fertilizer rate and plant spacing during the third season. The higher fertilizer rate and the 12-inch spacing gave highest yields.

The 60-26-50 lb./acre N-P-K rate was sufficient for maximum yields of corn all 3 season. The 30-12-25 lb./acre N-P-K rate was sufficient all 3 seasons for squash, and during the second season, for cucumber and snap bean as well. The 60-26-50 lb./acre rate of N-P-K was needed for maximum yields the first season for cucumber and snap bean and the third season for cucumber. The lack of a yield response to fertilizer by cucumber and snap bean the second season may have been influenced by the higher soil soluble salts present prior to planting and the reduced leaching that occurred compared to the 1981 and 1983 seasons.

Leaching of the soluble fertilizer salts from the bed was affected by mulching (Table 2) and by rainfall received during the growing seasons (Table 3). During the second season, the effect of mulch on fertilizer leaching was quite apparent. Rainfall was least during the second season. Two leaching rainfalls occurred, but these occurred in different months. Leaching during the second season was severe in plots without mulch but was greatly reduced in mulched plots. During the first and third seasons rainfall was greater, but, more importantly, more days with rainfall totals from 1 to 2.5 inches occurred and these occurred during the same month. Leaching in these 2 seasons was great, even during the first season when mulch covered all beds.

The effect of higher fertilizer rates on soil soluble salts was variable. Higher fertilizer rates generally resulted in higher total soluble salts, but differences were usually not significant except during the first season. Leaching probably caused soil soluble salts to become similar with time regardless of fertilizer rates. The initial soil soluble salts in the bed were lower the last season because an adjacent experiment resulted in overhead irrigation being applied for 6 instead of 2 weeks during strawberry plant establishment.

Casual examination of roots indicated that rooting was good in the bed volume, and few root knot nematodes were observed.

In summary, vegetable yields in these trials were about average for Florida, and were produced without the added expense of fumigation, bed preparation, and mulching. Leaching of fertilizer was a problem, especially when the mulch on top of the bed was slit for fertilizer application and when the bed received a large amount of rainfall or irrigation. Several light applications of fertilizer would be more appropriate than one large single application to reduce leaching when the mulch is slit for fertilizer application. Equipment is now available to inject fertilizer in small slits through the sides of the bed. Leaching would be reduced because holes are not made on the upper surface of bed. In addition, fertilizer can be supplied as needed which would further reduce the risk of leaching. This should enhance the feasibility of double cropping mulched strawberry beds.

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BUSH SNAP BEAN CULTIVARS SUITABLE FOR WINTER PRODUCTION IN SOUTH FLORIDA

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Abstract. **Variety trials were conducted over three seasons (1982-83 to 1984-85) to evaluate bush snap bean (*Phaseolus vulgaris* L.) cultivar performance during the winter growing season in Dade County, Florida. Although results varied somewhat between trials, snap bean pod yields from 'Strike', 'Triumph', and 'Sprite' were the most consistently high. 'Savor', 'Picker', and '76-017' maintained quality marketable pod appearance longer than 'Triumph' or 'Sprite' in a postharvest storage test. Snap bean pod removal force, an important factor for machine harvest, was generally less with 'Triumph' and '76-017' compared to other entries. Other promising cultivars and additional cultivar characteristics will be discussed.**

Eighteen thousand acres of snap beans were harvested in the 1983-84 growing season in Dade County compared to 7,000 acres just four years before (3). This increase was due to a favorable market price for the commodity over those years and to declining snap bean acreages in Palm Beach County. Also, an increase in the availability of harvest labor has allowed other Dade farmers to enter and compete successfully in the bean market without the expense of purchasing mechanical harvesters.

Snap bean yields often range between 200 and 300 bushels per acre during the favorable climatic conditions of the fall and spring seasons in Dade County. However, during the midwinter period when market prices are highest, yields often range between 75 and 150 bushels per acre due to adverse, cool weather conditions.

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The lowest temperatures in Dade County occur during January. Mean monthly temperatures (based on 1941-70 data) were 70.4, 66.4, 65.3, 66.1, 69.4, and 73.1 for the months of November, December, January, February, March, and April, respectively, at the Tropical Research and Education Center in Homestead (4). This weather station location is considered a few degrees warmer (on a cold night) compared to the areas where the majority of bean acreage is planted. The greatest probability of freezing temperatures occurs in the month of January followed by December and February (5).

Low temperature during bean seed germination is a factor which slows emergence and increases susceptibility of seedlings to soil diseases (6,8). Differences in cold tolerance and susceptibility to soil disease organisms have been found among bean breeding lines and cultivars (1,2,7). The purpose of these trials was to investigate the adaptability of some promising new snap bean cultivars grown under the adverse environmental conditions of the winter growing period in Dade County. These cultivars were compared to the predominant standard cultivars (Triumph and Sprite) grown by local farmers.

Materials and Methods

Three snap bean variety trials were conducted each season for 3 years beginning in January 1983. One trial was conducted at the Tropical Research and Education Center in Homestead and two trials were conducted in growers' fields (concurrent with their plantings) each year. Fertilizer rates, disease and insect control measures were per grower standards in all trials. Trials at the TREC were conducted on raised beds while grower trials were planted "on the flat" which is standard practice.

Planting dates are listed in Table 1. Planting and harvesting in grower trials corresponded with grower planting and harvesting schedules. Harvesting occurred, on the average, about 60 days after planting.

Trials conducted at TREC were arranged in completely randomized block design with 4 replications. The growers' equipment was used to plant trials in growers' fields with about 125 feet of row planted to each cultivar. Four 10-ft sections spaced along each cultivar row were harvested for data collection.

A hand-held, maximum reading, pull force gauge (Durometer) was used to measure the force (in pounds) required to remove pods from stems of snap bean plants (Table 5). A small hook connected to the gauge was attached to the pod's pedicel. The gauge was then moved upward slowly until the pod detached. An average of 10 readings per plot were used to determine pod removal force.

Snap bean pods from each cultivar in the 1984 TREC trial were used in a postharvest storage test. Four replications of 2 lb. of pods from each cultivar were placed in a plastic bag, sealed, and held for 10 days at 55°F. The pods were then rated for marketability.

Three rows of '76-017', each 1500 ft long, were planted in the fall of 1983 (concurrent with grower plantings) to determine machine harvestability.

Table 1. Snap bean cultivar trials—planting and harvesting dates, 1983-85, Dade County, FL.

Operation	TREC[z]	Grower A	Grower B
		1983	
Planting	19 Jan.	17 Jan.	13 Jan.
Harvesting	23 Mar.	17 Mar.	14 Mar.
		1984	
Planting	15 Feb.	24 Jan.	1 Feb.
Harvesting	16 Apr.	26 Mar.	30 Mar.
		1985	
Planting	29 Jan.	11 Feb.	19 Feb.
Harvesting	5 Apr.	10 Apr.	18 Apr.

[z]Tropical Research & Education Center, Homestead, Fla.

Results and Discussion

Marketable bean pod yields were significantly influenced by cultivar in each trial (Table 2). Yields from Grower B in 1983 were low compared to other trials that year due to the early planting date and the low, exposed field location. Windy conditions and record rainfall occurred in Jan. and Feb. 1983. TREC and Grower A trial locations were on higher ground and protected somewhat by nearby windbreaks or groves. In general, yields from 'Strike' were the most consistently high followed by 'Sprite' and 'Triumph' over the 3 year period. Yields from 'Peak' were high in 1983 and 1985, but dropped below the leading entries in 1984.

Bean pod widths among cultivars were not significantly different in the 1983 grower trials (Table 3). Pod widths among cultivars in the 1984 TREC trials were different but none were significantly different from the standard local cultivars 'Triumph' and 'Sprite'. Pod length was variable in the 1983 trials but in 1984, the lengths of pods were not significantly different from the standard cultivars. Pod color was not rated, but all cultivars tested were green-pod types with enough similarity to the currently popular cultivars to be acceptable in the marketplace. However, pods of '76-017' were noticeably darker green compared to 'Triumph' or 'Sprite'.

Pod appearance was rated after a postharvest storage test (Table 4). '76-017', 'Savor' and 'Picker' maintained quality marketable appearance longer than 'Triumph', 'Casabel', 'Sprite' or 'Peak'. Between the 2 cultivars currently popular with local growers, 'Triumph' pod appearance was significantly better than 'Sprite'.

Plant height is an important cultivar characteristic for machine harvest in the winter season. 'Savor' plants were consistently tall while 'Sprite' appeared stunted in several trials compared to some other entires (Table 5). Also, 'Savor' leaves were noticeably larger than the leaves of other cultivars. Snap bean plants from the earliest planting date (13 Jan. 1981) were severly stunted by cold weather while plants in the latest planting (19 Feb. 1985) were not significantly different in height. Grower B reported machine harvested yields from this early planting at 75 bushels per acre while hand picked yields from the variety trial at that location averaged 113 bushels per acre (Table 2). Since the plants were small many pods were left in the field, unable to be picked up by the harvester.

Another important cultivar characteristic for machine harvest is the force required to remove pods from the plants (9). 'Peak' and 'Picker' required more force compared to 'Triumph' or '76-017' (Table 6). The cultivar '76-017' was field tested by a local grower and excellent machine harvest characteristics were noted with easy pod

Table 2. Marketable snap bean pod yields as influenced by cultivar, Dade County, Florida.

Cultivar	Source	1983 TREC[z]	1983 Grower A	1983 Grower B	1984 TREC	1984 Grower A	1984 Grower B	1985 TREC	1985 Grower A	1985 Grower B
					bushels per acre					
Triumph	Sun	187 cd[y]	298 a	120 a	287 ab	203 ab	182 c	297 a-c	135 c	260 a
Sprite	Sun	227 a	—	—	283 a-c	213 a	282 a	317 ab	131 c	245 a
Strike	Asgrow	—	—	—	297 a	212 a	268 ab	324 a	265 a	228 ab
Peak	Asgrow	205 a-c	311 a	117 ab	228 d	161 c	172 c	324 a	215 ab	240 a
Resisto	Rogers	—	—	—	297 a	209 a	220 bc	279 a-c	166 bc	229 ab
Savor	Moran	196 b-d	283 a	133 a	249 b-d	149 c	182 c	265 a-c	169 bc	126 d
Picker	Moran	229 a	256 ab	123 a	279 a-c	—	206 c	285 a-c	139 c	187 c
Casabel	Keystone	—	—	—	240 cd	199 ab	202 c	—	—	197 bc
82-6414	Rogers	—	—	—	300 a	175 bc	194 c	246 c	—	223 a-c
82-160	Rogers	—	—	—	322 a	175 bc	208 c	302 ab	—	149 d
76-017	Rogers	212 a-c	205 bc	77 c	289 ab	174 bc	198 c	281 a-c	—	—
Score	Moran	182 cd	273 a	120 a	—	—	—	—	—	—
Flo	Asgrow	222 ab	115 d	115 d	—	—	—	—	—	—
Lancer	Rogers	172 d	315 a	96 bc	—	—	—	—	—	—

[z]Tropical Research & Education Center, Homestead, Fla.
[y]Mean separation in columns by Duncan's multiple range test, 5% level.

Table 3. Snap bean pod length and width as influenced by cultivar.

Cultivar	1983 Grower A Length	1983 Grower A Width	1983 Grower B Length	1983 Grower B Width	1984 TREC[z] Length	1984 TREC[z] Width
			inches			
Savor	5.0 ab[y]	0.36	4.4 a	0.34	4.6 ab	0.36 a-c
Peak	4.9 a-c	0.37	3.9 cd	0.31	4.5 ab	0.38 ab
Picker	4.6 bc	0.36	4.2 ab	0.35	4.7 a	0.38 ab
Triumph	4.6 bc	0.35	4.1 ab	0.31	4.2 a	0.33 cd
76-017	4.6 a-c	0.35	3.8 d	0.30	4.2 bc	0.33 cd
82-160	—	—	—	—	4.9 a	0.35 bc
82-6414	—	—	—	—	4.5 ab	0.35 cd
Strike	—	—	—	—	4.4 ab	0.35 bc
Resisto	—	—	—	—	4.9 a	0.39 a
Sprite	—	—	—	—	4.5 ab	0.36 a-c
Casabel	—	—	—	—	4.1 bc	0.37 ab
Flo	5.0 a	0.37	4.1 bc	0.35	—	—
Lancer	4.9 a-c	0.34	4.0 b-d	0.30	—	—
Score	4.5 c	0.37	3.8 cd	0.31	—	—

[z]Tropical Research & Education Center, Homestead, Fla.
[y]Mean separation in columns by Duncan's multiple range test, 5% level.

removal and low trash content. In addition, '76-017' exhibited only 10% white mold infection compared to 25-30% observed in adjacent rows of 'Triumph'. 'Savor' was not significantly different from 'Sprite' in removal force, however, several growers have reported difficulty in machine harvesting 'Savor' and complain of a high trash content. In this case, plant size as well as removal force may be involved since 'Savor' plants and leaves are generally larger than other cultivars. Although plant size is important so that pods are far enough off the ground to be picked up by the harvester, too much growth may be detrimental. One grower, with good grading facilities, is unconcerned about the high trash content with 'Savor' since he obtains a quality packout after grading.

Table 4. Snap bean pod appearance after storage as influenced by cultivar, TREC, 1984.

Cultivar	Appearance[z] rating
76-017	4.0 a[y]
Savor	4.0 a
Picker	4.0 a
82-6414	3.7 ab
82-160	3.7 ab
Strike	3.3 ab
Resisto	3.3 ab
Triumph	3.0 bc
Casabel	2.3 cd
Sprite	1.7 de
Peak	1.0 e

[z]1 = not sellable, 3 = lower limit of sellability, 5 = optimum quality.
[y]Mean separation in columns by Duncan's multiple range test, 5% level.

Differences in cultivar performance during Dade's winter growing season were evident. Although snap bean yields varied somewhat between trials, yields for 'Strike', 'Triumph' and 'Sprite' were the most consistently high. Between the 2 cultivars planted most widely in Dade County, plant height and pod appearance after storage of 'Triumph' was better than 'Sprite'. Wide differences in post harvest storageability were found among cultivars. With the emphasis on quality and the long shipping distances required to get the product to market, more research among cultivars on postharvest quality in storage is needed. Other promising cultivars warrant trial by growers.

Table 5. Snap bean plant height as influenced by cultivar.

Cultivar	1983			1985	
	TREC[z]	Grower A	Grower B	Grower A	Grower B
			inches		
Savor	13.7 ab[y]	14.2 a	9.7 a	22.1 a	23.5
Triumph	12.5 b-d	14.3 a	8.4 bc	21.7 a	22.0
Picker	14.4 a	13.9 ab	8.5 b	20.1 ab	22.0
Peak	13.1 b-d	12.7 b-d	8.0 bc	21.1 a	21.7
Flo	13.7 ab	12.5 cd	8.7 b	—	—
Score	13.6 a-c	13.1 a-c	8.3 bc	—	—
Lancer	12.4 cd	13.3 a-c	7.4 c	—	—
Sprite	12.3 d	—	—	18.3 b	21.6
76-017	—	—	8.1 bc	—	—
Resisto	—	—	—	21.5 a	21.7
Strike	—	—	—	21.1 a	22.4

[z]Tropical Research & Education Center, Homestead, Fla.
[y]Mean separation in columns by Duncan's multiple range test, 5% level.

Table 6. Snap bean pod removal force as influenced by cultivar, 1984.

Cultivar	Grower A	Grower B
	pounds	
Peak	2.7 a[z]	2.8 ab
Picker	—	3.1 a
Casabel	2.5 ab	2.7 a-c
Resisto	2.4 a-c	2.9 ab
Sprite	2.3 a-c	2.6 a-c
82-160	2.2 a-c	2.8 ab
Savor	2.2 a-c	2.7 a-c
82-6414	2.2 a-c	2.5 bc
Strike	2.1 a-c	2.5 bc
Triumph	2.0 b-d	2.3 c
76-017	1.5 d	1.8 d

[z]Mean separation in columns by Duncan's multiple range test, 5% level.

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