line 24, Tema and Paulista genotypes.

3.1.11. Total snap pod yield

Data presented in Table (5) for this character indicated that Line 20 and Line 24 produced the highest yield/feddan in the four seasons followed by Paulista and Tema genotypes. Mohamed (1997) found that Dilana and Tema cultivars produced the greatest early and total yield. Atilla (2007) and Araujo *et al.* (2012) found that the early and total yield were significantly affected by the tested cultivars.

Accordingly, from the foregoing results, it could be concluded that Line 20 and Line 24 gave the highest values in the fall and summer seasons for both early and total snap yield per feddan.

3.2. Direct and indirect effects of component characters on snap pod yield

Path coefficient analysis of the results of the first season between all possible combinations was estimated (Table 6).The analysis appeared to provide a clue to the contribution of various components of the yield to over all pod yields in the genotypes under study.

In the present investigation, the resultant variable was pod yield while the remaining

Table (3): Mean values of snap pod width,snap pod weight, number of dry seeds/pod and 100- dry seeds weight of 16 bean genotypes evaluated in fall and summer seasons of 2011, 2012 and 2013.

Genotype	Snap pod width (mm)				Snap pod weight (g)			
	Fall 2011	Summer 2012	Fall 2012	Summer 2013	Fall 2011	Summer 2012	Fall 2012	Summer 2013
Line 18	5.2 abcd	5.0 abc	5.3 abcd	5.2 ab	3.5 bc	3.4 bcd	3.3 bcdef	3.6 b
Line 20	5.0 abcd	4.8 bc	5.1 bcd	5.0 abc	4.3 a	4.6 a	4.6 a	4.5 a
Line 24	4.9abcde	4.9 abc	5.0 cde	5.2 ab	4.7 a	4.8 a	4.5 a	4.7 a
Line 27	4.4 cde	4.2 de	4.5 efg	4.2 de	3.1 bcd	3.3 bcde	3.1 def	3.0 ef
Line 38	5.6 ab	5.3 ab	5.7 ab	5.5 a	3.5 b	3.7 bc	3.6 bcd	3.4 bcde
Line 143	5.5 abc	5.5 a	5.6 abc	5.5 a	3.4 bc	3.7 b	3.7 bc	3.5 bcd
Line 156	5.3 abcd	5.2 ab	5.2 bcd	5.4 ab	3.5 bc	3.1 cdef	3.2 bcdef	3.1 cdef
Line 5-2	4.0 e	3.8 e	4.0 g	4.0 de	3.2 bc	3.7 bc	3.3 bcde	3.4 bcde
Line 18-2	4.0 e	4.0 de	4.4 fg	3.8 e	2.2 e	2.7 ef	2.9 ef	2.4 g
Line 41-2	4.7 bcde	4.5 cd	4.8 def	4.8 bc	3.1 bcd	2.9 def	2.9 ef	3.1 def
Tema	5.2 abcd	5.0 abc	5.0 cde	5.2 ab	3.4 b	3.8 b	3.7 b	3.5 bc
Paulista	5.3 abcd	5.1 abc	5.2 bcd	5.2 ab	3.0 bcd	3.3 bcdef	3.2 bcdef	3.0 def
Xera	5.1 abcd	5.0 abc	5.0 cde	5.0 abc	2.9 cd	2.7 f	2.7 f	2.8 fg
Bronco	5.5 ab	4.8 bc	5.6 abc	5.4 ab	3.4 bc	3.3 bcde	3.1 cdef	3.1 def
Giza3	5.9 a	5.5 a	5.8 a	5.3 ab	3.3 bc	3.3 bcde	3.5 bcde	3.3 bcdef
Baslim	4.3 de	4.2 de	4.2 g	4.5 cd	2.6 de	2.7 ef	2.7 f	3.1 def

Genotype	Number of dry seeds/ pod				100- dry seeds weight (g)			
	Fall 2011	Summer 2012	Fall 2012	Summer 2013	Fall 2011	Summer 2012	Fall 2012	Summer 2013
Line 18	6.0 abc	5.9 ab	5.8 ab	5.3 bcd	18.4 efg	17.9 f	17.2 fg	17.2 gh
Line 20	6.4 a	6.1 a	6.5 a	6.0 a	18.3 efg	19.7 cdef	19.5 cdef	17.7 g
Line 24	6.3 ab	5.3 ab	5.8 ab	5.4 abcd	20.7 de	22.0 c	18.3 ef	20.2 ef
Line 27	5.9 abc	5.3 ab	5.7 ab	5.6 abcd	24.7 b	25.5 b	25.0 ab	24.5 c
Line 38	5.7 bcd	5.9 ab	5.8 ab	5.5 abcd	24.4 bc	24.5 b	23.6 abc	23.5 cd
Line 143	6.5 a	5.9 a	6.1 a	6.0 a	22.1 cd	20.9 cde	22.1 bcde	20.3 ef
Line 156	5.2 de	5.3 ab	5.1 ab	5.0 d	24.5 bc	21.6 cd	23.0 abcd	21.9 de
Line 5-2	6.3 ab	5.6 ab	6.1 a	5.6 abcd	18.5 ef	18.9 ef	19.9 cdef	18.3 fg
Line 18-2	6.1 abc	5.5 ab	6.0 ab	5.3 bcd	17.6 fg	17.4 fgh	16.1 fg	17.2 gh
Line 41-2	6.5 a	5.9 a	6.3 a	5.7 abc	17.3 fg	14.9 h	16.7 fg	15.4 h
Tema	5.5 cde	5.4 ab	5.8 ab	5.4 abcd	26.2 b	25.6 b	26.5 a	27.1 b
Paulista	5.6 bcde	5.4 ab	5.4 ab	5.4 abcd	18.2 efg	19.3 def	18.2 ef	17.5 gh
Xera	6.2 ab	5.9 ab	4.2 b	5.8 ab	18.5 efg	17.8 fg	19.2 def	16.9 gh
Bronco	5.4 cde	5.6 ab	5.7 ab	5.4 abcd	25.5 b	25.6 b	27.0 a	27.1 b
Giza3	5.9 abcd	5.3 ab	5.8 ab	5.3 bcd	28.8 a	28.0 a	26.7 a	30.1 a
Baslim	5.0 e	5.05 b	5.1 ab	5.1 cd	15.9 g	15.3 gh	13.3 g	16.6 gh

Means followed by the same letters within each column do not differ significantly according to Duncan's Multiple Range test at the 5% level.

Table (4): Mean values of the number of snap pods/plant and early snap podsyield of 16 bean genotypes evaluated in the fall and summer seasons of 2011, 2012 and 2013.

Genotype	Number of snap pods/plant				Early snap pods yield (Ton/feddan)			
	Fall 2011	Summer 2012	Fall 2012	Summer 2013	Fall 2011	Summer 2012	Fall 2012	Summer 2013
Line 18	41.3 cde	41.7 bcd	42.5 bc	40.8 cd	1.77 cd	1.97 cde	1.90 de	2.07 c
Line 20	49.6 ab	49.4 a	51.1 a	52.9 a	2.95 a	3.33 a	3.25 a	3.12 a
Line 24	50.3 a	50.1 a	49.3 a	48.3 b	2.85 a	3.03 ab	2.88 bc	2.78 b
Line 27	44.2 bcd	45.8 ab	42.4 bc	41.7 c	2.08 bc	1.85 de	1.92 de	1.85 cd
Line 38	40.4 cde	39.5 cde	39.4 cd	37.8 cdef	1.52 de	1.73 e	1.63 e	1.62 d
Line 143	40.2 cde	35.2 f	39.3 cd	35.5 ef	1.33 efg	1.20 f	1.17 f	1.15 e
Line 156	34.2 f	38.4 def	37.6 cd	35.9 ef	2.03 bc	2.13 cde	1.93 de	2.00 c
Line 5-2	38.1 ef	41.3 bcd	36.2 cd	37.6 cdef	1.03 g	1.23 f	1.03 f	1.00 e
Line 18-2	38.6 def	36.2 ef	34.7 d	34.7 f	1.07 fg	1.20 f	1.00 f	1.03 e
Line 41-2	40.3 cde	39.4 cdef	38.9 cd	39.8 cde	1.83 c	1.82 e	1.63 e	1.77 cd
Tema	48.6 ab	47.8 a	49.7 a	48.4 b	2.65 a	2.92 b	2.98 ab	2.70 b
Paulista	45.2 abc	43.4 bc	48.4 a	45.9 b	2.87 a	2.73 b	2.57 c	2.68 b
Xera	40.5 cde	41.3 bcd	38.7 cd	39.2 cde	1.82 cd	1.98 cde	1.95 de	1.90 cd
Bronco	41.9 cde	40.6 cde	39.6 cd	41.1 c	1.97 bc	2.23 cd	2.18 d	2.07 c
Giza3	44.9 abc	43.2 bc	47.0 ab	46.2 b	2.20 b	2.27 c	1.95 de	1.93 c
Baslim	37.2 ef	37.8 def	37.9 cd	36.7 def	1.35 ef	1.30 f	1.13 f	1.07 e

Means followed by the same letters within each column do not differ significantly according to Duncan's Multiple Range test at the 5% level.

Table (5): Mean values of the total snap pod yield of 16 bean genotypes evaluated in the fall and summer seasons of 2011, 2012 and 2013.

Genotype	Total snap pods yield (Ton/feddan)			
	Fall 2011	Summer 2012	Fall 2012	Summer 2013
Line 18	5.50 b	5.23 bc	5.23 bcd	5.03 bc
Line 20	6.37 a	6.46 a	6.20 a	6.43 a
Line 24	6.23 a	6.08 a	6.17 a	6.07 a
Line 27	5.00 c	5.02 bc	4.67 defg	4.67 bcde
Line 38	4.63 def	4.90 bcd	4.60 efg	4.32 defg
Line 143	4.50 efg	4.03 e	4.42 fgh	4.10 efgh
Line 156	4.85 cde	4.87 bcd	5.28 b	5.10 b
Line 5-2	4.17 gh	3.98 e	4.10 gh	3.75 gh
Line 18-2	4.07 h	4.07 e	4.10 gh	3.97 fg
Line 41-2	4.42 fgh	4.40 de	4.30 fgh	4.13 efgh
Tema	5.47 b	5.37 b	5.27 bc	4.90 bcd
Paulista	5.25 bc	5.40 b	5.17 bcde	5.13 b
Xera	4.83 cdef	4.78 cd	4.65 efg	4.43 cdef
Bronco	4.77 def	5.10 bc	5.00 bcde	4.93 bcd
Giza3	5.00 cd	4.70 cd	4.70 cdef	4.45 cdef
Baslim	4.18 gh	4.33 de	4.00 h	3.53 h

Means followed by the same letters within each column do not differ significantly according to Duncan's Multiple Range test at the 5% level.

Table (6): Path coefficients (direct and joint effects) of snap pod yield and its related traits in bean for fall season 2011.

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	r_{xy}
Plant height X1	0.1911	-0.0052	0.0350	-0.0001	0.0274	0.0041	0.0676	0.0617	-0.0297	0.0591	0.411
Number of branches/plant X2	-0.0052	0.1929	0.0287	-0.0025	0.0657	-0.0123	0.0969	0.0778	-0.0968	0.0717	0.417
Pod length X3	0.0780	0.0646	0.0858	-0.0021	0.1010	0.0011	0.0953	0.0872	-0.0824	0.0715	0.500
Pod width X4	0.0040	0.0939	0.0353	-0.0052	0.0830	-0.0023	0.0532	0.0345	-0.0884	0.0579	0.266
Pod thickness X5	-0.0227	-0.0550	-0.0376	0.0019	-0.2306	0.0007	-0.0746	-0.1253	0.0439	-0.1176	-0.617
Number of seeds/pod X6	0.0172	-0.0521	0.0021	0.0003	-0.0035	0.0457	0.0497	0.0636	0.0577	-0.0067	0.174
Pod weight X7	0.0556	0.0804	0.0352	-0.0012	0.0740	0.0098	0.2324	0.1317	-0.0379	0.1059	0.686
Number of pods/plant X8	0.0424	0.0540	0.0269	-0.0006	0.1040	0.0105	0.1102	0.2779	-0.0343	0.1331	0.724
100- seeds weight X9	0.0285	0.0935	0.0354	-0.0023	0.0507	-0.0132	0.0442	0.0478	-0.1995	0.0379	0.123
Early yield X10	0.0590	0.0723	0.0321	-0.0016	0.1418	-0.0016	0.1288	0.1934	-0.0395	0.1912	0.776

characters represented the casual variables. The matrixes of direct and joint effects for the ten yield-related traits on pod yield are shown in Table (6). The direct contribution of the number of pods per plant was the highest value (p=0.2779) followed by pod weight, the number of branches per plant, early yield, plant height, pod length and the number of seeds per pod, whereas pod thickness had a maximum negative direct effect on pod yield (p=-0.2306) followed by 100-seed weight and pod width. From the results of this season, it could be concluded that the number of pods/plant, pod weight, pod thickness, 100-seed weight, the number of branches/plant, early yield and plant height were the most important contributing characters towards pod yield of bean. The number of branches/plant is considered an important trait to the pod yield followed by pod thickness, pod weight, plant height, the number of pods /plant and pod length. Their indirect effects contributed 13.50, 12.92, 9.91, 8.57, 7.20 and 5.85 % (Table 7). From the previous results of path analysis of the first season, it could be concluded that the number of branches/plant, plant height, the number of pods/plant and pod weight were the most important contributing characters to the total variability of the tested beans.

The early yield recorded the highest value in the second season for its direct contribution (p=0.6376) followed by the number of pods per plant, the number of seeds per pod and pod length. On the other hand, the direct effects of 100-seed weight, pod thickness, pod weight and plant height were positive and of secondary importance recording (p=0.0191), (p=0.0844), (p=0.0731) and (p=0.0654), respectively. Whereas, pod width and the number of branches/plant were negative and had insignificant effects (Table 8). Early yield recorded the highly relative important direct effect 27.946% followed by the number of pods/plant, the number of seeds per pod, pod width and pod length. Results showed clearly that the relative important indirect effect of the number of pods/plant 13.11% and pod length 12.02% were the important traits causing variation followed by pod width, pod weight, plant height, pod thickness and the number of branches/plant (Table 9).

Table (7): Direct and indirect effects of yield components and their relative importance in snap pod yield of bean for fall season 2011.

Characters	Direct effect X_i			Indirect effect X_i / X's			Total effect		
	Effects	CD*	RI %	Effects	CD*	RI %	Effects	CD*	RI %
Plant height X1	0.1911	0.0365	2.8247	0.2199	0.0840	8.5741	0.4110	0.1206	11.3988
Number of ranches/plant X2	0.1929	0.0372	2.8781	0.2293	0.0884	13.5048	0.4222	0.1256	16.3829
Pod length X3	0.0858	0.0074	0.5691	0.2717	0.0466	5.8486	0.3574	0.0540	6.4177
Pod width X4	-0.0052	0.0000	0.0021	0.1380	-0.0014	0.2563	0.1328	-0.0014	0.2584
Pod thickness X5	-0.2306	0.0532	4.1155	-0.2730	0.1259	12.9223	-0.5036	0.1791	17.0378
Number of seeds/pod X6	0.0457	0.0021	0.1615	0.1643	0.0150	1.2564	0.2100	0.0171	1.4179
Pod weight X7	0.2324	0.0540	4.1800	0.1997	0.0929	9.9101	0.4322	0.1469	14.0901
Number of pods/plant X8	0.2779	0.0772	5.9727	0.0988	0.0549	7.1969	0.3766	0.1321	13.1696
100- seeds weight X9	-0.1995	0.0398	3.0789	0.0379	-0.0151	1.1687	-0.1616	0.0247	4.2476
Early yield X10	0.1912	0.0366	2.8288	0.0000	0.0000	0.0000	0.1912	0.0366	2.8288
Total D+I							1.8682	0.8353	87.2496
Residual								0.1647	12.7504
Total							1.8682	1.000	100.000

CD* = Coefficient of determination. RI % = Relative efficiency.

Table (8): Path coefficients (direct and joint effects) of snap pod yield and its related traits in bean for summer season 2012.

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	rxy
Plant height X1	0.0654	-0.0082	0.0406	-0.0613	-0.0271	0.0131	0.0264	0.0445	0.0041	0.2474	0.3450
Number of branches/plant X2	0.0163	-0.0329	0.0460	-0.0271	-0.0175	-0.0312	0.0018	0.0664	0.0059	0.2264	0.2540
Pod length X3	0.0172	-0.0098	0.1545	-0.0801	-0.0421	-0.0432	0.0195	0.0708	0.0061	0.3041	0.3970
Pod width X4	0.0253	-0.0056	0.0782	-0.1583	-0.0226	0.0060	0.0123	0.0080	0.0070	0.2327	0.1830
Pod thickness X5	-0.0210	0.0068	-0.0771	0.0424	0.0844	0.0532	-0.0092	-0.0517	-0.0019	-0.2270	-0.2010
Number of seeds/pod X6	0.0047	0.0057	-0.0368	-0.0052	0.0247	0.1816	0.0085	0.0010	-0.0027	-0.0185	0.1630
Pod weight X7	0.0237	-0.0008	0.0413	-0.0268	-0.0106	0.0212	0.0731	0.1097	0.0057	0.3316	0.5680
Number of pods/plant X8	0.0146	-0.0110	0.0549	-0.0063	-0.0219	0.0009	0.0402	0.1994	0.0063	0.4718	0.7490
100- seeds weight X9	0.0142	-0.0102	0.0493	-0.0584	-0.0084	-0.0260	0.0218	0.0664	0.0191	0.1843	0.2520
Early yield X10	0.0254	-0.0117	0.0737	-0.0578	-0.0300	-0.0053	0.0380	0.1476	0.0055	0.6376	0.8230

Table (9): Direct and indirect effects of yield components and their relative importance in snap pod yield of bean for summer season 2012.

Characters	Direct effect Xi			Indirect effect Xi / X's			Total effect		
	Effects	CD*	RI %	Effects	CD*	RI %	Effects	CD*	RI %
Plant height X1	0.0654	0.0043	0.2939	0.2796	0.0366	4.2493	0.3450	0.0408	4.5432
Number of branch/plantX2	-0.0329	0.0011	0.0745	0.2706	-0.0178	1.9115	0.2377	-0.0167	1.9860
Pod length X3	0.1545	0.0239	1.6410	0.2351	0.0727	12.0216	0.3896	0.0965	13.6626
Pod width X4	-0.1583	0.0251	1.7231	0.2435	-0.0771	6.2837	0.0851	-0.0520	8.0067
Pod thickness X5	0.0844	0.0071	0.4893	-0.2366	-0.0399	3.9778	-0.1522	-0.0328	4.4670
Number of dry seeds /podX6	0.1816	0.0330	2.2663	-0.0117	-0.0042	0.7679	0.1699	0.0287	3.0342
Pod weight X7	0.0731	0.0053	0.3668	0.4470	0.0653	4.4887	0.5200	0.0706	4.8556
Number of pods/plant X8	0.1994	0.0398	2.7340	0.4782	0.1907	13.1106	0.6776	0.2305	15.8446
100- seeds weight X9	0.0191	0.0004	0.0250	0.1843	0.0070	0.4828	0.2033	0.0074	0.5077
Early yield X10	0.6376	0.4066	27.9460	0.0000	0.0000	0.0000	0.6376	0.4066	27.9460
Total D+I							3.1138	0.7796	84.8536
Residual								0.2204	15.1464
Total							3.1138	1.00	100.00

CD* = Coefficient of determination. RI % = Relative efficiency.

Results in Table (10) of path coefficient analysis of the third season showed that early yield had the highest and positive effect on pod yield followed by pod weight, pod width and plant height.The maximum amount of negative direct effect was related to direct effect of pod thickness (-0.1396) the next trait was100-seeds weight and the number of branches/plant followed by the number of pods/plant, pod length and the number of seeds/pod. From results in Table (11) showed that the early yield was the maximum relative important trait under direct effect to the total yield variability followed by pod weight, and pod thickness. Pod weight recorded highly relative important indirect effect to the total yield variation followed by pod thickness, pod width, the number of pods/plant, the number of branches/plant, 100-seeds weight and pod length as the second important contributing characters towards pod yield of bean plants in the third season. Therefore, the relative importance of these characters to the total yield variability were, 12.65, 10.40, 5.35, 3.65, 3.33, 2.59 and 1.39%, respectively.

In the fourth season, early yield recorded the highest positive and direct effect followed by pod weight, pod thickness, pod length, the number of seeds per pod, 100-seeds weight and pod width. On the other hand the number of pods/plan had an important negative direct and not significant effects and the next traits were plant height and the number of branches/plant (Table12). The highest value of relative important direct effect was given by early yield followed by the number of pods/plant, pod weight, pod thickness and pod length (Table13).The results showed clearly that the relative important indirect effect of the number of pods/plant, pod length, pod weight and pod thickness were the important traits to yield variation.

Table (10): Path coefficients (direct and joint effects) of snap pod yield and its related traits in bean for fall season 2012.

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	rxy
Plant height X1	0.0240	-0.0064	-0.0009	0.0042	-0.0017	-0.0002	0.0136	-0.0078	-0.0285	0.0499	0.046
Number of branch/plant X2	0.0031	-0.0494	-0.0032	0.0238	0.0346	0.0000	0.0297	-0.0201	-0.0419	0.3133	0.29
pod length X3	0.0008	-0.0060	-0.0268	0.0359	0.0647	0.0000	0.0821	-0.0155	-0.0204	0.2803	0.395
pod width X4	0.0009	-0.0111	-0.0090	0.1064	0.0468	0.0001	0.0583	-0.0128	-0.0504	0.1799	0.309
pod thickness X5	0.0003	0.0123	0.0124	-0.0356	-0.1396	-0.0020	-0.0663	0.0244	0.0123	-0.4110	-0.593
Number of seeds / podX6	0.0005	0.0001	-0.0001	-0.0005	-0.0235	-0.0118	0.0483	-0.0053	-0.0113	0.0216	0.018
Pod weight X7	0.0016	-0.0073	-0.0109	0.0306	0.0458	-0.0028	0.2023	-0.0257	-0.0142	0.3935	0.613
Number of pods/plant X8	0.0041	-0.0214	-0.0090	0.0295	0.0736	-0.0014	0.1121	-0.0463	-0.0197	0.5256	0.647
100- seeds weight X9	0.0065	-0.0196	-0.0052	0.0508	0.0162	-0.0013	0.0271	-0.0086	-0.1057	0.1698	0.13
Early yield X10	0.0018	-0.0230	-0.0111	0.0284	0.0852	-0.0004	0.1181	-0.0361	-0.0266	0.6738	0.81

Table (11): Direct and indirect effects of yield components and their relative importance in snap pod yield of bean for fall season 2012.

Characters	Direct effect Xi			Indirect effect Xi / X's			Total effect		
	Effects	CD*	RI %	Effects	CD*	RI %	Effects	CD*	RI %
Plant height X1	0.0240	0.0006	0.0416	0.0220	0.0011	0.3923	0.0460	0.0016	0.4339
Number of branch/plant X2	-0.0494	0.0024	0.1762	0.3363	-0.0332	3.3296	0.2869	-0.0308	3.5058
Pod length X3	-0.0268	0.0007	0.0518	0.4270	-0.0229	1.9299	0.4002	-0.0222	1.9817
Pod width X4	0.1064	0.0113	0.8173	0.2218	0.0472	5.3490	0.3282	0.0585	6.1662
Pod thickness X5	-0.1396	0.0195	1.4074	-0.4427	0.1236	10.4016	-0.5823	0.1431	11.8089
Number of dry seeds/pod X6	-0.0118	0.0001	0.0101	0.0533	-0.0013	0.1480	0.0414	-0.0011	0.1581
Pod weight X7	0.2023	0.0409	2.9526	0.3537	0.1431	12.6516	0.5559	0.1840	15.6041
Number of pods/plant X8	-0.0463	0.0021	0.1550	0.5059	-0.0469	3.6475	0.4596	-0.0447	3.8025
100-dry seeds weight X9	-0.1057	0.0112	0.8058	0.1698	-0.0359	2.5898	0.0641	-0.0247	3.3956
Early yield X10	0.6738	0.4540	32.7676	0.0000	0.0000	0.0000	0.6738	0.4540	32.7676
Total D+I							2.2737	0.7147	79.6246
Residual								0.2823	20.3754
Total							2.2737	1.000	100.000

CD* = Coefficient of determination. RI % = Relative efficiency.

Table (12): Path coefficients (direct and joint effects) of snap pod yield and its related traits in bean for summer season 2013.

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	rxy
Plant height X1	-0.0639	-0.0081	0.0608	0.0033	-0.0136	0.0062	0.0110	-0.0492	0.0040	0.2935	0.244
Number of branches/plant X2	-0.0105	-0.0495	0.0882	0.0042	-0.0913	-0.0087	0.0112	-0.0832	0.0108	0.3466	0.218
Pod length X3	-0.0231	-0.0260	0.1680	0.0070	-0.1386	-0.0016	0.0609	-0.1063	0.0081	0.5356	0.484
Pod width X4	-0.0142	-0.0139	0.0790	0.0149	-0.0962	0.0078	0.0569	-0.0608	0.0113	0.4293	0.414
Pod thickness X5	0.0047	0.0245	-0.1264	-0.0078	0.1844	0.0025	-0.0373	0.0890	-0.0086	-0.5280	-0.403
Number of seeds / podX6	-0.0064	0.0069	-0.0042	0.0019	0.0074	0.0621	0.0318	-0.0289	-0.0040	0.0855	0.152
Pod weight X7	-0.0032	-0.0025	0.0464	0.0038	-0.0312	0.0089	0.2205	-0.1317	0.0013	0.4995	0.612
Number of pods/plant X8	-0.0136	-0.0178	0.0773	0.0039	-0.0710	0.0078	0.1257	-0.2311	0.0083	0.7655	0.655
100- seeds weight X9	-0.0077	-0.0160	0.0405	0.0050	-0.0474	-0.0075	0.0088	-0.0575	0.0334	0.1633	0.115
Early yield X10	-0.0197	-0.0181	0.0948	0.0067	-0.1025	0.0056	0.1160	-0.1862	0.0058	0.9497	0.852

Table (13): Direct and indirect effects of yield components and their relative importance in snap pod yield of bean for summer season 2013.

Characters	Direct effect Xi			Indirect effect Xi / X's			Total effect		
	Effects	CD*	RI %	Effects	CD*	RI %	Effects	CD*	RI %
	-0.0639	0.0041	0.1554	0.3079	-0.0393	2.1888	0.2440	-0.0353	2.3442
Number of branch/plant X2	-0.0495	0.0025	0.0933	0.2780	-0.0275	2.4286	0.2285	-0.0251	2.5219
Pod length X3	0.1680	0.0282	1.0753	0.3651	0.1227	10.9817	0.5331	0.1509	12.0570
Pod width X4	0.0149	0.0002	0.0085	0.3482	0.0104	0.7523	0.3631	0.0106	0.7608
Pod thickness X5	0.1844	0.0340	1.2945	-0.4824	-0.1779	9.3430	-0.2981	-0.1439	10.6375
Number of seeds\ pod X6	0.0621	0.0039	0.1470	0.0843	0.0105	0.7104	0.1464	0.0143	0.8574
Pod weight X7	0.2205	0.0486	1.8521	0.3692	0.1628	10.6253	0.5897	0.2115	12.4774
Number of pods/plant X8	-0.2311	0.0534	2.0331	0.7738	-0.3576	13.6172	0.5427	-0.3042	15.6502
100-seeds weight X9	0.0334	0.0011	0.0426	0.1633	0.0109	0.4159	0.1968	0.0120	0.4584
Early yield X10	0.9497	0.9019	34.3473	0.0000	0.0000	0.0000	0.9497	0.9019	34.3472
Total D+I							3.4960	0.7929	92.1121
Residual								0.2071	7.8879
Total							3.4960	1.000	100.00

CD* = Coefficient of determination. RI % = Relative efficiency.

The results of path analysis in the four seasons showed that early yield, pod weight, the number of pods per plant and the number of branches per plant were the most important contributing traits to the total yield variability of snap bean. It is concluded that these traits could be important for designing selection criteria index in snap bean breeding. Results of this experiment in the four seasons are in agreement with those obtained by Mohamed (1997) who found that the number of primary branches, the number of pods/plant and early yield had significant positive correlation with total snap pods yield. Path analysis revealed that the number of primary branches had the greatest direct effects on pod yield. Goncalves *et al.* (2003) found that yield per plant and the number of pods per plant were important variables included in the study that presented the best combinations of path coefficient and correlation, both positive and of high magnitude and both were superior to that of the variable the number of seeds per pod. Roy *et al.* (2006) found that pods/plant, 100-seeds weight, seeds/pod, plant height and pod length had positive direct effect on yield. Atilla (2007) found that pod weight, pod length and pod number per plant had the highest effects on yield. Salehi *et al.* (2008) found that there were positive and significant correlations between the number of seeds per pod, the number of pods per plant and pod length, with grain yield. Rai *et al.* (2010) reported that the number of pods/plant and the number of seeds/pod showed maximum direct effect on yield. Salehi *et al.* (2010) reported that path analysis showed that the maximum direct and positive effects were given by the number of seeds per pod. The only direct and negative effect was related to pod length. Krasu and Oz (2011) concluded that seeds yield/plant had the highest direct effect on 100- seeds weight and plant height. Sofi *et al.* (2011) observed that seeds yield was significantly associated with the number of pods/plant followed by 100-seeds weight, seeds/pod and plant height. Mehra and Singh (2012) found that path coefficient analysis revealed that pods yield per plant and the number of pods per cluster were the most important traits affecting pods yield. Araujo *et al.* (2012) found that indirect selection for pods yield could be by using the number of pods per plant as a reference and, for indirect selection for pod yield, the characters average length of the pod, 100- seeds weight and pods yield considering the latter primary character for pod yield. Kulaza and Ciftci (2012) found positively significant relationships among yield and yield per plant, the number of branches per plant, the number of pods per plant. There were strong direct effects of the 1000-seeds weight, yield per plant and plant height on yield. Ahmed and Kamaluddin (2013) found that the number of seeds/pod, plant height and the number of pods/plant showed positive and significant association with yield. The number of pods/plant, 100 seeds weight and pod length had maximum positive direct effect on yield.

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معامل المرور كنموذج احصائي لإنتقاء بعض السلالات الجديدة من الفاصوليا

رافت محمد جلال- وفاء وهبة محمد شافعى* - سحرعبدالعزيز فرج*

قسم الخضر – معهد بحوث البساتين و * المعمل المركزى لبحوث التصميم والتحليل الاحصائى
مركز البحوث الزراعية – الجيزة – مصر

ملخص

يهدف هذا البحث إلي تقييم بهدف انتخاب اصناف من الفاصوليا الخضراء باستخدام معامل المرور وهو تحليل احصائي يلقي الضوء علي مدي مساهمة الصفات الخضرية في كمّ المحصول.

أجريت هذه التجربة بمحطة بحوث البساتين بسدس بمحافظة بنى سويف، التابعة لمعهد بحوث البساتين، مركز البحوث الزراعية، خلال أربع مواسم (نيلى ٢٠١١،صيفى ٢٠١٢، نيلى ٢٠١٢، صيفى ٢٠١٣) على الفاصوليا الخضراء. زرعت ستة عشر تركيب وراثى (عشر سلالات جديدة وست أصناف تجارية) وتم تقييمها من ناحية المحصول وصفات النمو وهى : ارتفاع النبات، عدد الفروع لكل نبات، طول القرن الأخضر، سمك القرن الاخضر، عرض القرن الأخضر، وزن القرن الأخضر، عدد البذور فى القرن الجاف ، وزن ١٠٠ بذرة جافة، عدد القرون الخضراء على النبات، والمحصول المبكر والكلى الأخضر .أظهرت النتائج تفوق السلالتين ٢٠و٢٤ وأعطت محصول عالى عن باقى التراكيب الوراثية فى كل العروات .وأظهر معامل المرور للصفات تحت الدراسة أن صفات المحصول المبكر، وزن القرن الاخضر، عدد القرون الخضراء على النبات، عدد الفروع على النبات هى الأكثر أهمية ويمكن ان تكون فعاله فى برامج الإنتخاب لزيادة المحصول الأخضر فى الفاصوليا.

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (٦٥) العدد الأول (يناير ٢٠١٤):١٠٤-١١٨.