

# EVALUATION OF SIX FRESH GREEN BEAN VARIETIES FOR POD QUALITY AND YIELD

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## ABSTRACT

*Six green bean varieties, including four varieties of the common bean (*Phaseolus vulgaris* L.) and two varieties of black-eyed peas (*Vigna unguiculata* L. Walp.), were evaluated in a replicated small plot trial at the Gladstone Road Agricultural Centre during 2012. At harvest, the varieties were assessed for pod quality and yield. Results from this study indicated that there were significant differences among the six varieties with respect to the total number of pods per plant, weight of pods per plant and pod length. The fresh green bean yields ranged from 2.5 to 7.7 tonnes per hectare among the four *Phaseolus* varieties and averaged 4.25 tonnes per hectare for the two black-eyed peas, suggesting that these yields are acceptable for cultivation on Bahamian soils.*



String bean (*Phaseolus vulgaris* L.) variety 'Gold Dust'

## Introduction:

Legumes are an important component in the diets of humans and animals throughout the world and are cultivated under a wide range of environmental conditions. Total world production exceeds 17 million tonnes, with China, Indonesia, India and Turkey among the largest producers and consumers of this crop (FAOSTAT, 2010). Legumes are tolerant of heat and drought conditions and produce well on marginal soils. They are noted for their ability to fix nitrogen in the soil (Amanuel *et al.*, 2000) and are used to improve soil conditions. Two important legume species are the common bean (*Phaseolus vulgaris* L.) and the black-eyed peas (*Vigna unguiculata* L. Walp.).

As a food, these legumes may be consumed as dried beans or in the fresh state as green beans. They are also widely used as a vegetable when harvested while the young tender pods are still immature. In different locations, these immature pods are referred to as string beans, snap beans, French beans or green beans. They are rich in protein and iron and contain essential nutrients such as ascorbic acid, Vitamin A, Vitamin B and calcium (Kelly and Scott, 1992; Ndegwa *et al.*, 2006). Green beans are a very valuable crop when cultivated for the fresh market and are a means by which local farmers can diversify their agricultural production.

Green beans grown for their tender pods require between 50-75 days, depending upon variety and planting season. An important first step in the production of high yielding green beans is the selection of the appropriate varieties, since some varieties are more suited to other climate and soil conditions. By cultivating the appropriate varieties, local farmers can become leading producers of this specialty crop. The evaluation and selection of high yielding, disease tolerant varieties with quality characteristics acceptable to the local market are essential to the improvement of local production.

Six green beans, including four varieties of string beans (*Phaseolus vulgaris* L.) and two varieties of black-eyed peas (*Vigna unguiculata* L. Walp.), were grown at the Gladstone Road Agricultural Centre during the 2011-2012 winter vegetable season. This study was conducted to determine the plant characteristics, such as plant height, pod yield and pod length, of the six varieties and to select from among them those suitable for cultivation for the fresh market.



Green bean variety trial being established at the Gladstone Road Agricultural Centre, New Providence (left); close-up of bean plot (right).

### ***Objective:***

The purpose of this present study was to evaluate six green bean varieties for their pod quality and yield on Bahamian soils.

### ***Materials and Methods:***

The green bean evaluation was conducted at the Gladstone Road Agricultural Centre from December 2011 to March 2012. All varieties evaluated were common beans, *Phaseolus vulgaris*

L., with the exception of the two black-eyed pea varieties ‘California #5’ and ‘Queen Ann’ which are classified scientifically as *Vigna unguiculata* (L.) Walp. The four green bean varieties included ‘Burgundy’, ‘Crocket’, ‘Gold Dust’ and ‘Supremo’. All of the beans are short, bush type plants that do not require support. They are early maturing varieties that produce all of their pods within a short period of time, after which production ceases. The pods of ‘Burgundy’, ‘Crocket’ and ‘Gold Dust’ are round and thin, while those of ‘Supremo’ are short and flat. Three of the green bean varieties, ‘Crocket’, ‘Gold Dust’ and ‘Supremo’, and the two black-eyed peas, ‘California #5’ and ‘Queen Ann’, are products of the Seedway Seed Company and are developed for the fresh market. The variety ‘Burgundy’ is a purple coloured heirloom variety of unknown origin. The variety ‘Supremo’ and the two black-eyed peas are dual crops, used for their young, tender pods and their mature dried beans.

Chemical fungicides and insecticides were used in this trial to gauge the performance of the green bean varieties under optimal conditions. The leaves were sprayed weekly, using the fungicide Bravo® and the insecticide Xentari® in combined applications as a preventative measure against insect pests and diseases. Weeds were controlled by hand weeding. The varieties were planted in 3.0 m (10 ft) long plots in double rows with spacing of 20 cm (8 in) between plants within the row and a spacing of 50 cm (20 inches) between the double rows. The rows were 1.5 m (5 ft) apart. The usual cultural practices were observed to ensure that an even stand of plants was established in the field plots. The plants were side dressed with 8-18-8 fertiliser, applied in one application at a rate of 30 g (1.0 oz) per plant, at the flowering stage. The rows were irrigated with a drip irrigation system which supplied water throughout the growing season.

Upon maturity of the green pods, the beans were harvested by hand. For this study, all observations and measurements were made on the initial harvest of marketable pods. Ten plants were harvested at random from each of the three plots, for each variety. The pods were graded, then weighed and measured. The total number of pods per plant was recorded. Pod length (cm) was measured with a ruler. Ten pods were selected randomly from the total batch of harvested pods from each variety to assess their post-harvest quality characteristics. They were examined for disease levels and visible signs of chlorosis. Colour and shape were determined by visual examination. The fibre content was determined by breaking the pod and determining whether it snapped cleanly or did not snap, due to excessive string and seediness.

The mean daily maximum and minimum temperatures for the trial period were 27°C (80.6°F) and 19.2°C (66.6°F), respectively. The total rainfall for the period was 135.9 mm (5.35 in). Mean monthly sunshine duration for the period was 8.1 h. Weather information was obtained from the Meteorological Department of The Bahamas.

Table 2. Weather data on rainfall, hours of sunshine and mean maximum and minimum temperatures for New Providence for the period of December 2011 to March 2012, courtesy of the Meteorological Department of The Bahamas.

Month	Total rainfall (mm/inches)	Mean monthly radiation (h)	Mean maximum temperature (°C/°F)	Mean minimum temperature (°C/°F)
December 2011	22.9/0.9	7.0	26.9/80.4	19.8/67.6
January 2012	6.6/0.26	8.0	26.1/78.9	17.8/64.0
February 2012	44.2/1.74	8.1	27.2/81.0	19.2/66.6
March 2012	62.2/2.45	9.3	27.8/82.1	20.1/68.2

Note: Monthly mean values have been rounded up to the nearest tenth

### Statistical Analyses:

All experimental results were analysed using Instat+™ and ASSISTAT. Instat is an interactive statistical package, copyright © 2006, Statistical Services Centre, University of Reading, UK. All rights reserved. ASSISTAT, Version 7.6 beta (2012), website – <http://www.assistat.com>, by Francisco de Assis Santos e Silva, Federal University of Campina-Grande City, Campina Grande, Brazil.

### Results:

The analysis of variance (Table 1) revealed significant differences in the number of pods per plant, pod length, total weight of pods per plant and plant height among the green six beans evaluated in this study. Seedling emergence for all varieties averaged 7-10 days after planting, with maturity dates ranging between 51 and 75 days. Stand establishment was very good for all six of the green bean varieties. Plants were healthy with no manifestation of insect or disease problems. For the *Phaseolus* beans, flowers first appeared after about 35 days of growth, with 50% of them appearing after 45 days. Pods were ready for harvest after about twenty days. The two black-eyed pea varieties took a longer time to flower, averaging about 51 days. Pods were harvested within 25 days after 50% flowering was observed.

Table 1. Analysis of variance (ANOVA) for number of pods per plant, pod length, total weight of pods per plant and plant height among six string bean varieties. Standard error is for each treatment mean. Error mean square has 179 df. \*, \*\* and \*\*\* denote statistical significance at 5, 1 and 0.1% level of confidence, respectively. ns indicates differences between means not significant.

-----Significance levels-----					
Source	df	Number of pods per plant	Pod length (cm)	Total weight of pods per plant (g)	Plant height (cm)
Varieties	5	**	**	**	**
Error	174				
Std. Err		0.22	0.21	0.88	0.47

The yield and yield contributing characteristics of the six green bean varieties are shown in Table 2. The variety ‘Supremo’ excelled above the other green beans in producing the highest yield of pod weight per plant, followed by the variety ‘Gold Dust’. ‘Gold Dust’, in turn, had more pods per plant than any of the other six varieties, but it was the shortest in height and had one of the shortest pod lengths. The two black-eyed pea varieties, ‘California #5’ and ‘Queen Ann’, produced the longest beans and were the tallest plants among all varieties, but did not fare well in the number of pods per plant or pod weight per plant. The mean weight for each of the six varieties was expressed as g per plant. These figures were extrapolated to reveal the yield potential of the six varieties, expressed as tonnes per hectare and pounds per acre (Table 2).

Table 2. Number of pods per plant, pod length (cm), total weight of pods per plant (g) and plant height (cm).

Variety	Number of pods per plant	Pod length (cm)	Total weight of pods per plant (g)	Plant height (cm)	Yield potential (tonnes/hectare)	Yield potential (lb/acre)
Burgundy	5.2c	10.8c	12.5d	25.9c	2.5	2,226.7
California #5	5.0c	15.6a	20.4c	29.7b	4.1	3,637.6
Crocket	7.5b	10.8c	18.0c	19.8e	3.6	3,218.7
Gold Dust	10.5a	11.4c	27.3b	18.9e	5.5	4,872.2
Queen Ann	5.4c	16.3a	22.1c	33.7a	4.4	3,946.3
Supremo	5.7c	14.2b	38.7a	22.7d	7.7	6,900.5

The t-test at a level of 5% probability was applied. Means with different letters differ significantly.

The six green bean varieties in this study displayed acceptable pod colours, pod lengths, and fibre contents (Table 3). In general, they exhibited very little variation from the accepted standards for green beans (USDA-AMS, 1997), in the post harvest quality characteristics observed. However, the actual number of days to maturity for the variety ‘Supremo’ was more than fifteen days earlier than the stated number of days to maturity for that variety. All other varieties matured within range of the number of days expected for each of them.

Table 3. Post-harvest quality characteristics of two string bean varieties evaluated at the Gladstone Road Agricultural Centre during 2011.

Variety	Stated number of days to maturity	Actual number of days to maturity	Pod colour	Pod curvature	Fibre/String content	Visible signs of disease or chlorosis
Burgundy	52	51	Deep purple	Straight to slightly curved	Absent	None
California #5	72	75	Dark green	Straight	Absent	None
Crocket	58	58	Green	Straight to slightly curved	Absent	None
Gold Dust	55	57	Yellow	Straight to slightly curved	Absent	None
Queen Ann	72	75	Dark green	Straight	Absent	None
Supremo	72	57	Green with red speckles	Slightly curved	Absent	None

Plate 1 gives some indication of the quality of the six bean varieties. Pods were healthy in appearance. No serious pest or disease problems were evident. The varieties ‘Burgundy’ and ‘Gold Dust’ displayed colours different to the usual green pod. The pod of ‘Burgundy’ was deep purple in colour, while ‘Gold Dust’ had a pale yellow colour. ‘Supremo’ was green with red speckles.

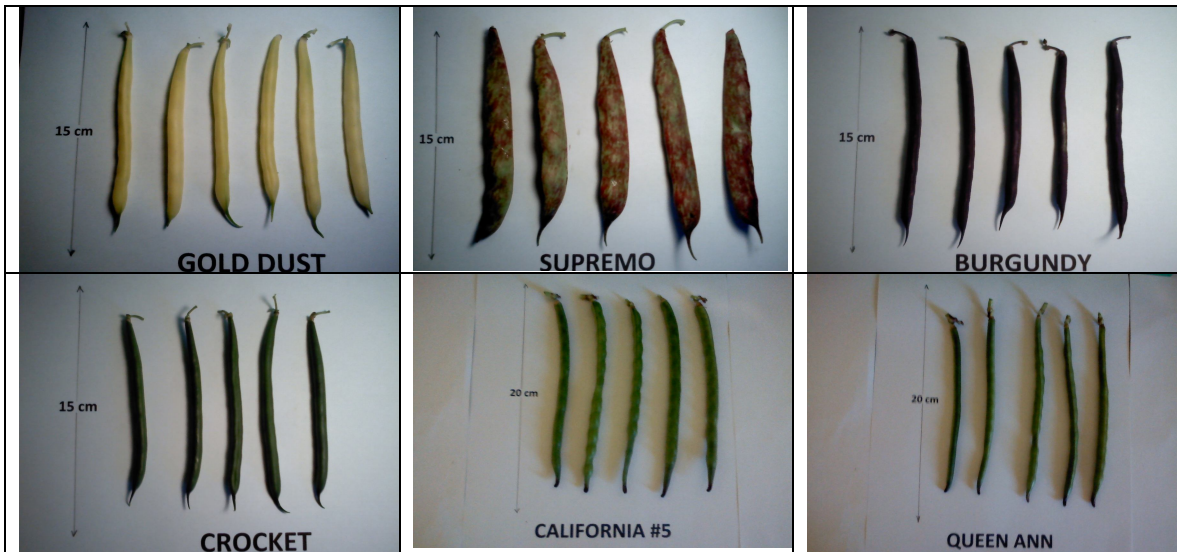


Plate 1. Pods of the six green bean varieties evaluated at the Gladstone Road Agricultural Centre during 2012.

**Discussion:**

Results, on a tonnes per hectare basis, were extrapolated from the mean weights expressed as g per plant and are displayed graphically (Figure 1). The fresh green bean potential yields ranged from

2.5 to 7.7 tonnes per hectare among the four *Phaseolus* varieties and averaged 4.25 tonnes per hectare for the two black-eyed peas. With the exception of the variety ‘Supremo’, yields are well below the world average (FAOSTAT, 2010) of 8.5 tonnes per hectare, but are within the range for developing countries, which fluctuates between 2.4 and 4.3 tonnes per hectare (Soejono, 1992).

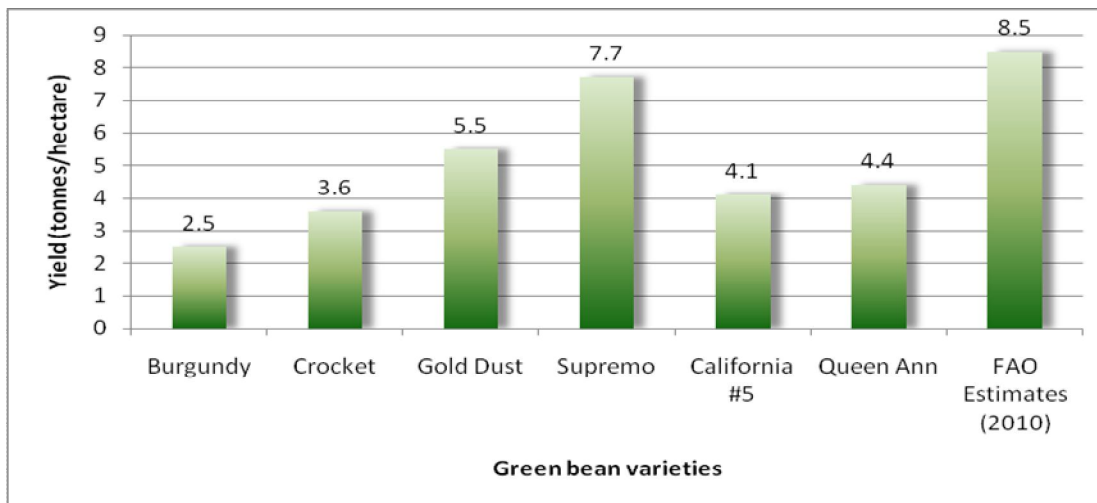


Fig. 1. Average yields six green bean varieties evaluated at the Gladstone Road Agricultural Centre during 2012. FAO global yield estimates for green beans in 2010 are found in the column at far right.

Chemical pesticides significantly reduced the incidences of insect pest and diseases in the trial plots, when compared to the previous bean trial (Richardson, 2012), which assessed the resistance of four green bean varieties to insect pests and diseases. The weekly spraying of pesticides resulted in a substantial improvement in the overall performance of the green bean varieties. The beneficial effects of chemical pesticides on beans have been demonstrated by other researchers (Amatobi, 1994; Oparaeke *et al.*, 2005; Muthomi *et al.*, 2007; Nderitu *et al.*, 2007), who have reported a significant reduction in insect pests and foliar fungal diseases in all legume species studied.

The heirloom variety ‘Burgundy’ had the lowest yields and did not perform as well as the other improved green bean varieties. However, this variety might be of importance to local bean production, as the previous green bean trial has shown it to be more tolerant of pest and disease problems than any of the improved varieties, in particular the common bean rust (*Uromyces viciae-fabae*). Also, seeds from this variety can be saved from year to year by farmers who may not have ready access to improved bean varieties.

The differences in the stated number of days to maturity and the actual number of days to maturity may be attributed to any number of factors, including climatic, environmental or growing conditions. There was also a significant variation in the days to maturity among the six green bean varieties, which ranged from 51 to 75 days. The difference in days to maturity could be attributed to photoperiod, since different bean varieties respond differently to a specific photoperiod. This corroborates earlier data of Amanullah *et al.*, (2006) whose study also reported significant variation in days to maturity among common bean germplasm.

Significant variation was observed for the number of pods per plant, pod length, total weight of pods per plant and plant height. As with the varying maturity dates, these differences could also be

attributed to differences within the genetic make-up of the green bean varieties. Other characteristics, such as pod colour, fibre content and visual appearance, which may affect pod quality, are within market standards for grades of green beans (USDA-AMS, 1997).

### ***General Comments:***

The four common bean and two black-eyed pea varieties are short-term crops that are relatively easy to produce, and for small farmers can meet a growing market demand. This evaluation of the yield and quality characteristics revealed traits that make them suitable for local production. The variety 'Supremo' is suitable for its high yield. Though 'Burgundy' was low in yield, it has good qualities with respect to pest and disease tolerance. With proper management practices, local farmers could generate a healthy income from the cultivation of this specialty crop.

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### ***References:***

- Amanuel G.S., Kiihne R.F., Tanner D.G., Vlek P.L.G. (2000). Biological nitrogen fixation in faba bean (*Vicia faba* L.) in the Ethiopian highlands as affected by P fertilization and inoculation. *Biol. Fertil. Soils*. **32**, 353-359.
- Amanullah, A.A. Khan, K. Nawab and Q. Suhail. (2006). Performance of promising common bean (*Phaseolus vulgaris* L) germplasm at Kalam-Swat. *Pak. J. of Bio. Sci.*, **9** (14): 2642-2646.
- Amatobi, C. (1994). Field evaluation of some insecticides for the control of insect pests of cowpeas (*Vigna unguiculata* L.) in the Sudan savanna of Nigeria. *International Journal of pest Management*, **40**, pp 13-17.
- FAOSTAT. (2010). *Food and Agricultural Commodities Production*; Available online: <http://faostat.fao.org> (accessed 30 June 2012).
- Kelly, J.F. and Scott, M.K. (1992). The nutritional value of snap beans versus other vegetables, p. 23-46. In: Henry, G. and W. Janssen (Tech. Eds.). CIAT Proceedings of an International Conference on Snap beans in the developing world held from 16<sup>th</sup> to 20<sup>th</sup> October 1989 in Cali, Colombia.
- Muthomi, J.W., Otieno, P.E., Chemining'Wa, G.N. and NDeritu, J.H. (2007). Effect of chemical pesticide spray on insect pests and yield of food grain legumes. *African Crop Science Conference Proceedings*, Vol. **8**, pp 981-986.

- Ndegwa, A. M., Muchui, M. N., Wachiuri, S. M. and Kimamira, J. N. (2006). Evaluation of snap bean varieties for adaptability and pod quality. *In: Proceedings of the 10th KARI Biennial Conference*. KARI HQs, Nairobi, Kenya. 13th-17th Nov. 2006.
- Nderitu, J. H., Wambua, E., Olubayo, F., Kasina, J. and Waturu, C. (2007). Evaluation of pesticide/variety combinations for thrips (Thysanoptera: Thripidae) management on French Beans (*Phaseolus vulgaris* L) in Kenya. *African Crop Science Conference Proceedings*, Vol. **8**, pp 987-992.
- Oparaeke, A.M., Dike, M.C., Amatobi, C.I. (2005). Field evaluation of extracts of five Nigerian spices for control of post-flowering insect pests of cowpea, *Vigna unguiculata* (L.) Walp. *Plant Protection Science*, **41**:14–20.
- Richardson, K.V. (2011). Evaluation of four green bean varieties (*Phaseolus vulgaris* L) for pest and disease tolerance. *GRAC Crop Research Report No.7*, Department of Agriculture, Nassau, Bahamas.
- Soejono I. (1992). Production of snap beans versus yardlong beans in Indonesia. In: G. Henry and W. Janssen (eds.), *Snap beans in the developing world: Proceedings of an international conference held in Cali, Colombia, 16-20 October 1989*. CIAT Publication No. 195: 277-293. Cali.
- USDA-AMS (1997). United States Department of Agriculture Agricultural Marketing Service. *United States Standards for Grades of Snap Beans*. Effective July 5, 1990. (Reprinted - January 1997) (<http://www.ams.usda.gov/AMSV1.0/>).
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