

Study on Behavior of Some Dry Colored Common Bean Seeds Varieties for Local and Exportation Market

Nabila, A. Ewais and Mona, S. Gaafar

Vegetable Research Department, Horticulture Research Institute,
Agriculture Research Center, Giza, Egypt

Abstract: Due to the changes in the Egyptian public taste in foods and the importance of colored bean seeds for its contents from high nutritional value, specially some antioxidants that it is protecting human body health from many diseases, it should be focusing production of colored bean seeds varieties to meet the local and export market demands. The current study was conducted at Barrage Horticulture Research Station, Agriculture Research Center (A R C), Qalubia Governorate, Egypt to study behavior of plant growth, yield and pods quality of some different colored bean seeds varieties (Candy, Eclipse Black, Red Hawk, Lebaron and Red Candy) as well as Nebraska variety as a control. The experiment was arranged in a randomized complete block design. The results showed there were no significant differences for the vegetative growth among all colored bean seeds varieties and the control and the intensity of 100 seed, while showed significant on values average of 100 seed weight (g) and average 100 seed volume (cm³). In addition it's showed significant values for the total seeds yield (ton/fed). Whereas the highest values were observed in the Candy variety. Also the results showed significant difference increases for phosphorus, total sugars, total protein % and total phenols in the seeds among the colored bean seeds varieties and the control. Moreover, it notice that there were differences in the either the cooking time and flavor in all varieties, the taste of Candy variety was good and soft with the highest seed yield while the Red candy variety was the best one in the color and taste for that it can recommended by choose any one of this two varieties in plantation of colored bean seeds.

Key words: Phaseolus vulgaris • Evaluation • Seed yield • Cultivars • Colored bean seeds

INTRODUCTION

The common bean (*Phaseolus vulgaris*) is widely cultivated in the world due to its high market value and good nutritional composition as it is contain high percentage of protein content in the dry seeds and good source of fiber in the case of snap beans type. It is consumed either as dry beans (grain) or snap bean, (i.e. green type) [1]. The common beans play a vital role in the vegetarian diets and provide numerous health benefits connected with eating pattern always [2]. The food habits in later life study conducted in Japanese, Greek and Australian populations which have demonstrated and preferred dry seed beans and other legume foods are the only foods linked with a reduced risk of mortality [3]. Hence, health-promoting effects are directly proportional to increased bean intake. It is founded that its immature

edible pod and dry seeds contain protein, carbohydrate, fat, fiber, thiamine, riboflavin, calcium and iron. Snap bean and other beans, such as kidney bean, navy bean and black bean are referred as common bean probably they all derived from a common ancestors [4].

The dry bean is considered as strain of common bean which is developed for succulent pods having little fiber through breeding and selection [4]. The immature pods and seeds are produced for fresh consumption and processing in the form of canned or frozen products [5]. The dry common beans have excellent anti-oxidant activities because of its content from phenolic acids, flavonoids, stilbenes and tannins. These anti-oxidant activities are primarily due to the reducing capacity of polyphenols as they play vital functions in neutralizing free radicals and scavenging radicals or suppressing lipid peroxidation, [6]. In addition, polyphenols involve

chelation of metal ions, causing impairment/cessation of oxidative mechanisms. Generally, the anti-oxidant activity is elevated during digestion and absorption of the common beans in the intestine. Normally, phenolic compounds are released higher in the stomach due to its acidic environment where the acid medium and enzyme-mediated hydrolysis facilitate the higher solubility of polyphenols along with starch and proteins [7]. They serve as a cost-effective source of nutrients. Health benefits of beans are generally acquired from direct attributes, including their high content of proteins, dietary fibers, low saturated fat content, vitamins, minerals and phytochemicals as well as replacement in the diet when they substitute for animal products [8]. These replacements of meat and other animal products with beans are highly linked with enhanced animal welfare and the decrease in inputs of environmental resources [8]. Different market classes of snap bean exist based on pod characteristics and plant type. Pod characteristics such as sieve size, percent seed weight of total pod weight, pod fiber content, smoothness and straightness, color and flavor are among others determine the degree to which snap beans are accepted by consumers and processors. For large scale production in the country, with the growing demand for local and export markets there is a need to develop new varieties with high pod yield and enhancing pod characters.

Regarding to the color bean seeds it is consider very common benefit food because it has a delicious taste and a range of beneficial nutrients for health. It's containing full of potassium, magnesium, iron and protein. Therefore its good replacement of meat for vegetarians. The color bean seeds also contain a lot of antioxidants that consider address for anti of many diseases that enhance the body immunity. The colored bean seeds are the most common all over the world and are very popular especially in India and throughout Central America. The colored seed beans as part of a balanced diet make sense for anyone looking for better overall nutrition in their meals. In general, black beans, red beans, green beans, red kidney beans and soybean from both organic and inorganic types of beans possessed higher total phenolic content and antioxidant capacity [9].

In general, the total phenolic content showed strong correlations with the antioxidant capacities of the beans analyzed. Thus, total phenolic content could be used as on indicator in evaluating the antioxidants capacity of beans which may preliminarily applied as natural sources of antioxidants functional food [10].

The beans are one of the most nutritionally complete foods available and the beans have long been a familiar food and part of trademark dishes in cultures throughout the world.

Thus, the present study was conducted to evaluate and choose identify favorable colored bean seeds varieties characterize with high yield and best quality for wider production and consumption in our country as well as for developing new product in the exportation market.

MATERIALS AND METHODS

Six varieties of colored bean seeds were evaluated in 2015, 2016 and 2017 at Barrage Horticulture Research Station, Horticulture Research Institute, Agriculture Research Center (A R C), Qalubia Governorate, Egypt, to study behavior of the plant growth, yield and pods quality of some different colored seed beans varieties as shown at (schedule 1). The seeds of common bean varieties. (Candy, Eclipse Black, Red Hawk, Lebaron, Red Candy and Nebraska) were sown in hills on one side of ridge at 7 cm spaces .Each experimental unit area was 2.8m² where consisted of one ridge (4m long and 0.70m width). The soil type of the experimental location was clay-lame with pH 8.1 and 2.4% organic matter content. The first season sowing date was on 11th September (autumn plantation) but where all pods was infected by pod borer and so we had changed the sowing date to escape from the infection. The new sowing date was donning on 9th and 5th March (summer plantation) in both seasons of 2016 and 2017 respectively, the high and low temperatures of the two growing seasons are shown in Table (1). And used the recommended mineral fertilization of common bean plants (200 kg/fed. ammonium sulphate +200kg /fed. Calcium super phosphate+100 kg / fed. Potassium sulphate).

The experiment was arranged in a randomized complete block design with three replicates.

Data Recorded:

Growth Parameters: Five plants from each experimental unit were randomly taken at 70 days after seed sowing (at the stage of producing the pods) and the following data were recorded:

Plant length, the stem diameter (cm), number of leaves per plant and branches per plant. Another random sample of three plants from each experimental unit was taken and dried at 70°C till constant weight where the whole plant dry weight (g/plant) was determined using the standard method as illustrated by A.O.A.C [11].

Schedule 1: Morphological Characteristics (flower color, seed color and seed shape) and source of the six dry colored common bean seeds varieties in the experiment

| Varieties | Flower color | Seed color | Seed shape | Source |
|---------------|----------------|------------|--------------|--|
| Candy | Violet | Cranberry | Kidney | Netherlands Farmers Center Service Holland |
| Eclipse Black | Dark purple | Black | Kidney | Netherlands Farmers Center Service Holland |
| Red Hawk | Violet reddish | Red | Kidney | Netherlands Farmers Center Service Holland |
| Lebaron | White | Dark red | Kidney small | Netherlands Farmers Center Service Holland |
| Red Candy | Violet | Dark red | Kidney | Netherlands Farmers Center Service Holland |
| Nebraska | White | White | Kidney | Horticultural Research Institute |

Table 1: Meteorological data of Qalubia governorate region during the summer seasons of 2016 and 2017.*

| Month | AIR Temperature °C | | | | | | Relative Humidity | | Rain | |
|-------|--------------------|------|------|------|------|------|-------------------|------|------|------|
| | 2016 | | | 2017 | | | 2016 | 2017 | 2016 | 2017 |
| | Max. | Min. | Aver | Max. | Min. | Aver | | | | |
| March | 33.5 | 9.6 | 18.9 | 38.2 | 9.3 | 21.2 | 55.9 | 48.9 | - | - |
| April | 41.4 | 12.9 | 22.2 | 38.8 | 12.6 | 23.2 | 51 | 47.9 | - | - |
| May | 41.9 | 17.4 | 26.5 | 45.4 | 16.8 | 27.7 | 45.7 | 46.1 | - | - |
| June | 43.9 | 19.6 | 29.2 | 43.6 | 20.4 | 29.6 | 49 | 47.5 | - | - |

*Agricultural Research Center, Central Laboratory for Agricultural Climate, Ministry of Agricultural and Land Reclamation.

The leaf area was calculated according to the following formula of Wallace and Munger [12].

$$\text{Leaf area} = (\text{cm}^2) \text{ leaves dry weight (gm)} \times \text{disk area} / \text{disk dry weight}$$

Flowering Date: Number of days from sowing to 25% flowering.

Dry Seed Yield and its Components: The total dry seeds yield was picking after 95-100 days from sowing.

A random sample of 50 dry pods from each experimental unit was taken at 95 days after sowing to determine the following data: Average of 100 seeds weight (g).

- Average of 100 seeds volume (cm³) by using graduated cylinder.
- Intensity 100 seeds = weight (g) / volume (cm³).
- Total dry seeds yield (ton /fed).

Chemical Components: Total nitrogen, potassium and phosphorus were determined in the dry seeds on the basis of dry weight Chapman and Pratt [13]; Jackson [14] and Olsen and Sommers [15] respectively. Total protein in the dry seeds calculated as multiplying nitrogen by 6.25 according to Stewart [16].

Total sugars were determined in pods calorimetrically according to the method described by Dubois *et al.* [17].

Total phenols was determined in pods calorimetrically according to the method described by Snel and Shell [18].

Panel Test: In this research, the prediction performance of taste and cooking time which are routinely visually assessed.

Panel test flavor was conducted by 20 untrained volunteer participants to test the taste and the cooking time than based on the scale where 10= Excellent, 8=Good, 6= Medium, 4= Fair and 2= poor [19].

Statistical Analysis: All data were subjected to the statistical analysis of variance and treatment means were compared according to the least significant differences (L.S.D) at 5% level test as described by Snedcor and Cochran [20].

RESULTS AND DISCUSSION

Vegetative Growth Characters: Data of vegetative growth characters were determined as plant length, stem diameter, number of leaves and branches/plant as well as plant dry weight and leaf area of six dry colored bean seeds varieties are shown in (Table 2). The results revealed that there were no significant differences between some different colored bean seeds varieties ,i.e., (Candy, Eclipse Black, Red Hawk, Lebaron and Red candy) compared with Nebraska variety as control (cultivated in Egypt and weight seed color) with respect to vegetative growth characters, i.e., plant length, number of leaves and branches / plant as well as dry weight and leaf area. In another meaning, the vegetative growth characters were similar among the colored varieties and Nebraska c.v as shown in Table 2.

Table 2: Vegetative growth characteristics of some colored common bean dry seeds varieties at 70 days after seed sowing during 2016 and 2017 seasons.

| Varieties | Plant length (cm) | | Stem diameter (cm) | | No. of leaves /plant | | No. of branches /plant | | Dry weight (g) /plant | | Leaf area (cm ²) | |
|--------------------|-------------------|-------|--------------------|------|----------------------|-------|------------------------|------|-----------------------|-------|------------------------------|--------|
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| Candy | 43.33 | 42.33 | 0.65 | 0.67 | 15.00 | 14.67 | 3.00 | 3.00 | 17.80 | 16.13 | 325.27 | 295.40 |
| Eclipse Black | 64.33 | 44.33 | 0.77 | 0.75 | 33.67 | 31.00 | 3.67 | 4.00 | 19.53 | 19.20 | 552.03 | 525.13 |
| Red Hawk | 43.00 | 62.00 | 0.85 | 0.83 | 22.67 | 23.33 | 3.67 | 3.67 | 19.30 | 18.10 | 366.47 | 392.17 |
| Lebaron | 65.00 | 61.33 | 0.70 | 0.70 | 23.33 | 22.67 | 4.00 | 4.00 | 14.77 | 15.37 | 320.40 | 337.13 |
| Red Candy | 41.67 | 44.00 | 0.78 | 0.80 | 21.33 | 20.67 | 3.00 | 3.00 | 22.80 | 22.40 | 496.63 | 497.20 |
| Nebraska | 51.00 | 51.33 | 0.52 | 0.57 | 11.67 | 12.00 | 2.67 | 3.00 | 16.47 | 17.13 | 295.40 | 302.70 |
| L.S.D at 5 % level | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |

Table 3: Characteristics of flowering and seed yield and its components of some colored common bean dry seeds varieties during 2016 and 2017 seasons

| Varieties | Flowering date (day) | | Average 100 seed weight (g) | | Average 100 seed volume (cm ³) | | Intensity 100 Seeds (g/cm ³) | | Total dry seed yield (t/fed) | | Relative seed Yield (%) | |
|--------------------|----------------------|-------|-----------------------------|-------|--|-------|--|-------|------------------------------|-------|-------------------------|--------|
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| Candy | 36.0 | 36.0 | 63.03 | 63.42 | 56.67 | 57.00 | 0.979 | 0.899 | 1.163 | 1.160 | 108.83 | 107.40 |
| Eclipse Black | 52.0 | 50.7 | 24.31 | 24.10 | 19.33 | 19.33 | 0.795 | 0.802 | 0.907 | 0.917 | 84.52 | 84.40 |
| Red Hawk | 36.0 | 35.3 | 50.47 | 51.40 | 44.00 | 43.67 | 0.872 | 0.85 | 0.673 | 0.690 | 62.72 | 63.88 |
| Lebaron | 47.0 | 45.7 | 27.84 | 28.74 | 24.33 | 25.33 | 0.874 | 0.881 | 0.563 | 0.577 | 52.46 | 53.42 |
| Red Candy | 39.0 | 38.0 | 55.17 | 55.84 | 48.33 | 50.33 | 0.876 | 0.901 | 0.757 | 0.763 | 70.54 | 70.64 |
| Nebraska | 40.0 | 40.7 | 49.87 | 50.24 | 41.00 | 41.00 | 0.816 | 0.816 | 1.073 | 1.080 | 100 | 100 |
| L.S.D at 5 % level | 1.593 | 1.033 | 1.177 | 1.767 | 2.97 | 1.98 | NS | NS | 0.069 | 0.059 | | |

Plant height, number of branches/ plant, number of leaves/ plant and dry weight/ plant (as average two seasons) of Nebraska cv. Were about 59.6 cm, 4.2, 17 and 22.44g Hamouda *et al.*[21].

Dry Seed Yield and its Components: Data presented in (Table 3) indicated that, there were no significant differences among the different colored bean varieties comparing with Nebraska variety on intensity of 100 seed , while there were among significant differences among varieties on flowering date whereas, Candy and Red Candy more earliness than the other varieties, average 100 seed weight (g) and volume of 100 seed (cm³)which this two characters showed more significant values in Candy, Red Candy and Lebaron respectively .Generally the highest values were obtained in the Varity (Candy) comparing to the other varieties and the Nebraska cv. . Also the data showed significant increment on the total seeds yield (ton /fed). The highest values were observed in the variety (Candy) which gave 1.16 (ton /fed) in the all seasons comparing with Nebraska which gave 1.07 and 1.08(ton /fed) in the first and second seasons, respectively. As for relative seed yield, data in Table 2 show that the increases in seed yield were about 8.83 and 7.40% for Candy cultivar over Nebraska cultivar (control) in 1st and 2nd seasons, respectively, whereas the decreases in seed yield were about 15.48 and 15.10% for Eclipse

Black cultivar, 37.28 and 36.12% for Red Hawk cultivar, 47.54 and 46.58% for Lebaron cultivar and 29.46-29.36% for Red Candy cultivar less Nebraska cultivar (control) in the 1st and 2nd seasons, respectively.

Seed yield, days to maturity and 100-seed weight as average three seasons of Red Hawk cultivar were about 2539 kg , 94.5 days and 55.4 g, respectively, whereas 100 seed weight and seed yield /fed (as average two seasons) of Nebraska cultivar were about 27.12g and 587.31kg [22, 21].

In spite of the low yield of some colored bean seeds varieties, the seed price of these varieties is equivalent to the price of white varieties by one and half. It is obvious that the total seed yield was higher in the colored bean varieties specially the Candy variety, in addition the higher price of colored been seeds.

The Chemical Component of the Dry Seeds:

The determined chemical properties in the dry seeds, i.e., N%, P%, K%, total sugars % and total phenols % are shown in (Table 4). The data indicated significant effects which were observed in the varieties (Candy and Eclipse Black) for nitrogen and protein, also were observed in the Variety (Lebaron) for phosphorus. Also the results showed significant differences on the total sugars and the total phenols in the Variety (Red Candy). The highest values were (14.4%-14.6%)

Table 4: Chemical component characteristics of some colored common bean dry seeds varieties during 2016 and 2017 seasons

| Varieties | N% | | P% | | K% | | Protein% | | Total sugar% | | Total phenols% | |
|--------------------|-------|-------|-------|-------|------|------|----------|--------|--------------|-------|----------------|-------|
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| Candy | 3.010 | 3.080 | 0.642 | 0.651 | 3.67 | 3.72 | 18.813 | 19.250 | 12.69 | 12.60 | 1.644 | 1.645 |
| Eclipse Black | 3.070 | 3.047 | 0.856 | 0.843 | 3.82 | 3.92 | 19.187 | 19.047 | 14.04 | 14.09 | 1.758 | 1.726 |
| Red Hawk | 2.703 | 2.773 | 0.798 | 0.740 | 3.64 | 3.86 | 16.893 | 17.333 | 10.72 | 10.77 | 1.723 | 1.745 |
| Lebaron | 2.883 | 2.927 | 0.951 | 0.952 | 3.91 | 3.83 | 18.023 | 18.290 | 10.00 | 9.83 | 1.781 | 1.773 |
| Red Candy | 2.723 | 2.730 | 0.907 | 0.91 | 3.87 | 3.65 | 17.020 | 17.060 | 14.42 | 14.60 | 1.862 | 1.831 |
| Nebraska | 1.897 | 1.870 | 0.526 | 0.544 | 3.78 | 3.67 | 12.023 | 11.687 | 12.28 | 12.15 | 0.912 | 0.914 |
| L.S.D at 5 % level | 0.174 | 0.095 | 0.041 | 0.032 | NS | NS | 1.629 | 1.112 | 0.194 | 0.414 | 0.017 | 0.017 |

Table 5: Results of evaluation the panel test of dry seed bean varieties.

| Varieties | Mean | Taste | Cooking time |
|---------------|-------|-----------|--------------|
| Candy | 8.22 | Good | 2/3 hour |
| Eclipse Black | 7.29 | Good | 1/2 hour |
| Red Hawk | 7.95 | Good | 3/4 hour |
| Lebaron | 7.25 | Good | 2/3 hour |
| Red Candy | 8.95 | Excellent | 1/2 hour |
| Nebraska | 8.66 | Good | 1hour |
| LSD | 0.037 | --- | --- |

and (1.86%-1.83%) comparing with Nebraska that gave (12.28%-12.15%) and (0.91%-0.91%) in the first and second seasons, respectively. In this regard, Oomach *et al.* [6]; Akillioglu and Karakaya [7]; Messina [8] and Hanis *et al.* [9] found that, black bean, red bean, green bean, red kidney bean and soybean from either organic or inorganic beans types possessed higher total phenolic content and antioxidant capacity. It is notice from the data in Table (4) that the most colored dry seed bean varieties contain high significant values of N%, P%, Protein, total sugar % and total phenols % comparing to the control (Nebraska variety) as the white seed color, that is mean the colored dry seed bean varieties consider more nutrient components than the white dry seed bean varieties.

Panel Test: Data presented in Table (5) indicated that, results of evaluation panel test of dry seed bean varieties, showed significant result between varieties and the highest values were obtained from Red Candy variety.

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