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THE INTRODUCTION OF NEW SHORT-DAY ONION VARIETIES INTO THE VEGETABLE PRODUCTION SYSTEM IN ST KITTS AND NEVIS.

C.S. Weekes and A. Farrier

*Caribbean Agricultural Research and Development Institute,
Basseterre, St Kitts and Nevis.*

ABSTRACT

Several multi-locational varietal trials were carried out by CARDI in St Kitts and Nevis for the period 1992 to 1994. Because of these trials, the variety Texas Grano was replaced with new short-day cultivars. The new varieties, H7, H9, H60, H202 and PSX 2789, have been successfully introduced into the onion production systems and in 1995 accounted for over 95% of commercial production.

INTRODUCTION

Onion is the second most important vegetable imported into St Kitts and Nevis after White potatoes and in 1990, 250 t of onions were imported at a cost of over EC\$480,000. The replacement of 50% of imports as targeted by the Onion Task Force represents an opportunity for farmers to increase their income. In 1991 a study of the onion (*Allium cepa*) production system by the Caribbean Agricultural Research and Development Institute (CARDI), revealed that a major constraint to increased production was that the current commercial variety Texas Grano, gave low yields and had poor storability (CARDI, 1993a). In order to achieve 50% replacement of imports by the 1995/96 production season it was necessary to evaluate and introduce new varieties into the production system.

In a varietal evaluation of 1991, the varieties Special 38 and Granoble produced higher yields than H7 and Texas Grano (CARDI, 1993b). Further evaluations were necessary to screen new varieties that combined high yields with good storability. This paper reports on the evaluation and introduction of the new varieties in St Kitts and Nevis during the production seasons 1992/93 and 1993/94.

MATERIALS AND METHODS

Onion varieties

The sources and characteristics of the varieties tested are presented in Table 1. Most of the varieties tested were recommended by the CARDI Barbados Unit. Additionally, samples from Peto Seed Company were obtained from the Department of Agriculture, St Kitts.

Experimental sites

The soils at the research sites in Nevis were predominantly clay loams with good water retention while those in St Kitts were sandy loams with poor water retention. At all sites the major crops planted before onion were vegetables. Details of the sites used for field experiments throughout the investigations are presented in Table 2.

Table 1 Varieties, seed supplier and years tested

Cultivar	Seed supplier	Years tested
Arad (H60)	Hazera Seed Ltd.	1992-94
Ben Shemen	Hazera Seed Ltd.	1992-94
Barak (H8)	Hazera Seed Ltd.	1992-93
Elad (H9)	Hazera Seed Ltd.	1993-94
Grandstand (H7)	Hazera Seed Ltd.	1992-94
Granoble	Peto Seed Co. Inc..	1992-93
Mercedes (PSX2789)	Peto Seed Co. Inc.	1993-94
Sivan (H202)	Hazera Seed Ltd.	1992-94
Special 38	ARCO Seed Co.	1992-94
Texas Grano 502	Peto Seed Co. Inc.	1992-94

Table 2 Description of sites used for onion trials, 1992-94

Study number	Farm	Location	Soil type	Altitude (m)
1	Danny Liburd	Cades Bay (N)	Clay loam	10
	Phipps	New River (N)	Clay loam	15
	Seabrooks	Molyneaux (S)	Sandy loam	165
	CARDI	Mattingley (S)	Sandy loam	65
		Taylors (S)	Sandy loam	27
2.	Greenhill	Greenhill (S)	Sandy loam	300
	Bayfords	Bayfords (S)	Sandy loam	325
	Newman	Mattingley (S)	Sandy loam	120
3.	CARDI	Taylors (S)	Sandy loam	27
	Greenhill	Greenhill (S)	Sandy loam	300
	Cades Bay	Cades Bay (S)	Clay loam	10
	New River	New River (S)	Clay loam	15

(N) = Nevis; (S) = St Kitts

Experimental design and analysis.

The experimental design was a randomized complete block with a minimum of three replicates per farm. Plots were 2 m² in area and the experimental units were 1 m². Analysis of variance was carried out for marketable yield, number of marketable bulbs and bulb size. The ANOV Program (CARDI) was used for statistical analysis of the data.

Crop management

Onions were seeded on well prepared raised beds using a garden seeder. A seeding depth of 1.5 to 2 cm and a seed rate of 5.5 kg/ha was used. Five rows were planted on a 1 m bed with 20 cm between rows. Weeds were controlled by using DCPA (Dacthal W75) four days after seeding (DAS) at a rate of 12 kg/ha. This was followed at 30 DAS by pendimethalin (Prowl) at 5 L/ha. Each plot received one application of oxyfluorefin (Goal) at 0.25 L/ha to control established broadleaf weeds. Manual weeding was carried out when necessary but did not exceed two operations per plot.

The plants were fertilized at 21 DAS with NPK (15–15–15) at 538 kg/ha. Sulphate of ammonia (148 kg/ha) and muriate of potash (70 kg/ha) were applied together at 42 and 56 DAS. Pest and disease control were carried out when required. The onions were harvested when about 75% of the tops had fallen over. The observations recorded included marketable and unmarketable weights per plot, bulb size and days to maturity.

Storage

Mature, healthy bulbs from each variety were selected, graded and placed in netted bags on onion racks. The racks were placed indoors under ambient conditions. Bulbs suffered weight loss due mainly to sprouting, soft rot (*Erwinia* spp.), black mould (*Aspergillus* spp.) and dehydration. Total weight loss was recorded at monthly intervals for a period of 4 months after the establishment of the trial.

Specific trial details

Study 1: Evaluation of eight onion varieties, 1992/3

A trial was established in November 1992 using eight varieties (H7, H60, H9, H202, H8, Special 38, Granoble, Benshemen) and Texas Grano 502 as control on four farms in St Kitts and one farm in Nevis. The plots were harvested by 31 March 1993. Two replicates of 100 bulbs of each variety were placed in storage.

Study 2: Validation of four onion varieties, 1993/4.

The four new promising varieties, H7, H9, H60 and H202, were validated at Bayfords, Mattingley and Green Hill in St Kitts. The plots were established between 12 and 30 December 1994. On each farm the design was a 4 x 4 latin square. The method of establishment and the other details were similar to those described earlier. All the data were analyzed

using the CARDI Program No 2 ANOV version 6. Analysis was also conducted using non-traditional methods to account for spatial variation amongst plots.

Study 3: Evaluation of eight varieties, 1993/4.

This trial was established on two farms in Nevis and two farms in St Kitts. The plots were planted between 23 November and 14 December 1993. The varieties used were H7, H9, H60, H202, Ben Shemen, Special 38, Granoble, Texas Grano and PSX 2789. This trial was laid down as 8 x 4 latin squares.

Cured sound bulbs of the eight varieties were selected and separated into two bulb sizes; large and small to medium. Large bulbs were no less than 6.35 cm in diameter while small to medium bulbs were larger than 3.20 cm but less than 6.35 cm. The number of replicates per variety and size category varied, but the minimum number of replicates for any single variety was three. The data were analyzed using SAS statistical programme.

RESULTS

Study 1: Evaluation of eight onion varieties, 1992/3

Results from the trials are presented in Tables 3, 4 and 5. The occurrence of 'blast' disease at CARDI reduced yields at that site. The mean marketable yield for Texas Grano 502 across all farm sites was significantly lower than those for H7 and Special 38. The largest mean bulb size was obtained for Special 38. However, this was only significantly larger ($P < 0.05$) than that for H8. Bulb size was heavily influenced by plant stand and nutrition. The number of split bulbs for H8 is suggested for the smaller bulb size.

At Liburd the marketable yields for H7 and H9 were significantly higher than for the other varieties (Table 3). At Seabrookes H7, H202 and Special 38 produced marketable yields significantly ($P < 0.05$) higher than the other varieties. At Phipps H7, H202 and H60 produced the highest marketable yields ($P < 0.05$).

H60 produced consistently high yields and large bulbs (Table 4) on all farms and matured about 10 days later than H7. Variety H9 matured the earliest (95 DAS) while Ben Shemen was the latest maturing at 157 DAS (Table 5). Bulbing of Ben Shemen only occurred on the farms at Liburd and Seabrookes.

After 3 and 4 months in storage, H60, H202, H7 and H9 recorded the lowest percentage weight loss. These losses were significantly ($P < 0.05$) lower than the other varieties. Throughout the storage trial Special 38 and Texas Grano 502 recorded the highest storage losses (Table 5).

Table 3 Study 1: Mean marketable yields (kg/plot) for nine onion varieties on five sites in St Kitts and Nevis

Variety	CARDI	Peets	Phipps	Seabrookes	Liburd	Variety mean
H7	0.49	2.08	1.63	8.08	3.83	3.22
Granoble	0.84	2.05	0.99	5.03	1.38	2.06
Texax Grano	0.58	1.88	2.49	4.08	1.58	2.12
H8	0.50	1.16	1.48	3.73	0.83	1.54
H9	0.39	1.44	0.49	4.22	2.93	1.89
H60	0.95	1.69	2.62	5.96	2.13	2.67
H202	0.66	2.28	1.73	7.26	1.33	2.65
Special 38	1.06	2.69	1.06	6.86	2.35	2.80
Ben Shemen	0	0	0	4.45	1.63	1.22
Site mean	0.61	1.70	1.39	5.52	2.00	
SE (24 df)	0.25	0.44	0.48	1.25	0.54	

SED (32 df) for overall variety mean = 0.52

SED for site mean = 0.39

Table 4 Study 1: Mean marketable bulb size (g) for nine varieties of onion at five sites

Variety	CARDI	Peets	Phipps	Seabrookes	Liburd	Variety mean
H7	31.60	43.10	32.82	60.98	97.49	47.20
Granoble	38.18	39.80	50.33	57.35	89.30	54.99
Texax Grano	30.52	45.57	31.05	57.89	87.78	50.56
H8	31.25	25.21	42.28	46.92	40.00	37.13
H9	30.00	37.64	31.11	47.55	102.80	49.82
H60	35.50	38.85	45.96	55.44	95.73	54.30
H202	30.34	55.60	45.92	49.14	93.33	54.87
Special 38	25.54	59.12	33.12	53.59	108.05	55.88
Ben Shemen	0	0	0	42.48	65.20	21.54
Site mean	28.10	38.32	34.73	52.37	83.30	
SE (24 df)	6.45	17.93	9.11	7.49	21.37	

SED (32 df) for overall variety mean = 7.22

SED for site mean = 5.38

Table 5 Study 1: Percentage weight loss of onion varieties in storage

Cultivar	1 month	2 months	3 months	4 months
H7	4.97	10.41	23.80	31.27
Granoble	13.62	27.67	39.16	41.20
Texas Grano	11.67	20.11	34.02	38.14
H8	1.88	13.67	20.80	23.48
H9	3.74	11.95	27.92	29.54
H60	9.45	25.53	46.87	53.65
H202	23.64	31.18	57.97	65.75
Special 38	17.00	39.55	54.03	59.29
Ben Shemen	6.65	26.30	40.70	-
SED	7.28	9.17	9.38	10.05
df	9	9	9	8

Study 2: Validation of four onion varieties, 1993/4.

The results are provided in Tables 6 and 7. In Study 2 there were no differences in the mean marketable yields across all farms.

An examination of total and marketable yields showed no real difference in the performance of the varieties. There were significant differences between the varieties in the time to maturity at both Bayfords and Newman. At Bayfords the earliest maturing variety was H9 (94 days) followed by H7, H202 and H60. At Newman there was no difference in maturity time between H9 and H7 but H202 was the earliest maturing.

Table 6 Study 2: Marketable yield (kg/plot) of four onion varieties evaluated in St Kitts and Nevis

Variety	Bayfords	Newman	Greenhill	Variety mean
H7	2.86	3.21	1.06	2.37
H9	2.92	3.29	0.82	2.34
H60	2.35	3.80	0.93	2.35
H202	3.01	3.50	1.18	2.56
Site mean	2.78	3.45	0.99	
SED (15 df)	0.19	0.30	0.13	

SED (6 df) for overall variety mean = 0.22

SED for site mean = 0.19

Table 7 Days to maturity of four onion varieties evaluated in St Kitts and Nevis, 1993/94

Variety	Newman	Bayfords
H7	96.38	107.75
H9	94.00	110.13
H60	113.75	125.63
H202	105.63	106.51
SED (15 df)	1.92	3.22

Study 3: Evaluation of eight varieties, 1993/4.

In Study 3 the mean marketable yield across all farms was lowest for Texas Grano 502 and this was significantly lower than the other varieties except for H202, and H60.

The yield results, presented in Tables 8 and 9, indicate that there were differences in the marketable yield of varieties on all farms. There were definite significant differences amongst varieties for days to maturity with PSX 2789, H9 and H7 being the earliest. The results were consistent for all farms.

Table 8 Evaluation of eight onion varieties in St Kitts and Nevis 1993/94.
Days to 50% maturity

Variety	CARDI	Greenhill
H9	69.89	81.34
H7	73.69	79.61
Special 38	81.85	96.56
PSX 2789	67.78	75.67
Granoble	95.71	99.04
H202	96.83	103.03
H60	95.25	103.39
Texas Grano	95.24	102.11
SED (14 df)	1.98	2.11

Table 9 Evaluation of eight onion varieties in St. Kitts and Nevis 1993-94.
Marketable plot yield (kg)

Variety	CARDI	New River	Greenhill	Cades Bay	Variety mean
H9	4.91	4.35	2.49	4.38	4.03
H7	5.03	2.77	3.29	6.05	4.29
Special 38	4.66	5.72	3.00	7.10	5.12
PSX 2789	4.20	3.75	2.28	6.04	4.07
Granoble	4.47	2.78	2.58	3.43	3.32
H202	4.21	3.44	2.47	6.16	4.07
H60	3.46	2.89	1.98	6.29	3.66
Texas 502	3.71	1.14	2.18	5.80	3.21
Site mean	4.33	3.36	2.53	5.66	
SED (14 df)	0.48	0.77	0.28	0.56	

SED (21 df) for overall variety mean = 0.61

SED for site mean = 0.43

There were significant differences between the varieties in storage at 3 and 4 months for both number of bulbs and bulb weight. PSX 2789 and H7 recorded the lowest weight loss in storage while Special 38 and Texas Grano recorded the highest (Table 10). The smaller bulbs stored better than the large bulbs at both 3 and 4 months (Table 11).

Table 10 Percentage of sound bulbs loss after 3 and 4 months in storage

Variety	% at 90 days	SEM	%at 120 days	SEM
H60	24.36 (8)	3.72	32.76 (8)	4.68
H9	16.86 (8)	3.72	24.38 (8)	4.68
H7	14.90 (9)	3.51	21.12 (9)	4.41
Texas Grano	50.26 (3)	6.08	64.24 (3)	7.64
Granoble	20.01 (3)	6.08	47.24 (3)	7.64
PSX 2789	11.50 (5)	4.71	18.58 (5)	5.92
H202	24.72 (9)	3.51	32.28 (9)	4.41
Special 38	28.51 (4)	5.26	37.74 (4)	6.61

mean square error at 90 days = 110.85

mean square error at 120 days = 175.0

() No of replicates

Table 11 Percentage bulb number and weight loss after 3 and 4 months in storage for large and medium size onion bulbs

Bulb size	% bulbs at 90 days	% weight loss at 90 days	% bulbs at 120 days	% weight loss at 120 days
Large	27.39	33.06	39.70	45.75
Medium to small	20.40	28.10	29.88	36.58
SED	0.05	0.20	.03	0.04

DISCUSSION AND RECOMMENDATIONS

The marketable yields for the varieties H7, H60, H202 and Special 38 were consistently better than those of Texas Grano 502. Similar results were obtained in Montserrat (Weekes and Ross, 1994). There were variations for marketable yield for a particular variety between sites; these differences may be the result of the management practices and inherent soil fertility at the sites.

There was consistency in the maturity time for varieties at individual sites. The earliest maturing varieties tested were PSX2879, H9, H7 and H202 and these matured significantly earlier than Texas Grano 502. The differences in maturity time between two sites can be accounted for by the differences in elevation and temperature. The higher altitudes are known to have a lower temperature than the low elevations. Abdalla (1967) noted that at lower temperatures the time to maturity of onion bulbs increases.

Following the results of Study 1 it was decided that for the 1993/94 season, H7 should be recommended as the major commercial variety and that H9, H60 and H202 should be introduced into the production system albeit in small plots. It was observed that H8 produced many thick necks and split bulbs and that its yields were low. No further evaluation was necessary for H8. Variety Ben Shemen was recommended for further testing because it bulbed later and therefore could be used in extending the production season. A recommendation was made for testing new varieties as they were made available.

The earliest varieties (H9, H7 and PSX 2789) also exhibited the best keeping quality. The performance of PSX 2789 was encouraging since this variety produced high yields, matured early and stored well.

It was recommended that farmers should plant varieties with different maturity periods to provide an extension in the harvesting and marketing of the crop.

Following the results from the storage trials, Special 38, Granoble and Texas Grano were not recommended for further commercial production and in the 1994/5 crop these varieties were not commercially produced. Seed of Special 38 was also not available for

commercial production after 1993 because the company (ARCO) ceased production of the variety (F. Chandler, personal communication).

The three varieties, H7, H9 and H60, were commercially produced and should remain in the production system. The variety PSX 2789 with its high marketable yield, earliness and good storage life was recommended in the 1994/5 season for limited commercial production. This variety had been tested and recommended for production in Barbados in the 1993/94 season (Chandler, 1994).

The trials were supported by on-farm demonstration plots that served to introduce farmers to the varieties recommended for commercial production. Twelve demonstration plots were established between the 1992/93 and 1993/94 production seasons. The 1995 onion crop totalling 128 t was estimated to comprise 70% H7, 20% H9, 7% PSX 2789 and 3% H202. H60, although highly recommended, was not produced in 1994 and 1995 because of the unavailability of seed early in the cropping season. Ben Shemen is recommended for planting after February but has not been produced because of the shortage of water for irrigation.

The introduction of the new varieties has contributed to an increase in production from 7.5 t in 1991 to an estimated 128 t in 1995. The period of availability of onions on the domestic market has increased from 2 to 5 months (CARDI 1994) with planting occurring from September to January. The better storability of the new varieties has contributed to the reduction in post-harvest losses from 40% in 1992 to an estimated 15% in 1995. These new varieties have made it possible for export trials to Dominica. The average marketable yield of onion has increased from an 7.5 t/ha in 1991 to 15 t/ha in 1994.

The screening of new varieties is continuing and it is expected that further introductions will be made in the future.

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