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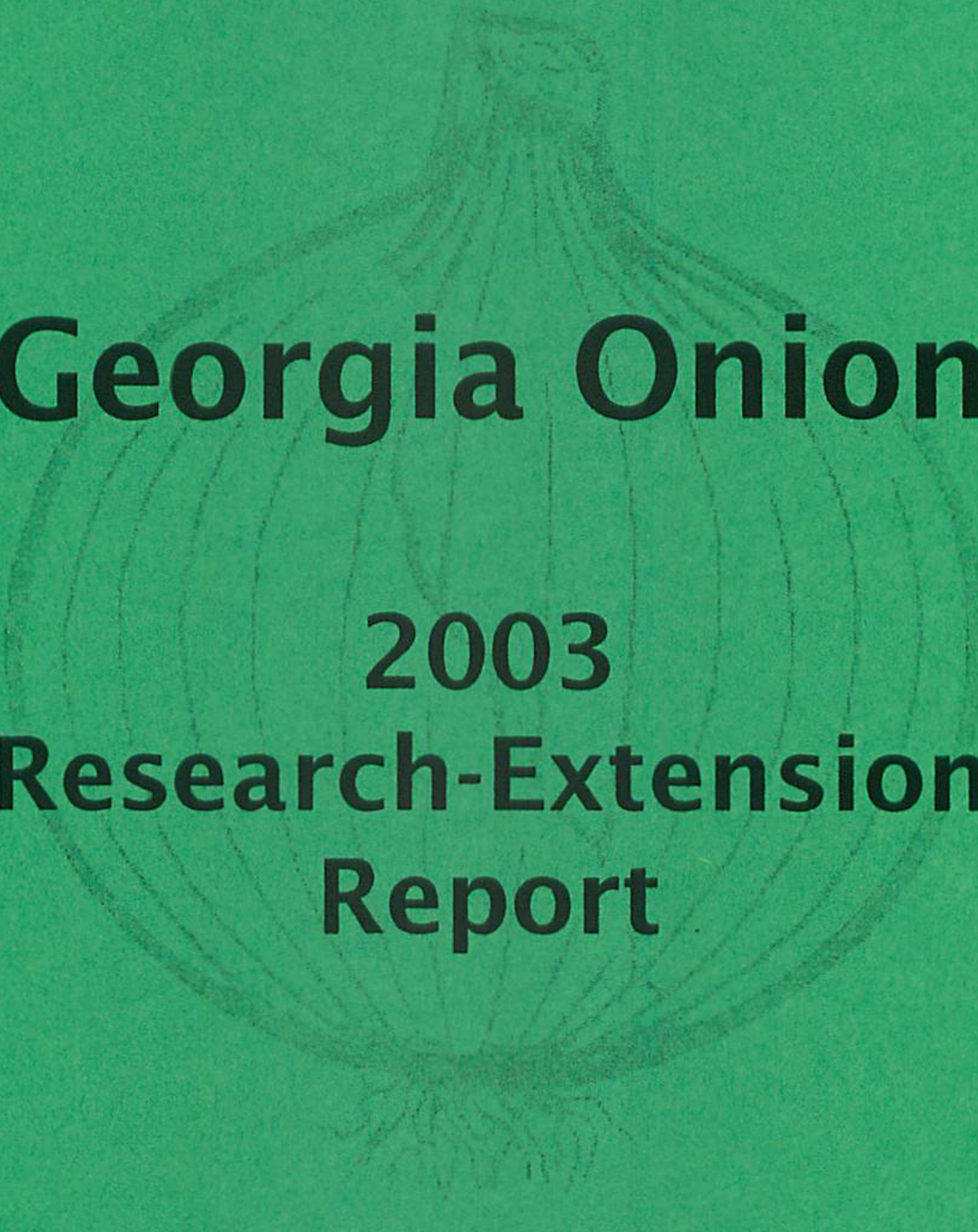

Georgia Onion

2003 Research-Extension Report

U.S. Department of Agriculture Cooperating

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2003 GEORGIA ONION RESEARCH - EXTENSION REPORT

(Summary Report of 2003 Data)

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Production costs supported by
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THE 2003 ONION RESEARCH-EXTENSION REPORT

Georgia's onion industry is primarily based upon the production of sweet onions, so called because of the mild pungency level and moderately high sugar level of varieties grown. Georgia's sweet onion industry is said to have originated on the farm of Moses Coleman, two miles East of Vidalia, more than 60 years ago. Mr. Coleman is given the credit of having observed the mild taste of some onions he had grown. It is reported that he sold a 50 pound bag for as much as $3.50. During 2003, growers in Georgia harvested over 12,500 acres of onions with an on farm value in excess of $75 million.

The University of Georgia and USDA/ARS, through Research and Extension programs, provide information on the production and handling of onions. The Onion Research-Extension Report is an official University of Georgia publication for conveying current information, either in the form of progress reports of research and demonstrations underway or reports of conditions in the field. Since the Onion Research-Extension Report is intended to convey current information, it should not be considered as a final authority containing peer reviewed manuscripts. The Onion Research-Extension Report may serve as a means of accountability to those who have supported the described programs. The Onion Research-Extension Report has been continuously edited and published since the first report, covering data gathered during 1992.

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VIDALIA ONION VARIETY TRIALS 2002-2003

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Introduction

Vidalia onion variety trials are part of a mandated testing program of the Georgia Department of Agriculture to insure mild onions. New varieties are required to undergo three years of trials and must have favorable results in comparison to the standard variety, Savannah Sweet. Criteria used to assess varieties are color, shape, pungency and taste panel evaluations. These onions must be a yellow Granex type over-wintering onion with a height to width ratio not greater than one. In addition, they must test favorably for pungency and in taste panel evaluations compared to Savannah Sweet. Varieties on the official list are required to remain in the trials in order to maintain their status. These trials are conducted annually by the University of Georgia.

Along with the mandated testing criteria, varieties are evaluated for yield, graded yield, seedstems, doubles, disease (when possible), storability in controlled atmosphere storage and single centers. These trials are supported by the Georgia Department of Agriculture, the Vidalia Onion Committee, various seed companies, and the University of Georgia. The trial begins in the fall with the sowing of seed for transplant production.

Materials and Methods

The trial was held at the Vidalia Onion and Vegetable Research Center in Lyons, GA. Seed were sown on September 20, 2002. These plants were harvested for transplanting to final spacing on December 3, 2002. Plants were set four rows to a bed, which were prepared with a 6-ft center-to-center spacing. Rows were 12 inches apart with a 5.25 inch in-row spacing. Each plot was 50 feet long with a 5-ft alley between plots on the same bed. Fertility, disease, and weed control followed University of Georgia Cooperative Extension Service recommendations for onion production. The experimental design was a randomized complete block with four replications. Twenty-five feet of each plot was harvested for yield data. Yield data consisted of field yield (representing yield at harvest); cured yield (after heat curing); the number of jumbos (greater than 3 inches in diameter); and the number of mediums (between 2 and 3 inches in size). The entire 50 foot plot of bed was used for data on stand count, seedstems, and doubles.

A ten bulb sample from each replication was composited for pyruvate testing, which is reported as micromoles per gram fresh weight. In addition, a ten bulb sample from replications one and two were evaluated by a professional taste panel for total sulfur, pungency, bitterness, heat and sweetness. The scale with the taste panel parameters is from 0-150.

R^2, coefficient of variation and an adjusted least significant difference (LSD) were calculated. The adjusted LSD is a Fisher's protected LSD that has been adjusted to allow five comparisons. It is equivalent to a Fisher's protected LSD at $p<0.01$. This year standard variety was changed from Granex 33 to Savannah Sweet.

Results and Discussion

The maximum number of onions (stand count) within a plot was 424. Reduction in stand count was a measure of how well a variety withstood the rigors of winter production (table 1). This season had much colder weather from about mid-January to mid-February than the previous season and had about 20 inches of rain during the growing season, which was about double from the previous season. It is not clear if these events affected production, but yields were about 100, 50-lb bags per acre fewer in 2002-2003 compared with the 2001-2002 season. A reduced stand in a particular variety was also reflected in yield reduction.

Every year has seen significant differences in seedstems among the varieties tested, but no varieties consistently have more or less seedstems from year to year. It is known that in years when cool temperatures occur near the end of the season the onions are more apt to develop seedstems. Seedstem formation or bolting is a function of both temperature and plant size. Plants must have a minimum amount of biomass in conjunction with low temperatures in order to bolt. Doubles are also a function of adverse weather conditions. Freezing temperatures that affect the growing point can result in an increase in double formation. Georgia Boy, SSC 6371 F1, and Sapelo Sweet had the highest number of doubles this season. Sapelo Sweet also had high numbers of doubles the previous season.

Typically, the onions to be harvested were pulled 2 days before clipping and left in the field to dry before clipping. Onion clipping began on April 9, 2003 and the last clipping date was May 14, 2003. Onions were harvested at approximately one week intervals as they matured. The greatest number of varieties harvested occurred on May 7, 2003.

Field yields ranged from 317, 50-lb bags per acre for Sweet Advantage to 911, 50-lb bags per acre for SRO 1001 (table 2). The best field yields were among the later harvested varieties. Cured yield was not reported for all varieties because heat curing was abandoned for late harvested varieties. Warm season bacterial diseases continue to be a problem with late harvested onions. This is exacerbated by heat curing, which sets up an environment for rapid spread of these diseases so reducing graded yields. In future trials, reporting cured yield data will probably be abandoned.

Varieties with the highest field yields tended to have the highest yields of jumbo onions. SRO 1001 and EX 19013 having the highest field yields, also had the highest jumbo yields of 814 and 521, 50-lb bags per acre, respectively. Finally, lower yielding varieties had higher yields of mediums. Table 3 summarizes the taste panel evaluations, pyruvate test, and sugar content. Total sulfur and sweetness in the taste test did not show any significant differences.

Summary and Conclusions

All of the varieties eligible for addition to the official variety list were recommended. These included Sapelo Sweet (DPS 1039), Granex Yellow PRR Asgrow, EX 19013, Sugar Belle F1 (SSC 6371 F1), SRO 1001 (RCX 5195-1), SSC 6372 F1, SRO 1000 (RCX 6043) and 99C 5092. The following were recommended for removal from the list: Rio Bravo, Yellow Granex Improved (Sun F1), Adonis, Dessex, and Mr. Max.

Southern Belle, PS 7092, Sweet Success (1514) and Sweet Melissa (SXO 1519), presently on the official list, were not entered in the trial for 2002-2003. Presumably, if these varieties are not entered in 2003-2004 they will have one more year of eligibility before being dropped from the official list. Southern Honey, presently on the official variety list, had a poor seed germination during the 2002-2003 season and was consequently not tested in 2002-2003.

Table 1. Evaluation for stand count, seedstems, doubles, yield, and harvest date.

Entry	Company	Stand Count[z] (No./50 ft. plot)	Seedstems (No./50 ft. plot)	Doubles (No./50 ft. plot)
Ohoopee Sweet (DPS 1024)	D. Palmer Seed	412	2	10
Georgia Boy (DPS 1032)	D. Palmer Seed	403	8	41
Mr. Buck (DPS 1033)	D. Palmer Seed	394	24	13
Sweet Advantage	D. Palmer Seed	389	0	12
Sapelo Sweet (DPS 1039)	D. Palmer Seed	383	2	20
Southern Honey	D. Palmer Seed		Poor Germination	
Yellow Granex EM 90 F1	Emerald Seeds (Clifton Seed Co.)	405	22	3
2012Y	K & B Development	405	25	1
2045Y	K & B Development	410	1	14
Savannah Sweet	Petoseed	401	1	0
99C 5092	Sakata Seed America, Inc	401	0	2
01ZG 5034	Sakata Seed America, Inc	406	11	6
Century (EX 07592000)	Seminis	389	2	3
Granex Yellow PRR	Seminis	401	8	6
EX 19013	Seminis	352	8	3
Granex 33	Seminis/Asgrow	409	6	5
Pegasus	Seminis/Asgrow	384	7	9
Cyclops (XP 6995)	Seminis/Asgrow	394	27	6
606 DY	Shaddy	401	1	1
72766 DY	Shaddy	380	1	3
SSC 6371 F1	Shamrock	418	1	26
SSC 6372 F1	Shamrock	383	9	5
SSC 33076	Shamrock	397	0	1
Nirvana	Sunseed	339	0	1
Sweet Vidalia	Sunseed	396	3	4
Sweet Melody	Sunseed	295	2	4
SRO 1000 (RCX 6043)	Sunseed	346	1	1
SRO 1001 (RCX 5195-1)	Sunseed	412	4	3
WI-3115	Wannamaker	400	2	4
WI-609	Wannamaker	408	3	5
WI-129	Wannamaker	410	2	4
	R^2	0.504	0.773	0.661
	CV	39%	36%	37%
	Adjusted LSD ($p<0.05$)	15	2	2

[z]Maximum stand count was 424.

Table 2. Harvest date and summary of yield.

Entry	Clipping Date	Field Yield (50-lb bags/A)	Cured Yield (50-lb bags/A)	Jumbos (50-lb bags/A)	Mediums (50-lb bags/A)
SRO 1001 (RCX 5195-1)	5/14/03	911		814	9
EX 19013	5/14/03	707		521	22
99C 5092	5/14/03	690		483	14
SSC 6371 F1	4/23/03	654	631	515	90
Ohoopee Sweet (DPS 1024)	5/2/03	644	609	420	53
WI-129	4/9/03	635	559	372	84
Century (EX 07592000)	5/7/03	614		419	53
Mr. Buck (DPS 1033)	5/7/03	607		445	95
Georgia Boy (DPS 1032)	5/7/03	599		313	58
01ZG 5034	4/23/03	569	547	409	76
Sapelo Sweet (DPS 1039)	5/2/03	564	529	393	90
Savannah Sweet	5/7/03	561		388	60
Granex Yellow PRR	5/14/03	555		388	30
Nirvana	5/7/03	547		230	22
Granex 33	5/7/03	546		252	59
Yellow Granex EM 90 F1	5/7/03	539		348	44
2045Y	5/2/03	535	497	319	124
Cyclops (XP 6995)	5/14/03	533		350	19
WI-3115	4/16/03	523	501	352	109
Pegasus	5/14/03	514		365	26
2012Y	5/7/03	511		307	37
WI-609	4/16/03	501	467	342	93
Sweet Vidalia	5/2/03	490	465	325	74
SRO 1000 (RCX 6043)	5/7/03	484		215	34
606 DY	4/9/03	437	384	149	117
SSC 6372 F1	4/23/03	415	396	259	109
SSC 33076	4/9/03	410	358	134	168
Sweet Melody	5/7/03	378		158	23
72766 DY	4/9/03	356	312	92	155
Sweet Advantage	4/16/03	317	297	85	178
Southern Honey					
	R^2	0.542	0.648	0.626	0.780
	CV	22%	17%	38%	40%
	Adjusted LSD ($p<0.05$)	221	154	240	52

Table 3. Taste panel evaluations, pyruvate analysis, and sugar content.

Entry	Total Sulfur[z]	Pungency[z]	Bitterness[z]	Heat[z]	Sweet[z]	Pungency (um/gfw)	Sugar (%)
99C 5092	23.1	23.6	12.8	21.4	27.7	4.4	8.0
01ZG 5034	22.2	29.1	14.9	28.3	28.2	4.0	8.5
Pegasus	25.8	30.4	15.3	27.7	23.6	5.0	7.5
Century (EX 07592000)	24.3	25.5	12.4	22.5	27.1	4.8	7.6
Cyclops (XP 6995)	24.3	27.5	12.9	22.0	24.2	4.6	10.7
EX 19013	24.9	26.0	13.8	24.4	24.4	4.4	7.2
Granex 33	27.6	29.6	15.6	27.7	21.8	5.0	7.7
Granex Yellow PRR						4.5	
Savannah Sweet	23.6	27.3	13.7	23.4	23.9	4.1	7.1
Nirvana	27.0	28.2	17.7	26.4	23.5	4.5	7.5
Sweet Melody	24.7	26.0	13.6	22.7	24.7	4.4	7.4
Sweet Vidalia	24.9	29.3	14.3	25.4	27.5	4.4	7.8
SRO 1000 (RCX 6043)	24.5	25.9	13.8	23.2	24.2	3.9	7.2
SRO 1001 (RCX 5195-1)	22.6	23.3	11.1	19.5	25.8	3.7	7.2
WI-609	20.6	25.0	13.0	24.6	28.3	3.7	7.2
WI-129	24.1	28.6	13.7	29.0	24.0	3.4	7.1
WI-3115	23.0	30.6	15.8	29.4	26.7	3.9	7.2
Yellow Granex EM 90 F1	23.2	23.9	12.4	20.3	25.4	4.3	8.1
SSC 6371 F1	24.8	33.0	17.9	28.5	22.4	4.9	8.5
SSC 6372 F1	23.5	31.9	14.5	27.3	25.5	4.7	9.7
SSC 33076	20.4	28.0	12.7	26.9	25.2	2.8	6.5
2012Y	24.5	26.1	13.1	24.0	24.3	5.0	7.8
2045Y	24.6	31.8	14.2	28.0	25.7	4.8	8.3
606 DY	21.8	29.9	14.2	27.7	25.2	3.2	6.3
72766 DY	20.7	26.0	12.3	22.0	25.1	3.0	6.9
Mr. Buck (DPS 1033)	24.3	27.2	13.8	24.5	24.3	4.6	7.6
Southern Honey							
Georgia Boy (DPS 1032)	27.0	29.3	16.6	28.5	22.6	4.7	8.8
Sweet Advantage	23.4	32.9	18.4	29.5	23.4	4.6	8.6
Ohoopee Sweet (DPS 1024)	26.7	26.9	15.6	23.9	25.0	4.7	8.4
Sapelo Sweet (DPS 1039)	26.9	28.9	14.2	25.2	25.8	3.8	9.1
	0.090	0.170	0.160	0.212	0.123	0.537	0.707
	26%	22%	30%	23%	19%	14%	11%
	NS	7.5	5.2	7.1	NS	3.0	1.6

[z]0-150 scale with 0-no taste, 150 intense taste; Total Sulfur-yolk of hard cooked egg=40; Pungency-horseradish=150, garlic=80; Bitterness-0.05%, 0.08%, 0.15% caffeine solutions=20, 50, 100; Heat-garlic=50, salsa=90; Sweet-2%, 5%, 10%, 16% sucrose solution=20, 50, 100, 150.

ON-FARM ONION VARIETY TRIAL IN BRANTLEY COUNTY

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Bob Boland, Extension Agent, Brantley County

Introduction

Short-day overwintering onion production is not restricted to the Vidalia growing region and growers in other regions of south Georgia have from time to time shown interest in producing the characteristic mild onions.

Small growers are looking for new crops, new opportunities, and new methods of marketing. Small scale, roadside markets are one avenue that has shown promise. Sweet onions can be an excellent choice for such growers. Although using the Vidalia trademark is not open to growers outside the Vidalia region, there are other marketing possibilities such as using the term 'Georgia Sweets'.

One grower in Brantley County has built a small fresh vegetable and fruit business offering a diverse selection of produce. With the help of the local county agent, he is marketing sweet onions under the name of 'Okefenokee Sweets'. A study was undertaken to evaluate short-day onion varieties that could be suitable for such small scale production practices.

Materials and Methods

Onion transplants were produced at the Vidalia Onion and Vegetable Research Center and transported to the Brantley County location for transplanting. Plants were transplanted into plastic mulch covered raised beds that were approximately 3 feet wide and 6 inches high. Two rows of onions were planted on these beds with an approximate in-row spacing of 6 inches and a between row spacing of approximately 18 inches.

The experimental design was a randomized complete block with three replications. Each plot was 20 feet long. Onions were harvested on May 14, 2003. Tops and roots were removed and the onions were counted and weighed.

Yield, number, and weight per bulb are summarized in table 1. The highest yielding varieties were Georgia Boy and Mr. Buck with average yields of 16.5 and 15.5 pounds per plot, respectively. These yields were significantly higher than Cyclops, Sweet Melody, Sweet Advantage, and WI 3115. Georgia Boy also had the greatest number of bulbs per plot. Generally, varieties with higher yields had a greater number of bulbs per plot. Although each plot was planted to the same number of bulbs, differences in bulb number per plot were probably due to a combination of factors that included losses due to disease and environmental stress as well as differences in varietal maturity dates. Variety is known to be a strong factor in maturity date. From previous experience, varieties mature over approximately one month. Early varieties would have been well past maturity on May 15th when the onions were harvested and would have been subject to losses due to over-maturity.

Summary and Conclusions

In conclusion, onion production is certainly viable under other production practices such as using plastic mulch. Hoever, caution should be exercised when making variety selections based on only one year's worth of data.

Table 1. On-farm evaluation of onions, Brantley County.

Entry	Yield (lbs/plot)	No. bulbs/plot	Weight/bulb (oz.)
Georgia Boy	16.5a	19.7a	13.5bc
Mr. Buck	15.5a	14.3ab	17.0ab
Pegasus	13.4ab	12.0bc	18.1a
SSC 6371	12.8ab	13.7bc	15.0abc
Ohoopee Sweet	11.6abc	15.0ab	12.2cde
SSC 6372	11.6abc	14.7ab	12.8cd
Cyclops	8.3bc	8.3c	15.7abc
Sweet Melody	7.5bc	12.3bc	9.7de
Sweet Advantage	7.4bc	12.0bc	9.8de
WI 3115	6.3c	11.7bc	8.8e

[z]Means followed by the same letter within a column are not significantly different by Duncan's Multiple Range Test ($p<0.05$).

EVALUATION OF CONTROLLED ATMOSPHERE STORAGE, SINGLE CENTERS AND BULB HEIGHT/WIDTH RATIO AMONG VARIETIES GROWN FOR THE 2001-2002 VARIETY TRIALS

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Heath Paradise, Extension Agent, Treutlen County
Jeff Cook, Extension Agent, Tattnall County
Randy Hill, Superintendent, Vidalia Onion and Vegetable Research Farm
Thad Paulk, Research Technician

Introduction

At the end of each onion harvesting season, a sample of each variety is placed in controlled atmosphere (CA) storage to evaluate storability in terms of marketable onions. In addition, as part of the ongoing evaluation of onions, upon removal from storage they are characterized as to the number of centers in each bulb and their height to width ratio.

CA storage is a low oxygen (3%), high CO_2 (5%) refrigerated (34 deg. F) atmosphere environment that can extend the shelf life of short-day onions. The introduction of this technology has dramatically increased the number of acres of onions grown in Georgia and has extended the availability of sweet onions into late summer and fall. Onions grown as Vidalia onions are a yellow Granex onion, which are characterized as broad on the distal (leaf) end of the bulb, tapering to the proximal (root) end with a height to width ratio below one. Onions with a height to width ratio greater than one are referred to as torpedos and are undesirable for this market. There are, however, some growers who are interested in onions that are close to one in the height to width ratio because they are better suited for onion ring processing, yielding more rings per onion. Single centers are also desirable for this processing market. Onions that average more than a single center produce fewer rings per onion.

Materials and Methods

Samples from each plot from the 2001 - 2002 variety trial at the Vidalia Onion and Vegetable Research Center (VOVRC) were transported to the Vidalia Storage Laboratory in Tifton, Georgia. The trial at the VOVRC was of a randomized complete block design with four replications. Approximately 50 pounds of graded onions from each plot were weighed and then placed in CA storage on about May 14, 2002. Onions were removed from storage on October 7, 2002, and immediately evaluated as to the weight of marketable onions. Then the marketable onions were kept at ambient room temperature for an additional 14 days and re-evaluated as to the weight of marketable onions. The percentage of marketable onions both immediately after CA storage and after a further 14 days of ambient storage was calculated based upon the pre-storage weight of onions.

A five-bulb sample from each plot was measured for bulb height and width after removal from CA storage. Each of these bulbs were then cut across the width, perpendicular to the growing axis and the number of centers recorded.

Results and Discussion

Table 1 lists the results of CA storage, the number of bulb centers by percentage weight and the height to width ratios. The table is sorted in descending order, based upon the percentage of marketable onions remaining after the onions have been removed from CA storage and held for a further 14 days under ambient temperature. Immediately following removal from storage, the onions had a percentage of marketable onions ranging from 61.0 - 90.4%. Then 14 days later the number of marketable onions dropped to a range of 32.4 - 83.2%. During the previous year, 2000 - 2001, the range was 18-63% marketable for onions immediately after removal from storage and no data was collected on the percentage of marketable onions 14 days after removal.

The earlier or later harvested onions generally had less marketable onions. It is not altogether clear why this is so. The later harvested onions are more susceptible to warm season bacterial diseases, but this is generally not the reason for the high number of culls. Usually high cull rates are due to Botrytis neck rot, which is difficult to detect prior to onion placement in CA storage. In 2002, Botrytis neck rot accounted for 77% of all the culls from storage.

Varieties with the lowest average number of centers were RCX 5195-1 and WI-609, with 1.0 and 1.1 average number of centers, respectively. Sweet Melody, Yellow Granex PRR Sunseed, and Mr Buck had the highest number of centers, all with an average number of 2.0 or higher.

The height to width ratio among the varieties tested ranged from 0.65-1.11. The two varieties with height to width ratios above 1.0 were Numex Chaco and Liberty, both of which are not on the official list of Vidalia onion varieties. WI-3115 and Georgia Boy had height to width ratios of 0.90 and 0.94, respectively. Based on this data these varieties would be better suited for processing, however, it should be noted that traditionally WI-3115 has had a much lower height to width ratio. More than one year of data should be used before assessing any variety for a specific characteristic.

Table 1. Controlled atmosphere storage results, average number of bulb centers, and height to width ratios for varieties entered in the 2002 onion variety trial.

Cultivar	Seed Company	Days after Removal From CA Storage 0	14	Bulb Centers (No.)	Height/Width Ratio
Georgia Boy (DPS 1032)	D. Palmer Seed	90.4%	83.2%	1.4	0.94
Sapelo Sweet (DPS 1039)	D. Palmer Seed	87.7%	82.6%	1.7	0.69
SSC 6372 F1	Shamrock	86.8%	82.4%	1.2	0.68
Ohopee Sweet (DPS 1024)	D. Palmer Seed	88.6%	81.7%	1.9	0.70
RCX 6043	Sunseeds	87.6%	79.4%	1.2	0.65
Sweet Advantage	D. Palmer Seed	85.1%	79.1%	1.5	0.79
Numex Chaco	Lockhart	89.4%	78.5%	1.2	1.04
Sweet Melissa	Sunseeds	88.0%	77.4%	1.5	0.69
Sugar Belle F1 (SSC 6371)	Shamrock	83.7%	76.6%	1.2	0.69
PS 7092	Seminis/Petoseed	86.8%	76.3%	1.5	0.72
Nirvana (1027)	Sunseeds	84.7%	74.8%	1.3	0.73
Sweet Vidalia	Sunseeds	84.5%	74.2%	1.2	0.69
99C 5092	Sakata	80.8%	72.7%	1.4	0.77
WI-609	Wannamaker	83.5%	72.5%	1.1	0.67
EX 07592001	Seminis/Asgrow	83.0%	72.4%	1.2	0.75
EX 07592000	Seminis/Asgrow	83.4%	71.6%	1.7	0.73
Southern Belle	D. Palmer Seed	79.2%	71.1%	1.7	0.76
Granex 33	Seminis/Asgrow	80.7%	70.6%	1.6	0.79
Pegasus	Seminis/Asgrow	81.0%	69.5%	1.5	0.72
Liberty	Bejo Seed Co.	85.1%	69.0%	1.5	1.11
Southern Honey	D. Palmer Seed	81.6%	69.0%	1.6	0.71
EX 19013	Seminis/Asgrow	86.3%	68.5%	1.3	0.79
RCX 5195-1	Sunseeds	79.4%	66.5%	1.0	0.71
Granex Yellow, PRR Asgrow	Seminis/Asgrow	81.0%	66.5%	1.5	0.69
Rio Bravo	Sunseeds	81.4%	65.2%	1.9	0.72
Yellow Granex PRR Sunseed	Sunseeds	79.7%	62.2%	2.4	0.72
WI-3115	Wannamaker	77.3%	61.9%	1.8	0.90
Savannah Sweet	Seminis/Petoseed	79.8%	52.5%	1.6	0.78
Mr. Buck (DPS 1033)	D. Palmer Seed	76.5%	52.3%	2.6	0.74
Cyclops (XP 6995)	Seminis/Asgrow	75.7%	49.3%	1.4	0.76
Sweet Melody	Sunseeds	61.0%	32.4%	2.0	0.78
	R^2	0.418	0.564	0.593	0.784
	CV	7%	11%	8%	8%
	Adjusted LSD ($p \leq 0.05$)	2.3%	4.1%	0.5	0.12

EVALUATION OF ORGANICALLY PRODUCED ONION TRANSPLANTS AND ORGANIC WEED CONTROL IN ONIONS

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Introduction

Organic production is considered the fastest growing area in U.S. agriculture and, with the adoption of USDA national standards for organic production, should continue to grow. Vidalia onions command a premium in the marketplace and if, they could be organically produced, would command even higher prices.

There has been considerable interest in the organic production of sweet onions. However, they present a challenge since they are heavy feeders. This is even more challenging in the Southeast with our long growing season, mild winter, and humid conditions. Such an environment makes it difficult to acquire and maintain high organic levels in the soil, the cornerstone of organic production. Mild winters in Southeast Georgia mean that cool season crops like onions can be grown there, but it means that weeds continue to grow as well.

A study was undertaken to evaluate onion transplant production under organic conditions and the use of various mulches for weed control.

Materials and Methods

Approximately four inches depth of compost, obtained from the Georgia Department of Corrections, was applied and incorporated at the site the plantbed onions were to be produced. In addition, a ton per acre of poultry litter was obtained from a local poultry farm and applied. These were both incorporated and then the bed prepared as done for conventional onion plantbed production.

A four-row vacuum planter, set to plant onions at a rate of 30-70 seed per linear foot, was used to seed varieties Sweet Vidalia, Cyclops, Nirvana, and Sugar Belle (SSC 6371). The between row spacing was set at 12 inches. Each variety was sown in a single row approximately 100 feet long on October 1, 2002. Approximately four weeks after seeding, an additional ton per acre of poultry litter was top dressed on the onions.

Transplants were harvested on January 15, 2003 and evaluated for length, diameter, and weight. Conventionally produced transplants of varieties Cyclops and Sugar Belle were also evaluated for length, diameter and weight for comparison with those organically grown.

The transplants were transported to an on-farm location in Screven County and planted on December 28, 2002. They were planted four rows to a bed with an approximate between-row spacing of 12 inches and an in-row spacing of five inches.

Four different mulch treatments were applied to these onions in a randomized complete block design with four replications. Each plot was 20 feet long. The treatments were: no weed control, wheat straw, Bermuda hay, and compost.

Data collected at the on-farm location included yield per plot, a weed control rating and weight of a 10-bulb sample per plot. The weed control rating was based on a 0-5 scale with 0 being no weeds and 5 being extremely weedy.

Results and Discussion

There was not much difference in the length or diameter of transplants grown conventionally or organically, but the weight of the conventionally produced transplants were heavier than those grown organically (table 1). Producing transplants of adequate size to handle and survive the winter may be a difficult part of organic onion production. Insufficient amounts of poultry litter, the main source of nitrogen, may have been used.

Evaluation of the various mulches for weed control in onions is summarized in table 2. The highest yields were in the plots with no mulch whereas wheat straw and Bermuda hay had an apparent alleopathic effect on the onions while surpressing the weeds. The mulch was applied after transplanting, which may have been a mistake since the onions were planted so close together and placing mulch around the plants was difficult without leaving much of the mulch on the plants. It may have been better to first mulch the ground and then plant the onions, keeping mulch away from the base of the plant.

The relatively poor weed control rating for wheat straw (table 2) does not reflect its ability to control weeds, but rather that wheat seed in the straw germinated as the season progressed and became the major weed in these plots.

Compost also provided poor weed control (table 2). This material stimulated weed growth more than any other treatment. The fertility of the compost material was probably exhibited by the weed growth. The use of this material as a weed control measure could probably require applications during the growing season.

Summary and Conclusions

In conclusion, wheat straw and Bermuda hay both had relatively good weed control characteristics, however the germination of wheat seed reduced the effectiveness of the wheat straw. It is possible to obtain wheat straw that is relatively free of wheat seed. The wheat should have been harvested prior to baling the straw. It may be possible to assess the wheat seed content of straw bales prior to use, thus eliminating or at least reducing this problem.

Compost does not appear to be a good choice of mulch unless applications are made to smother emerging seedlings. With small scale onion production, hand weeding and hoeing may be necessary and beneficial.

Table 1. Comparison of conventionally and organically produced onion transplants.

Variety	Length (cm)	Diameter (cm)	Weight (gm)
	Conventional Production		
Cyclops	31.4	0.8	18.6
6371	38.1	0.7	12.0
	Organic Production		
Sweet Vidalia	33.9	0.6	6.1
Cyclops	23.4	0.5	4.4
Nirvana	25.1	0.5	3.9
6371	19.5	0.4	2.8

Table 2. Effect of mulches on yield, weed control and bulb weight.

Treatments	Yield (lbs/plot)	Weed Control Rating^z	Bulb Weight (lbs/10 bulbs)
Nothing	19.0	4.3	2.4
Wheat Straw	5.1	4.3	1.5
Bermuda Hay	11.3	1.3	1.7
Compost	13.8	4.8	2.5

^{z}0-5 Scale, 0-No weeds, 5-Extremely weedy.

EVALUATION OF FERTILITY FOR DRY BULB ONION PRODUCTION

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Introduction

Onions are considered heavy feeders requiring fertilizer throughout the season to insure adequate growth. Soil test recommendations for dry bulb onions have not been updated in quite some time, therefore fertilizer research has been under way for the past few years to develop new recommendations for the soil test laboratory.

This is the last year of testing for onion fertilizer rates prior to making changes in the soil test recommendations. This year's study concentrated on the evaluation of different rates of phosphorus fertilizer with different sources of nitrogen and different rates of potassium were evaluated along with diammonium phosphate (DAP) as the sole nitrogen source. Two different formulations of complete fertilizer were also evaluated. Onon yield was the criterion for selection among the different fertilizer practices.

Materials and Methods

A soil test revealed that the soil to be utilized for this study required 150-40-180 units of nitrogen, phosphorus, and potassium, respectively for onion production. In addition, 60 units of sulfur were recommended. This study consisted of 24 treatments arranged in a randomized complete block design of four replications. Each plot was 20 feet long and consisted of four rows of onions planted with a 5.25 inch in-row spacing and a 12 inch between-row spacing on beds that were prepared with six feet center-to-center spacing. Fertilizer application was based on the soil test recommendation for those elements not under test.

Variety Nirvana was transplanted to these plots on December 4, 2002. Three fertilizer applications were made on January 3, February 6, and March 3, 2003. Unless P was part of a treatment, all P was applied on the first application date. Sulfur application was split with half applied on January 3rd and half on February 6th. Six different rates of P were applied either with 150 units of NH_4NO_3 or $CaNO_3$ as the N source. The P rates were 0, 40, 105, 170, 235, and 300 units.

DAP was used as the sole nitrogen source at 75, 100, and 150 units of N. Five different rates of K were also evaluated; 0, 70, 100, 160, and 190. Two liquid fertilizer products from Regal Chemical Co. (Alpharetta, GA), 18-6-8 and 14-0-12 with 8% sulfur were evaluated. Fertilizer of analysis 18-6-8 was applied to supply 150 units of N in 3 split applications on the dates noted above. Fertilizer of analysis 14-0-12 was applied in 2 applications on the first and second fertilizer application dates.

Finally, Meister slow release fertilizer 19-8-19 (Helena Chem. Co., Memphis, TN. Meister is a product of Chisso-Asahi Fertilizer Co., LTD., Tokyo, Japan) was applied at a rate of 125 or 150 units N. All the fertilizer was applied during the first fertilizer application date.

Results and Discussion

Interestingly, there were no differences in yield or graded yield among the treatments in the study (table 1). It has been noted in this study as well as in previous year's that applications of P particularly with NH_4NO_3 or as DAP resulted in larger, greener tops. Phosphorus uptake is known to be low under cool soil conditions even when high levels of soil P are present. This apparently explains the dramatic effect on plant tops when extra P is applied. This did not however translate into higher yields of onions.

Regardless of the amount of K applied, it did not appear to have any affect on onion yield. This mimics previous years' results where with or without K application there was no effect on onion yield.

The Liquigreen products from Regal Chemical are based on a urea formaldehyde N source. There are various sized molecular chains of urea formaldehyde in these formulations. The chain lengths of these molecules determine how quickly the N is available to the plant resulting in a slow release form of N. The chemical company claims that the product can be applied once for season long nitrogen availability, however this chemical like other slow release formulations is about three times the cost of conventional fertilizer. The advantage of a product such as this would be that application would occur only once and, because it is a liquid, it could be applied through the irrigation equipment.

Meister is also a slow release product that comes as a granular product. It also has the advantage of a one time application. The manufacturer recommends it be band applied directly under each row. We have applied this product banded, preplant incorporated, and broadcast with good success in all cases. With any high priced slow release product, environmental factors can have an effect on availability and efficiency. Unusually high temperatures or high rainfall can result in the need for additional fertilizer. Such unforeseen added expenses could make these products uneconomical to use.

Table 1. Fertilizer treatment effects on onion yield.

Treatment[z]	N-P-K (lbs/acre)	Field Yield 50-lb bags/Acre	Cured Yield 50-lb bags/Acre	Jumbos 50-lb bags/Acre	Mediums 50-lb bags/Ac
150 units N (NH_4NO_3), 0 units P_2O_5	150-0-180	532	370	160	36
150 units N (NH_4NO_3), 105 units P_2O_5	150-105-180	519	446	166	36
150 units N (NH_4NO_3), 170 units P_2O_5	150-170-180	452	388	129	33
150 units N (NH_4NO_3), 235 units P_2O_5	150-235-180	564	440	127	16
150 units N (NH_4NO_3), 300 units P_2O_5	150-300-180	518	375	69	12
150 units N (NH_4NO_3), 180 units K_2O	150-40-180	511	478	206	34
75 units N (DAP)	75-200-180	344	316	93	33
100 units N (DAP)	100-267-180	474	394	144	37
150 units N (DAP)	150-400-180	535	423	114	30
0 units K_2O	150-40-0	510	442	184	25
70 units K_2O (KCl)	150-40-70	431	353	117	21
100 units K_2O (KCl)	150-40-100	476	371	145	31
160 units K_2O (KCl)	150-40-160	449	386	163	40
190 units K_2O (KCl)	150-40-190	510	429	166	38
Regal Chemical (Liquigreen 18-6-8)	150-50-67	441	304	97	47
Regal Chemical (Liquigreen 14-0-12, 8% Sulfur)	150-0-129	506	353	133	56
Meister (19-8-19, 4.9% Sulfur)	125-53-125	430	358	73	48
Meister (19-8-19, 4.9% Sulfur)	150-63-150	472	397	125	47
150 units N ($CaNO_3$), 0 units P_2O_5	150-0-180	469	406	184	46
150 units N ($CaNO_3$), 40 units P_2O_5	150-40-180	419	359	184	29
150 units N ($CaNO_3$), 105 units P_2O_5	150-105-180	530	444	146	32
150 units N ($CaNO_3$), 170 units P_2O_5	150-170-180	457	384	122	28
150 units N ($CaNO_3$), 235 units P_2O_5	150-235-180	476	404	140	28
150 units N ($CaNO_3$), 300 units P_2O_5	150-300-180	544	454	180	25

[z]All treatments received 60 lbs per acre sulfur except Regal & Meister treatments.

PRELIMINARY EFFECTS OF TRANSPLANT SIZE ON ONION YIELD AND NUMBER OF SEEDSTEMS

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Introduction

Vidalia onions are primarily grown as a transplanted crop. Seed are sown in September in high density plantings and grown for 8-10 weeks prior to transplanting to their final spacing typically in November or December. Onion transplanting however can extend into February. This means that the size of the transplants can be significantly different because of this delay in planting. In addition, even when transplanted at the ususal time, there can be differences in transplant size. These differences can be due to variety, fertility, irrigation, as well as other environmental conditions. Generally, growers will harvest and reset transplants keeping varieties separate, but will make no effort to size transplants. However, there may be an informal assessment of transplant size, delaying transplanting if the transplants are deemed too small or advancing transplanting if they are deemed to be too large.

Workers that do the actual transplanting, in general, will also not make any distinction concerning transplant size. Informally, it has been noticed that when transplants are spindly, workers are apt to throw them away rather than have difficulty in transplanting them. Workers will also remove more of the top particularly with large transplants so they can be more easily planted. Workers want a transplant that can be easily handled and quickly planted, since they are paid by piece work. Other than these cases, there is no systematic attempt at grading transplants. This study was undertaken to assess the effect of transplant size on onion yield and seedstem development.

Materials and Methods

Transplants of Granex 33 were visually graded into three categories; small, medium, and large and transplanted on December 18, 2002. The experimental design was a randomized complete block with three replications. Each plot was 10 feet long and consisted of four rows of onions planted with a 5.25 inch in-row spacing and a 12 inch between-row spacing on a slightly raised beds set six foot center-to-center.

Seedstems were counted for each plot on April 25, 2003 and the onions were harvested on May 19, 2003. Harvested onions were weighed immediately and then graded into jumbos (>3 inches diameter) and mediums (2-3 inches diamter).

Results and Discussion

There were no differences in total, jumbo, or medium yields due to transplant size (table 1). There were differences with the number of seedstems per treatment with the large transplants having the greatest number of seedstems, averaging 19.3 per plot, which was significantly greater than the small transplants with an average of 4.0 seedstems per plot.

This preliminary data supports other research that has shown that larger plants, as they approach maturity, are more apt to develop seedstems than smaller plants. This work is preliminary and should be viewed with caution. It does suggest that further work should be done in this area. It is unlikely that growers will begin grading transplants prior to replanting, but information such as this may make it possible to predict the likelihood of seedstem formation due to transplant size. Growers might be able, at that point, to take action to minimize seedstem formation by adjusting fertility, removing more of the top prior to transplanting and/or adjusting the time of transplant harvest.

Table 1. Effect of transplant size on yield and seedstem formation.

Transplant Size	Field Yield (lbs/plot)	Jumbos (lbs/plot)	Mediums (lbs/plot)	Seedstems (No./plot)
Small	17.1	6.6	7.0	4.0 a[z]
Medium	18.9	9.4	7.5	13.5 ab
Large	17.7	7.9	6.5	19.3 b

[z]Means followed by the same letter are not significantly different by Duncan's Multiple Range Test ($p<0.05$).

EVALUATION OF VARIOUS PARAMETERS FOR DIRECT SEEDING OF VIDALIA ONIONS

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Introduction

The Vidalia onion crop has traditionally been a transplanted rather than direct seeded crop. Seedlings are grown in the late summer to early fall and transplanted to their final spacing in the late fall to early winter. There are several reasons for transplanting rather than direct seeding. Plants have an increased liklihood of cold hardiness and, in the Spring, a reduced likelihood of bolting (forming seedstems). The seedbed can easily be irrigated on a small plantbed area during hot, dry periods of late summer and early fall. Transplanting results in a stand of onion plants properly spaced and with very few skips.

Disadvantages of transplanting onions amount to the cost and the high requirement for labor. Although Vidalia onions are a high value crop and therefore the cost can be justified at the moment, the future availability of inexpensive labor is not assured. Circumstances surrounding labor availability could radically change at some point in the future.

Materials and Methods

Onion varieties Sweet Vidalia, Pegasus, Nirvana, and Century were direct seeded on three dates, October 7, 21, and November 5, 2002. Four rows were direct seeded with a Monosem vacuum planter model 540 (Lenexa, KS) with 12 inches between rows. The planter used a 36-hole plate set to plant at 5.375 inches. The seed were coated with a polymer to insure proper singulation (Filmcoat Plus coating, Harris Moran Seed Co., Salinas, CA).

The experiment was set up as a randomized complete block design of three planting dates with two replications. Each plot consisted of approximately 400 feet of direct seeded onions. Onion varieties were subplot effects of these planting date main plot effects.

Fertility consisted of using 5-10-15 fertilizer preplant incorporated at 800 pounds per acre. No further fertilizer was applied until December 19, 2002 when University of Georgia Cooperative Extension Service recommendations for dry bulb onions were followed until harvest.

In addition to the above fertilization protocol, early fertilizer application as a subsample effect was superimposed on the first and second planting date main plot effects configured as a randomized complete block design with four replications of 20 foot plots. These early fertilizer applications consisted of three treatments; no fertilizer, 150 pounds/acre of $CaNO_3$ or 200 pounds/acre of diammonium phosphate (DAP). For the October 7, 2002 planting date, these early fertilizer treatments were applied on November 14, 2002 and for the October 21, 2002 planting date these early fertilizer treatments were applied on November 26, 2002.

Mowing the onion tops was conducted as a subsample of the planting date main plot. This was configured as a randomized complete block design with four replications of 20 foot plots. Treatments were those of plots unmowed and plots mowed on March 12, 2003.

Plant spacing was measured on January 23, 2003 and March 24, 2003. Seedstems were counted on April 29, 2003 and onions were harvested on May 1, 2003.

Results and Discussion

Overall, based on this study and on prior experience, an October 15 planting date plus or minus one week appeared to be most satisfactory. Direct seeding earlier than this increased the risk of large numbers of seedstems at harvest. Planting later then this resulted in there being insufficient time for plant development prior to cold winter weather. Underdeveloped plants appeared to have insufficient cold hardiness. No data was collected on the November 5, 2002 seeding date. Neither plant stand nor plant growth was very good with this planting date and it was decided to abandon it early in the study.

Plant spacing is reported as the percentage of plants with less than a four inch in-row spacing (table 1). Earlier work with raw seed using a belt planter yielded poor results with plants seeded too close together. This ocurence resulted in misshapen bulbs and a poor yield. Other work with raw seed and a vacuum planter also resulted in seed too close together and with poor singulation. The vacuum planter in many cases picked up two or more seeds per hole on the planter plate. Seed coated with the polymer coating worked well and ensured seed singulation through the planter. This was evident from results during the 2001-2002 season. During the 2002-2003 season the coating was not correctly applied and the seed surface was not smooth. During the 2002 - 2003 season, the percentage of plants with less than a four inch spacing ranged from 29 - 52% compared with the previous year when it only ranged from 4 -10%.

Seedstem formation is a problem that in sufficient numbers may ruin a crop. Its occurrence varies from year to year. Although differences in seedstem formation occur between varieties from year to year, they do not occur between the same varieties from year to year. Environmental factors such as cool weather during the latter part of the season and plant variations such as large plants during these cool events may cause a high number of seedstems. This year's work did not indicate that early fertilizer applications had an effect on seedstem numbers (table 2). Among varieties, Sweet Vidalia had more seedstems than the other varieties in this study. This is contrary to results from the variety trial this year (see page 1) where Sweet Vidalia did not exhibit great number of seedstems and in fact was among the lowest number of seedstems for the varieties tested.

Planting date and early fertilizer application did not appear to have an appreciable affect on onion yield (table 3) although the late planting date may have resulted in somewhat higher yields of mediums. Mowing did not appear to have an effect on onion yield (table 4) however mowing may have caused an increase in seedstems (table 5) by stressing the plants which in turn resulted in increased flower formation.

Overall, the results of direct seeding look promising. Fertility management and planting date appear to be the best management tools for minimizing seedstem formation. All of the factors, seed coating, proper bed preparation, irrigation, planting depth, weed control, and planting date must be considered and correctly implemented in order to insure success of direct seeded onions.

At this juncture, it is recommended that a planting date of October 15 plus or minus one week, be chosen of drilling. That the seed be coated and that the seed be drilled with a properly calibrated vacuum seeder set to the proper depth of approximately 0.25 inches. Beds must be properly prepared, being smooth and free of debris. Moisture levels in the bed should be such that the planter operates correctly and there is sufficient residual moisture to encourage seed germination. Irrigation may be required one - two days prior to final bed preparation. The seed bed must be kept moist during the first week to 10 days after drilling to ensure good germination of the seed. No definite recommendations are yet available on fertilizer management. This coming season there is a plan to look for the best possible fertility program to provide good yields while minimizing seedstems.

Table 1. Percent of seedlings below 4 inch in-row spacing for the 2001-2002 and 2002-2003 seasons.

2001-2002 Season	Planting Date		
Variety	10/5/01	10/15/01	10/29/01
Nirvana	7%	6%	9%
Pegasus	6%	8%	4%
PS 7092	10%	8%	6%
Sweet Vidalia	8%	9%	10%

2002-2003 Season	10/7/02	10/21/02
Century	41%	43%
Nirvana	29%	37%
Pegasus	38%	32%
Sweet Vidalia	38%	52%

Table 2. Number of seedstems by variety and early fertilizer application for onions direct seeded on 10/7/02[z].

Variety	Early Fertilizer Applied 11/14/02	Seedstems
Century	No fertilizer	0
	150 lbs/A $CaNO_3$	1
	200 lbs/A DAP	0
Nirvana	No fertilizer	1
	150 lbs/A $CaNO_3$	2
	200 lbs/A DAP	2
Pegasus	No fertilizer	1
	150 lbs/A $CaNO_3$	1
	200 lbs/A DAP	2
Sweet Vidalia	No fertilizer	4
	150 lbs/A $CaNO_3$	8
	200 lbs/A DAP	4

[z]No seedstems with 10/21/02 planting date
Seedstems counted on 4/29/03

Table 3. Direct-seeded onion yields, 2002-2003 season.

		Planting Date							
		10/7/02				10/21/02			
Variety	Early Fertilization	Field Yield (lbs/plot)	Cured Yield (lbs/plot)	Jumbos (lbs/plot)	Mediums (lbs/plot)	Field Yield (lbs/plot)	Cured Yield (lbs/plot)	Jumbos (lbs/plot)	Medium (lbs/plo
Century	No fertilized	23.6	18.8	5.0	3.9	14.8	14.4	3.3	6.4
	150 lbs/A CaN0$_3$	12.9	11.6	2.5	2.4	19.5	16.1	3.6	6.5
	200 lbs/A DAP	13.1	11.8	3.9	2.2	12.6	11.4	2.6	4.3
Nirvana	No fertilized	18.5	17.0	7.1	4.0	10.9	9.8	1.6	5.7
	150 lbs/A CaN0$_3$	20.2	18.3	3.8	3.4	15.2	13.7	2.9	4.9
	200 lbs/A DAP	15.9	14.3	2.2	2.7	17.6	16.1	3.9	5.1
Pegasus	No fertilized	16.6	15.2	4.5	2.5	15.0	13.8	2.2	4.4
	150 lbs/A CaN0$_3$	14.6	13.1	3.5	3.9	15.0	13.4	2.5	4.3
	200 lbs/A DAP	14.9	13.7	3.2	1.9	17.6	16.9	2.8	7.8
Sweet Vidalia	No fertilized	14.3	13.1	4.5	2.7	25.4	23.5	8.3	6.5
	150 lbs/A CaN0$_3$	16.5	14.9	3.3	2.5	19.2	17.7	4.9	6.3
	200 lbs/A DAP	15.1	9.2	1.1	2.1	17.2	12.8	3.1	7.0

All treatments harvested on 5/1/03

No data collected on 11/5/02 planting

Early Fertilization Application: 11/14/02 for onions seeded 10/7/02, 11/26/02 for onions seeded 10/21/02

Table 4. Effect of mowing on yield of direct seeded onions.

Variety	Mowed				Unmowed			
	Field Yield	Cured Yield	Jumbos	Mediums	Field Yield	Cured Yield	Jumbos	Mediums
Century	15.0	13.9	4.0	4.2	11.5	9.5	1.4	4.7
Nirvana	14.1	12.9	2.6	3.3	11.1	10.1	1.6	4.0
Pegasus	13.6	12.6	3.1	3.5	10.6	9.8	2.6	1.9
Sweet Vidalia	19.6	17.3	6.7	3.9	15.3	14.4	2.1	5.0

Mowed on 3/12/03

Table 5. Effect of mowing onions on seedstem number.

Variety	Mowed	Unmowed
Century	2	1
Nirvana	2	4
Pegasus	4	3
Sweet Vidalia	10	5

Mowed on 3/12/03

YIELD OF SWEET ONION AS AFFECTED BY IRRIGATION SYSTEM AND MULCH

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Introduction

Sweet ('Vidalia') onions represent the leading vegetable crop by value ($75 million) in Georgia (Boyhan and Torrance, 2002). During 2002, Vidalia onions in Georgia were planted on about 13,500 acres and in most of the onion-producing areas of Georgia were planted on sandy loam soils with low water-holding capacities. Soil moisture levels may affect the quality and yield of onions. Low moisture conditions in the soil are conducive to poor yields (Shock et al., 1998), while excessive soil moisture conditions result in a waste of irrigation water, in nutrient leaching and may lead to rots and poor bulb quality.

Unpublished estimates indicate that onion growers in Georgia apply an average of 12 inches of water during the growing season. Onions in Georgia are typically irrigated with high-pressure systems such as sprinklers on center-pivot irrigation systems. However, sprinkler irrigation systems may have a lower water use efficiency compared with low pressure irrigation systems such as drip irrigation, particularly in shallow rooted crops such as onion (Al-Jamal et al., 2001).

There is an interest among onion growers to use drip irrigation as a means to increasing water use efficiency. Drip irrigation may also reduce the incidence and severity of bacterial diseases such as center rot of onion caused by *Pantoea ananatis* (Serrano) Mergaret, a major disease in Georgia.

Although not commonly used for onion production, drip irrigation alone or in combination with plastic mulch is widely used for vegetable production, particularly for tomatoes, peppers and melons (Lamont, 1993). There are benefits associated with using drip irrigation in conjuction with plastic mulch. Those benefits amount to higher yields, earlier harvests, improved weed control, cleaner fruit and increased efficiency in the use of water and fertilizers. In Southern Florida, onions produced on white-on-black or black plastic mulch have been shown to have higher marketable yields compared with onions grown on bare ground, with plants on white-on-black mulch having the highest yields (Vavrina and Roka, 2000).

The objective of this study was to determine the effects of irrigation systems (drip or sprinkler) and mulch (plastic film, wheat straw or bare soil) on bulb yield.

Materials and Methods

Experiments were conducted during the 1999-2000, 2000-2001 and 2001-2002 seasons at the University of Georgia's Blackshank Farm, at the Coastal Plain Experiment Station, Tifton, Georgia. The soil was a Tifton Sandy Loam (a fine loamy, silicious thermic Plinthic Paledults) with a pH of 6.3 to 6.8.

The experimental design was a split plot, where the main plot was irrigation system (drip vs sprinkler) and the subplot was mulch type [bare soil, black plastic film (38-µm thick; PlastiTech, St. Remi, Quebec) or wheat straw]. Each sub-plot consisted of three 60-ft long beds, with a 6-ft separation between the centers of adjacent beds. Each bed had four rows 9-inch apart, with a plant spacing of 6 inch. In drip-irrigated plots, there were two lines of drip tape per bed, each drip tape being located midway between rows in alternate rows.

Onion seedlings ('Sweet Vidalia', Sunseeds, Morgan Hill, Calif.) were transplanted on 2 Dec., 1999, 6 Dec., 2000 and 28-29 Nov., 2001. When plant tops were about half the size of full mature plants, the vegetative tops of 10 plants per replication were dried at 70 °C for 2 days and analyzed for mineral nutrient content.

Plants were harvested when 20% of the necks had collapsed (tops down). Onions were undercut 48 h before harvest and the bulbs were allowed to field-cure. After harvest, bulbs were cured for 3-5 days in a dryer at 37 °C air temperature (50 to 65% RH). After curing, bulbs were graded by size and appearance as marketable or cull (U.S.Department of Agriculture, 1995), counted and weighed. Data were analyzed using the Mixed Procedure of SAS (SAS Institute Inc., 2000).

Results and Discussion

Bulb yields under drip irrigation were similar to those under sprinkler irrigation. Plants grown on bare soil had the highest total yield during the three seasons and among the highest marketable yield. Plants on wheat straw mulch had reduced foliar N content (data not shown). Variability in yields among mulches and seasons was partly explained by changes in seasonal root zone temperature (measured with copper-constantan thermocouples, four inch deep) and soil water tension (measured with Water Mark sensors). Total and marketable yields and weight of individual bulbs increased with increasing root zone temperatures up to an optimum at 60 °F, followed by reductions in yields and individual bulb weight at >60 °F. Total and marketable yields increased with increasing soil tension down to -30 kPa.

Onion bulb yield was affected by mulch and varied among seasons, but was minimally affected by irrigation system. Onion plants on bare soil yielded more than plants on either black plastic mulch or wheat straw mulch. Yields on bare soil were highest probably because it had root zone temperatures that were closer to the optimal temperature for onion compared with either black plastic or wheat straw mulch. However, the response of onions to plastic mulch or wheat straw mulch has to be interpreted with caution.

In tomato, plant growth and yield under colored mulches varies among seasons, and this variability has been associated with the root zone temperatures under colored plastic film mulches (Díaz-Pérez and Batal, 2002). In onions grown in Southern Florida, yields were higher for plants grown on white-on-black plastic mulch than those on black mulch, while yields on bare soil were the lowest (Vavrina and Roka, 2000).

The variability in yields among mulches and seasons was also explained by the mean soil tension to which plants were exposed during the season. In all seasons, low soil tension (i.e., high soil moisture) was associated with reductions in bulb yield. The high yields of plants on bare soil were associated withincreases soil tension compared to plants on either black plastic mulch or wheat straw mulch. An occurrence of lower soil tensions in the soils covered with black plastic mulch or wheat straw compared with those of bare soil were expected because mulch is known to reduce soil evaporation (Liakatas et al., 1986). These results suggest that sweet onions benefited from being grown under mild water stress conditions.

Summary and Conclusions

In summary, plants on bare soil yielded more than plants on either black plastic film mulch or wheat straw mulch. Drip-irrigated onion plants yielded similarly as plants under sprinkler irrigation. Yield differences among mulch types and seasons were associated with differences in root zone temperature and soil water tension. Low soil water tension (i.e., high soil moisture) was associated with reduced yields.

Acknowledgements

We are thankful to the Vidalia Onion Committee for partial funding of this study. We acknowledge the support of United Irrigation and Roberts Irrigation Products Inc., for drip tape, and Hydro Agri North America, Inc. for calcium nitrate liquid fertilizer.

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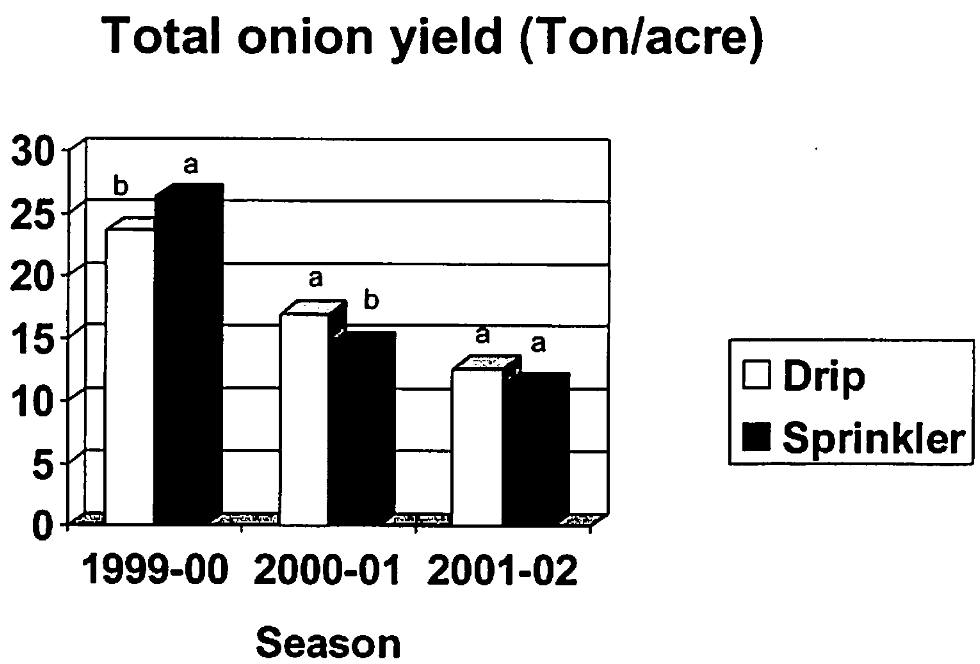


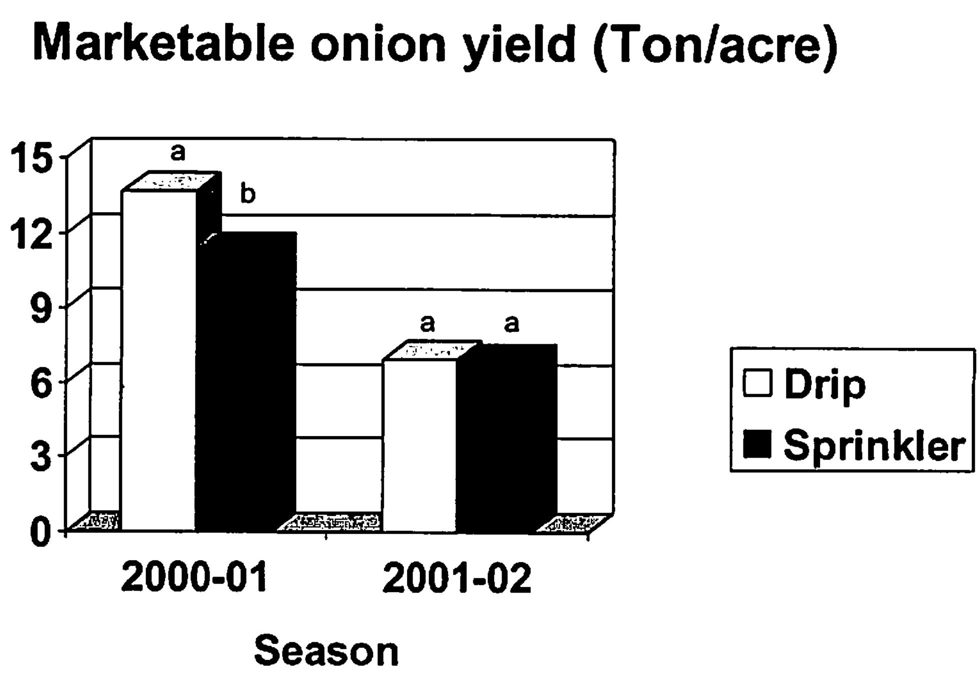
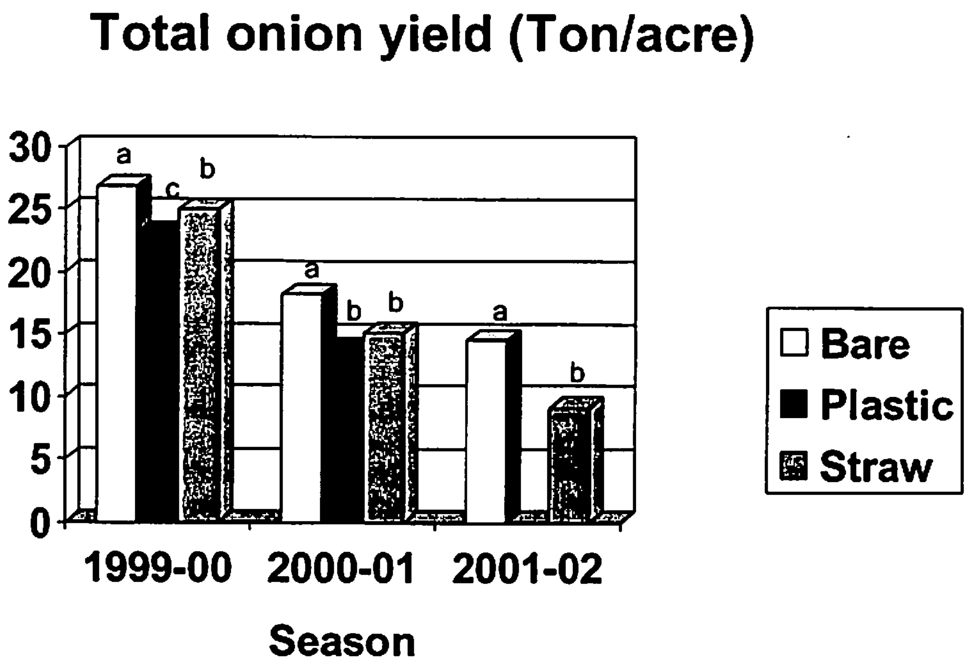


Figure 1. Effect of irrigation system on total and marketable yields of sweet onion.



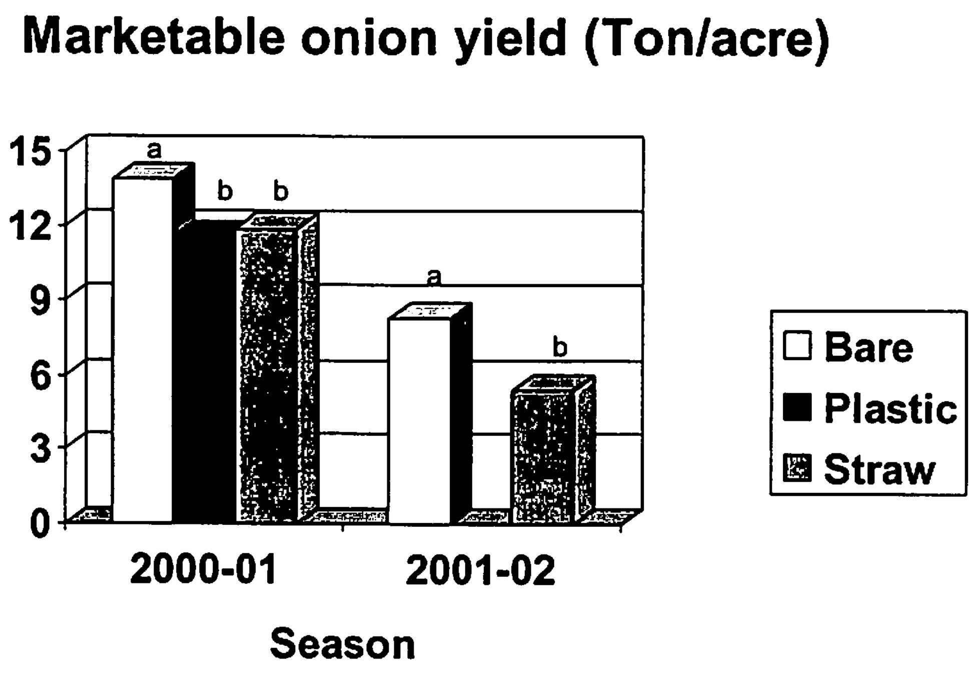


Figure 2. Effect of mulches on total and marketable yields of sweet onion.

EFFECT OF FUNGICIDE/BACTERICIDE PROGRAMS ON FOLIAR DISEASES OF ONIONS

David B. Langston, Jr., Extension Plant Pathologist

Introduction

Several fungal pathogens cause foliar diseases of onion in the Vidalia area. These are primarily *Botrytis squamosa* (Botrytis leaf blight), *Alternaria porri* (purple blotch), and *Stemphylium vesicarium* (Stemphylium blight). Of these diseases, Stemphylium blight has been the most problematic in recent years and was very damaging in 2002 when an estimated $30,000,000 was lost in yield and quality. Botrytis leaf blight and purple blotch can also cause serious damage if onions are left untreated. Constant fungicide screening is essential in identifying new chemicals that may aid in suppressing these diseases of onion. The purpose of this study was to identify new potential fungicides for suppressing foliar diseases of onion and compare them to currently labeled materials.

Materials and Methods

Four rows of 'Sweet Vidalia' onion transplants were planted to 6-ft beds (panels) on 18 Dec at Vidalia Onion and Vegetable Research Center in Toombs Co. GA. Plant spacing was 12 in. between adjacent rows and five in. between plants in the same row. The fertility program for these onions was consistent with University of Georgia Coop. Ext. Ser. recommendations. Experimental design was a randomized complete block with four replications. Fungicide/bactericide treatment plots were 15-ft long and were separated by non-treated border panels. Fungicides were applied using a CO_2-pressurized backpack sprayer calibrated to deliver 40 gallons per acre at 75 psi using TX-18 hollow cone nozzles. Spray dates were: 1=01/15; 2=01/24; 3=01/31; 4=02/07; 5=02/13; 6=02/20; 7=02/28; 8=03/10; 9=03/18; 10=03/28; 11=04/09. Onions were harvested on 1 May by digging the two center rows of each panel and allowing them to field dry. Onions were cured at approximately 100° F for 72 hours before being weighed and graded on 8 May.

Results

All treatments significantly reduced Botrytis leaf blight compared with non-treated plots by 14 Mar (table 1). All fungicide programs significantly suppressed purple blotch by 30 Apr compared with the non-treated check and programs containing copper materials were superior to the treatment to which Terpene was used. No significant yield differences were noted among treatments. No phytotoxicity was observed in any treatment in the test.

Table 1. Effect of fungicide/bactericide combinations on onion foliar diseases and yield.

Treatments and Spray Timing	BLB[1] 03/14	PB[2] 04/30	Total[3] Yield
Bravo @ 1.5 pt/A (1, 3) Rovral @ 1.5 pt/A (5, 7, 9) Bravo @ 1.5 pt/A + Cuprofix MZ Disperss @ 3.5 lb/A (2, 4, 6, 8, 10, 11)	2.0 bc[4]	57.5 c	22.0 a
Bravo @ 1.5 pt/A (1, 3) Quadris @ 12.4 fl oz/A (5, 7, 9) Bravo @ 1.5 pt/A + Cuprofix MZ Disperss @ 3.5 lb/A (2, 4, 6, 8, 10, 11)	2.0 bc	62.5 c	27.4 a
Bravo @ 1.5 pt/A (1, 3, 5, 7, 9) Bravo @ 1.5 pt/A + Cuprofix MZ Disperss @ 3.5 lb/A (2, 4, 6, 8, 10, 11)	1.6 c	63.8 c	24.7 a
Bravo @ 1.5 pt/A (1, 3, 5, 7, 9) Cuprofix MZ Disperss @ 3.5 lb/A (2, 4, 6, 8, 10, 11)	1.8 c	65.0 c	26.7 a
Bravo @ 1.5 pt/A + Cuprofix MZ Disperss @ 3.5 lb/A (1-11)	1.6 c	61.3 c	25.9 a
Bravo @ 1.5 pt/A (1, 3) Switch @ 11.0 oz/A (5, 7, 9) Bravo @ 1.5 pt/A + Cuprofix MZ Disperss @ 3.5 lb/A (2, 4, 6, 8, 10, 11)	1.9 c	67.5 c	23.5 a
Bravo @ 1.5 pt/A + Mankocide @ 2.5 lb/A (1 - 11)	1.9 c	66.3 c	24.9 a
Bravo @ 1.5 pt/A (1, 3, 5, 7, 9) Mankocide @ 2.5 lb/A (2, 4, 6, 8, 10, 11)	1.9 c	67.5 c	27.4 a
Bravo @ 1.5 pt/A (1, 3, 5, 7, 9) Terpene @ 2000 ppm + Tween 20 @ 0.02% v/v (2, 4, 6, 8, 10, 11)	2.6 b	83.8 b	23.3 a
Non-treated control	3.8 a	95.0 a	19.9 a

[1] Leaf area affected by Botrytis leaf blight (*Botrytis squamosa*) on a scale of 1 - 100 where 1= little to no disease and 100=total leaf area diseased.
[2] Leaf area affected by Purple blotch or Stemphylium leaf blight on a scale of 1 - 100 where 1= little to no disease and 100=total leaf area diseased.
[3] Total yield in lbs taken from the two center rows of each plot.
[4] Means in columns with the same letter(s) are not significantly different according to Fisher's Protected LSD Test at $P \leq 0.05$.

EFFECT OF FUNGICIDE SCHEDULES AND TIMING ON FOLIAR DISEASES OF ONIONS

David B. Langston, Jr., Extension Plant Pathologist

Introduction

Several fungal pathogens cause foliar diseases of onion in the Vidalia area. These are primarily *Botrytis squamosa* (Botrytis leaf blight), *Alternaria porri* (purple blotch), and *Stemphylium vesicarium* (Stemphylium blight). Of these diseases, Stemphylium blight has been the most problematic in recent years and was very damaging in 2002 when an estimated $30,000,000 was lost in yield and quality. Botrytis leaf blight and purple blotch can also cause serious damage if onions are left untreated. While several fungicides exist that can suppress one or more of these diseases, little is known about the correct fungicide schedule that is best for suppressing all of these diseases. Also, weather-based disease advisories may provide for improved fungicide timing and reducing the number of fungicide sprays. The purpose of this study was to identify the most efficacious and cost effective schedules and spray timings for currently labeled fungicides.

Materials and Methods

Four rows of 'Sweet Vidalia' onion transplants were planted to 6-ft beds (panels) on 18 Dec at Vidalia Onion and Vegetable Research Center in Toombs Co., Georgia. Plant spacing was 12 in. between adjacent rows and five in. between plants in the same row. The fertility program for these onions was consistent with University of Georgia Coop. Ext. Ser. recommendations. Experimental design was a randomized complete block with four replications. Fungicide/bactericide treatment plots were 15-ft long and were separated by non-treated border panels. Fungicides were applied using a CO_2-pressurized backpack sprayer calibrated to deliver 40 gallons per acre at 75 psi using TX-18 hollow cone nozzles. Spray dates are as follows: 1= Jan 15; 2=Jan 21; 3=Jan28; 4=Feb 5; 5=Feb 11; 6=Feb 18; 7=Feb 25; 8=March 5; 9=March 12; 10=March 21; 11=April 1; 12=April 12th. Onions were harvested on 1 May by digging the two center rows of each panel and allowing them to field dry. Onions were cured at approximately 100° F for 72 hours before being weighed and graded on 8 May.

Results

All treatments significantly suppressed Botrytis leaf blight compared with the non-treated check on 14 Mar except those that received Rovral and Switch applied according to TOMCAST (table 1). Significant suppression of purple blotch and Stemphylium blight was observed with all treatments, compared with the non-treated check, except those treated with Rovral, Switch, and Cabrio applied according to TOMCAST. There were no significant yield differences noted among treatments.

Table 1. Effect of fungicide schedules and timing on foliar diseases and yield of onion..

Fungicide Treatment and rate/acre	Botrytis Leaf Blight 3/14[1]		Purple Blotch Stemphylium 4/30[2]		Yield[3]	
Bravo @ 1.5 pt (1 - 9, 11 - 13)	2.88	e[4]	67.5	d-g	299	a
Bravo @ 1.5 pt (1, 2, 4, 6, 8, 11, 13) Rovral @ 1.5 pt (3, 5, 7, 9, 12)	4.33	c-e	58.3	fh	326	a
Bravo @ 1.5 pt (1, 2, 4, 6, 8, 11, 13) Switch @ 11.0 oz (3, 5, 7, 9, 12)	3.50	de	75.0	b-d	334	a
Cabrio @ 12.0 oz (1, 3, 5, 7, 9, 12) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13)	4.88	b-d	60.0	e-h	314	a
Cabrio @ 12.0 oz (1, 3, 5, 7) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13) Rovral @ 1.5 pt (9, 12)	4.50	c-e	56.3	gh	329	a
Quadris @ 12.4 fl oz (1, 3, 5, 7, 9, 12) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13)	5.00	b-d	56.6	gh	280	a
Quadris @ 12.4 fl oz (1, 3, 5, 7) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13) Rovral @ 1.5 pt (9, 12)	4.63	b-d	52.5	h	314	a
Quadris @ 12.4 fl oz (1, 3, 5, 7) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13) Switch @ 11.0 oz (9, 12)	4.33	c-e	71.6	c-e	326	a
Rovral @ 1.5 pt (1, 3, 5, 7, 9) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 12, 13)	4.33	c-e	66.7	d-g	293	a
Rovral @ 1.5 pt (1, 3, 5, 7) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13) Quadris @ 12.4 fl oz (9, 12)	4.50	c-e	60.0	e-g	334	a
Rovral @ 1.5 pt (1, 3, 5, 7) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13) Cabrio @ 12.0 oz (9, 12)	4.25	c-e	70.0	d-f	274	a
Rovral @ 1.5 pt (1, 3, 5, 7) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13) Switch @ 11.0 oz (9, 12)	4.5	c-e	63.8	d-h	289	a

Table 1(continued). Effect of fungicide timing on foliar diseases and yield of onion..

Switch @ 11.0 oz (1, 3, 5, 7, 9, 12) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13)	4.38 c-e	71.3	c-e	291	a
Switch @ 11.0 oz (1, 3, 5, 7) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13) Quadris @ 12.4 fl oz (9, 12)	4.75 b-d	72.5	b-e	350	a
Switch @ 11.0 oz (1, 3, 5, 7) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13) Rovral @ 1.5 pt (9, 12)	5.13 b-d	65.0	d-h	304	a
Rovral @ 1.0 pt + Bravo @ 1.0 pt (1, 3, 5, 7, 9, 12) Bravo @ 1.5 pt (2, 4, 6, 8, 11, 13)	4.00 c-e	66.7	d-g	311	a
Bravo @ 1.5 pt (1, 8, 14) Quadris @ 12.4 fl oz (7, 10) TOMCAST	5.00 b-d	66.7	d-g	326	a
Bravo @ 1.5 pt (1, 8, 14) Rovral @ 1.5 pt (7, 10) TOMCAST	5.63 a-c	83.8	a-c	298	a
Bravo @ 1.5 pt (1, 8, 14) Switch @ 11.0 oz (7, 10) TOMCAST	6.17 ab	85.0	ab	317	a
Bravo @ 1.5 pt (1, 8, 14) Cabrio @ 12.0 oz (7, 10) TOMCAST	4.88 b-d	85.0	ab	262	a
Non-treated control	7.13 a	95.0	a	319	a

[1] Leaf area affected by Botrytis leaf blight (*Botrytis squamosa*) on a scale of 1 - 100 where 1= little to no disease and 100=total leaf area diseased.
[2] Leaf area affected by Purple blotch or Stemphylium leaf blight on a scale of 1 - 100 where 1= little to no disease and 100=total leaf area diseased.
[3] Total yield in 40 lb bags/acre taken from the two center rows of each plot.
[4] Means in columns with the same letter(s) are not significantly different according to Fisher's Protected LSD Test at $P \leq 0.05$.

EFFECT OF FUNGICIDES AND FUNGICIDE TANK-MIXES ON FOLIAR DISEASES OF ONIONS

David B. Langston, Jr., Extension Plant Pathologist

Introduction

Several fungal pathogens cause foliar diseases of onion in the Vidalia area. These are primarily *Botrytis squamosa* (Botrytis leaf blight), *Alternaria porri* (purple blotch), and *Stemphylium vesicarium* (Stemphylium blight). Of these diseases, Stemphylium blight has been the most problematic in recent years and was very damaging in 2002 when an estimated $30,000,000 was lost in yield and quality. Botrytis leaf blight and purple blotch can also cause serious damage if onions are left untreated. Constant fungicide screening is essential in identifying new chemicals that may aid in suppressing these diseases of onion. The purpose of this study was to identify new potential fungicides for suppressing foliar diseases of onion and compare them to currently labeled materials.

Materials and Methods

Four rows of 'Sweet Vidalia' onion transplants were planted to 6-ft beds (panels) on 18 Dec at Vidalia Onion and Vegetable Research Center in Toombs Co., Georgia. Plant spacing was 12 in. between adjacent rows and 5 in. between plants in the same row. The fertility program for these onions was consistent with University of Georgia Coop. Ext. Ser. recommendations. Experimental design was a randomized complete block with four replications. Fungicide/bactericide treatment plots were 15-ft long and were separated by non-treated border panels. Fungicides were applied using a CO_2-pressurized backpack sprayer calibrated to deliver 40 gallons per acre at 75 psi using TX-18 hollow cone nozzles. Spray dates are as follows: 15 Jan , 21 Jan, 28 Jan, 5 Feb, 11 Feb, 18 Feb, 25 Feb, 5 March, 12 March, 21 March, 1 April, and 12 April. Onions were harvested on 1 May by digging the two center rows of each panel and allowing them to field dry. Onions were cured at approximately 100° F for 72 hours before being weighed and graded on 8 May.

Results

Botrytis leaf blight was suppressed by all treatments compared with the non-treated check on 14 March (table 1). Superior suppression of Botrytis leaf blight was exhibited by Omega 500 and Pristine. Significant suppression of purple blotch and Stemphylium blight was observed in all treatments compared to the non-treated check on 30 April. Once again, Omega 500 and Pristine demonstrated superior disease suppression of purple blotch and Stemphylium blight compared to other treatments. Treatments that significantly increased the percentage of jumbo onions compared with the non-treated check were Cabrio, Omega 500, Pristine, Quadris, Rovral, Rovral + Equus, and Scala. Although significant differences in yield were detected among treatments, none of the treatments significantly differed from the non-treated check.

Table 1. Effect of fungicides and fungicide tank-mixes on foliar diseases and yield of onion.

Fungicide and rate/acre	Botrytis Leaf Blight 3/14[1]	Purple Blotch/ Stemphylium 4/30[2]	Percent Jumbo[3]	Total Yield[4]
Equus @ 1.5 pt	2.25 ef[5]	63.8 de	84.5 c-g	281 c-f
Equus @ 1.5 pt tank-mixed with Mankocide @ 2.5 lb	2.31 ef	65.6 de	83.7 d-g	279 d-f
Mankocide @ 2.5 lb	2.63 d-f	75.6 c	86.5 b-f	316 a-f
Dithane @ 3.0 lb	3.10 de	85.0 b	78.9 g	286 b-f
Reason @ 5.5 fl oz	5.50 bc	86.2 b	81.3 fg	271 ef
Famoxate @ 6.0 oz	6.25 b	91.3 ab	83.2 e-g	268 f
Scala @ 27.0 fl oz	5.19 c	65.0 de	89.7 a-d	335 ab
Omega 500 @ 1.0 pt	1.13 g	50.7 g	89.4 a-e	323 a-d
Equus @ 1.0 pt tank-mixed with Rovral @ 1.0 pt	2.31 ef	65.0 de	92.4 ab	350 a
Quadris @ 12.4 fl oz	4.75 c	60.6 ef	90.2 a-c	329 a-c
Rovral @ 1.5 pt	3.44 d	70.7 cd	90.3 a-c	319 a-e
Switch @ 11.0 oz	2.88 d-f	68.8 c-e	85.8 c-f	330 a-c
Pristine @ 10.6 oz	1.88 fg	57.8 fg	92.9 a	350 a
Cabrio @ 12.0 oz	3.10 de	65.0 de	90.3 a-c	330 a-c
Non-treated control	7.13 a	97.5 a	82.2 fg	317 a-f

[1] Leaf area affected by Botrytis leaf blight (*Botrytis squamosa*) on a scale of 1 - 100 where 1= little to no disease and 100=total leaf area diseased.
[2] Leaf area affected by Purple blotch or Stemphylium leaf blight on a scale of 1 - 100 where 1= little to no disease and 100=total leaf area diseased.
[3] Percent of onions in jumbo and colossal size per plot.
[4] Total yield in 40 lb bags/acre taken from the two center rows of each plot.
[5] Means in columns with the same letter(s) are not significantly different according to Fisher's Protected LSD Test at $P \leq 0.05$.

LASER-PUFF FIRMNESS EVALUATION OF ONIONS

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Introduction

During harvest and handling there is potential for mechanical injury to produce. The durability of produce may be described as its ability to withstand mechanical injury. Even though there are relationships between durability and physical properties of the produce, these relationships vary with the produce in question and may not be clearly known. Firmness is one such physical property. Firmness may be measured in different ways, for example by measuring the resistance to puncturing the skin or flesh of the produce with a probe (figure 1) or by measuring the resistance to compression of the skin or flesh by a non destructive source.

Mechanical harvesting of sweet onions is taking place in addition to hand harvesting. In an attempt to select varieties of onions more suitable for mechanical harvesting, there is a need to evaluate the different varieties being grown. Assuming that there is some association between firmness and durability, a project has been undertaken to evaluate the firmness of sweet onions using the laser-puff firmness tester (Prussia et. al., 1994) as an indication of their durability for mechanical harvesting. The technique for onions was developed by Maw et al. (2000).

Materials and methods

Sweet onions were grown and harvested during the years 1999 - 2003 at the Vidalia Onion and Vegetable Research Station at Reidsville, Georgia, there being three replications of each variety. The onions were harvested by hand, cured and held in cold storage at 34 ^{0}F until they were tested. During testing with the laser-puff firmness tester, 10 onions per replication were examined. Onions were placed one at a time on a base pad, gently held in place by hand. Adjustments were then made in the position of the onion to cause a laser beam and air jet to coincide at the surface of the onion shoulder. It was found beneficial to have the surface of the onion free of flimsy scales and with the neck slightly facing the laser beam. When a puff (0.2 s) of air, was focused on the surface of the onion, the indentation observed by deflection of the laser beam was dependent upon the pressure selected. A suitable air pressure was chosen by experiment to be 10 lbf/in.^{2}, whereby a reading of deformation could be received without breaking the skin of the onion. This same pressure was used on all onions throughout the study.

For each year of varieties tested, a comparison was made between the average indentation for all replications of one onion variety with the average indentation for all replications of other onion varieties grown during the same year. Readings were taken in volts where one volt = one mm of laser beam deflection representing the depth of indentation made by the puff of air. The results were then converted to 1- the indentation in mm, in order to indicate a reverse relationship between depth of indentation and firmness since an increase of indentation implied a reduction in firmness. The indentation data was analyzed using PROC MIXED (Littell et al., 1996). Then, for those varieties that were present for three or more years, the average rank was calculated and arranged to give an overall rank of firmness for those onion varieties. The study did not seek to explore relationships between firmness and other physical properties of those varieties tested.

Results and discussion

Results of the firmness readings are given in the bar graphs of figures 2 - 6 for years 1999 - 2003. The varieties are arranged in ascending order of firmness. Patterns of relative firmness were recognized when the orders of onion variety firmness were compared from year to year. An overall comparison by rank of firmness is given in table 1 for those onion varieties present three or more years.

WI 609 was consistently one of the softest onions in all years tested (2000 - 2003).

Sugar Belle (SSC 6371) was found to be a soft onion.

Mr. Buck (DPS 1033) was found to be quite a soft onion.

Sweet Advantage (DPS 1058) was quite a soft onion except in 2000 when it was second to the firmest onion variety.

WI 3115 varied from being quite a soft onion to one having a central position for most years (2000 - 2003), although in 2001 it was quite a firm onion.

Pegasus was in soft, central and firm positions compared with other varieties during the three years it was grown (2001-2003) and gives an example of the variable nature of sweet onions and how firmness may be related to harvest maturity or the presence of disease.

SSC 6372 was found to be in a central position between being quite soft or quite firm.

Georgia Boy (DPS 1032) was also found to be in a central position.

Granex 33 varied from year to year but never to the extreme soft or firm positions.

Sweet Vidalia tended to be in a central to firmer position, compared with other varieties.

Cyclops (XP 6995) was another variety that had a variation of firmness from year to year.

Nirvana was in a central to firmer position, during the years tested (2001 - 2003).

Sapelo Sweet (DPS 1039) was quite a firm onion.

PS 7092 was found to be a firm onion.

Savannah Sweet was consistently one of the firmest onions in all years tested (2001-2003).

Considering the tests for significance on table 1, WI 609 was significantly (P = 0.05) softer than PS 7092 and Savannah sweet.

Acknowledgments

The authors wish to thank Mr. Charles Welsh for conducting tests and Mr. Stanley M. Thain and Mr. Matthew Evans for technical assistance.

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Table 1. An overall rank by firmness of those onion varieties that were tested for three or more years during 1999-2003.

Onion variety	Company Code	Number of years	Firmness Rank Mean
WI 609		4	0.145 a
Sugar Belle	(SSC 6371)	3	0.348 a b
Mr. Buck	(DPS 1033)	3	0.373 a b c
Sweet Advantage	(DPS 1058)	4	0.403 a b c
WI 3115		4	0.442 a b c d
Pegasus		3	0.467 a b c d
SSC 6372		3	0.514 a b c d
Georgia Boy	(DPS 1032)	4	0.551 b c d e
Granex 33		5	0.552 b c d e
Sweet Vidalia		4	0.585 b c d e
Cyclops	(XP 6995)	3	0.604 b c d e
Nirvana		3	0.766 c d e
Sapelo Sweet	(DPS 1039)	3	0.788 d e
PS 7092		3	0.925 e
Savannah Sweet		3	0.926 e

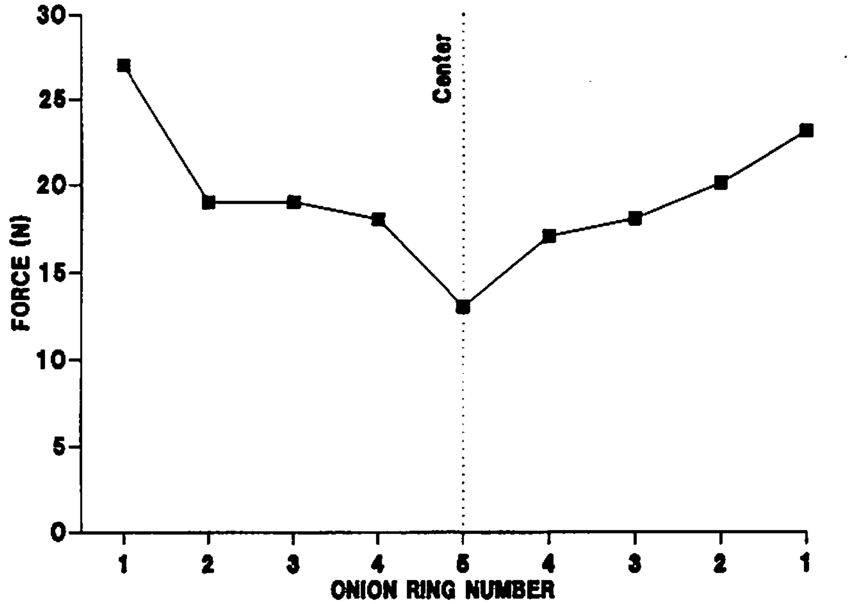

Figure 1. Puncture force distribution through successive onion rings, for fresh onions (Maw, et al., 1996).

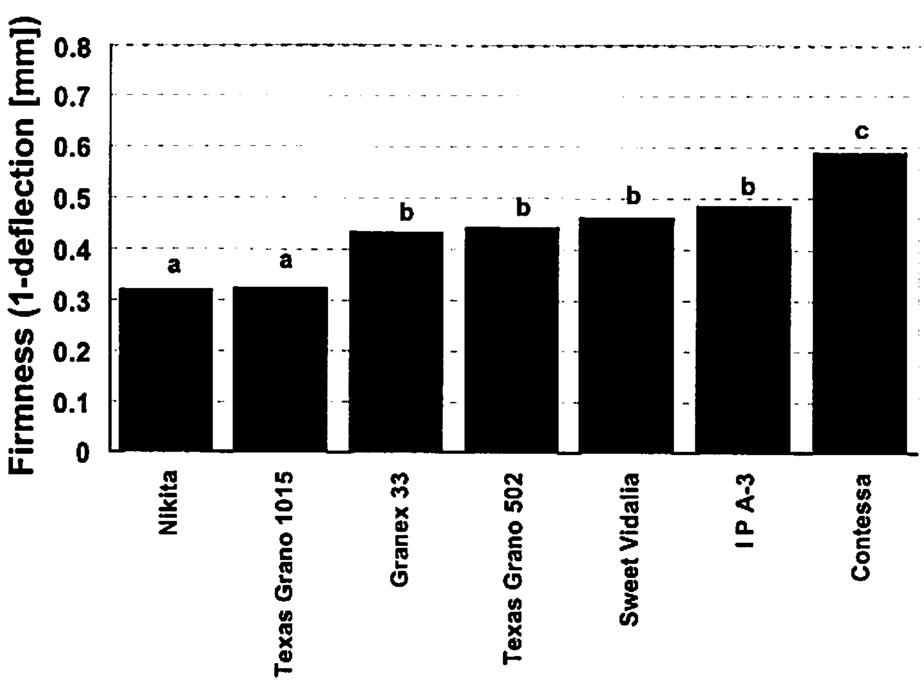

Figure 2. Mean values of firmness for different onion cultivars, 1999. Means with the same letter are not significantly different according to Fisher's LSD test (Steel and Torrie, 1960)($P = 0.05$).

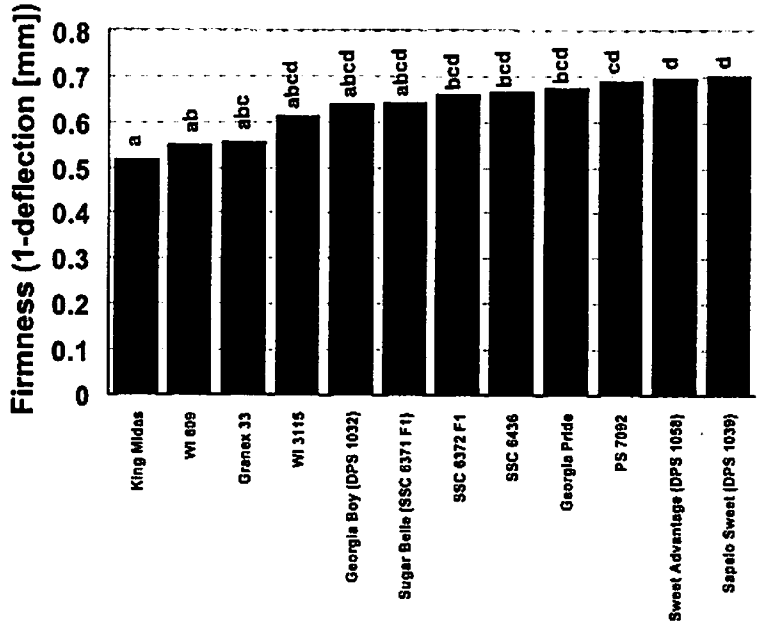

Figure 3. Mean values of firmness for different onion cultivars, 2000. Means with the same letter are not significantly different according to Fisher's LSD test (Steel and Torrie, 1960)(P = 0.05).

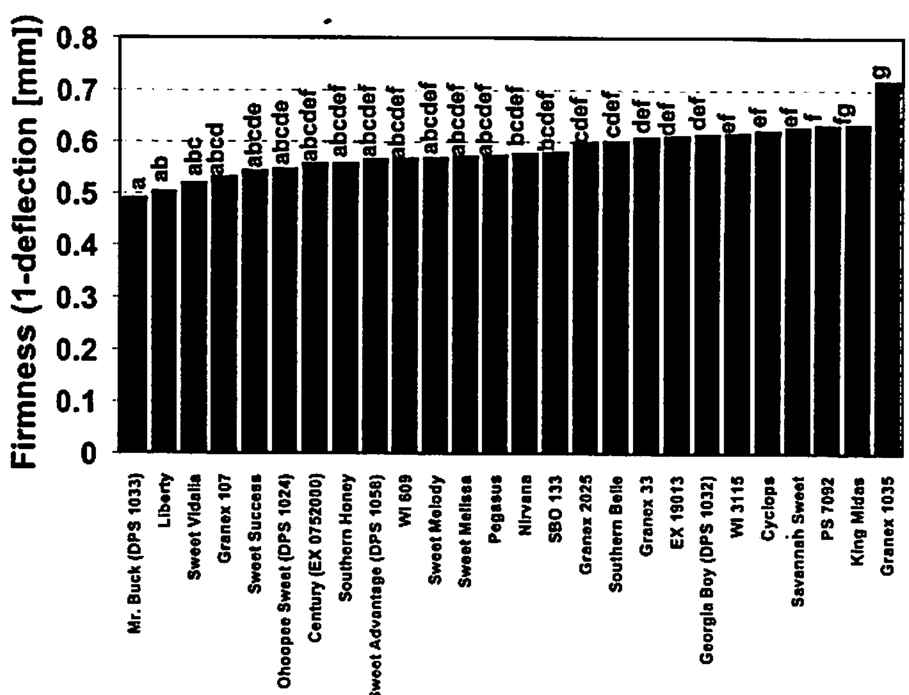

Figure 4. Mean values of firmness for different onion cultivars, 2001. Means with the same letter are not significantly different according to Fisher's LSD test (Steel and Torrie, 1960)(P = 0.05).

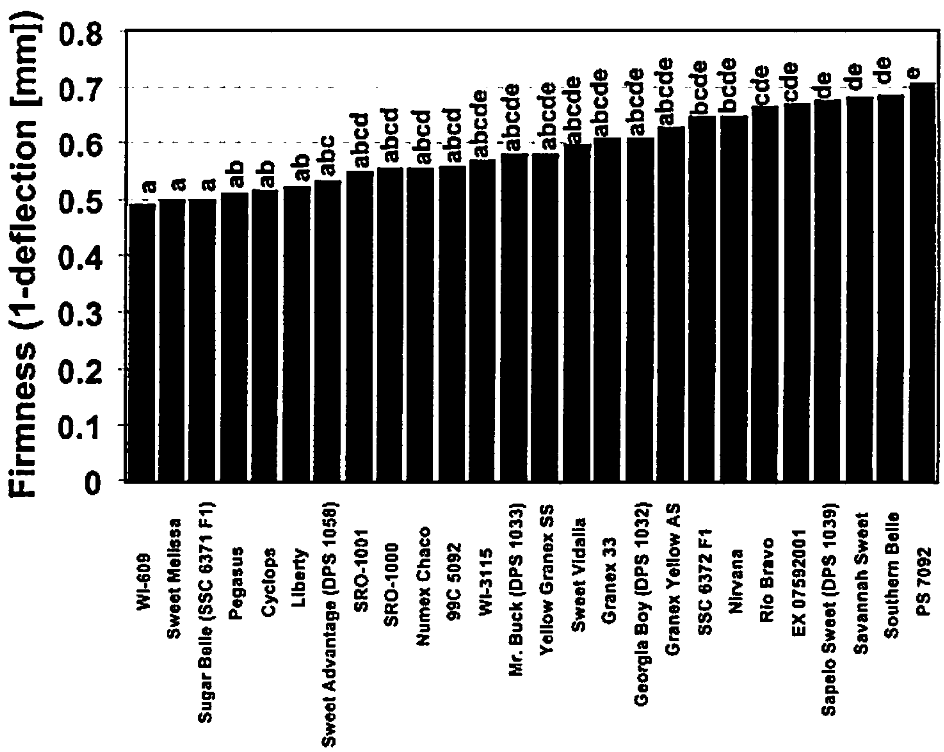

Figure 5. Mean values of firmness for different onion cultivars, 2002. Means with the same letter are not significantly different according to Fisher's LSD test (Steel and Torrie, 1960)($P = 0.05$).

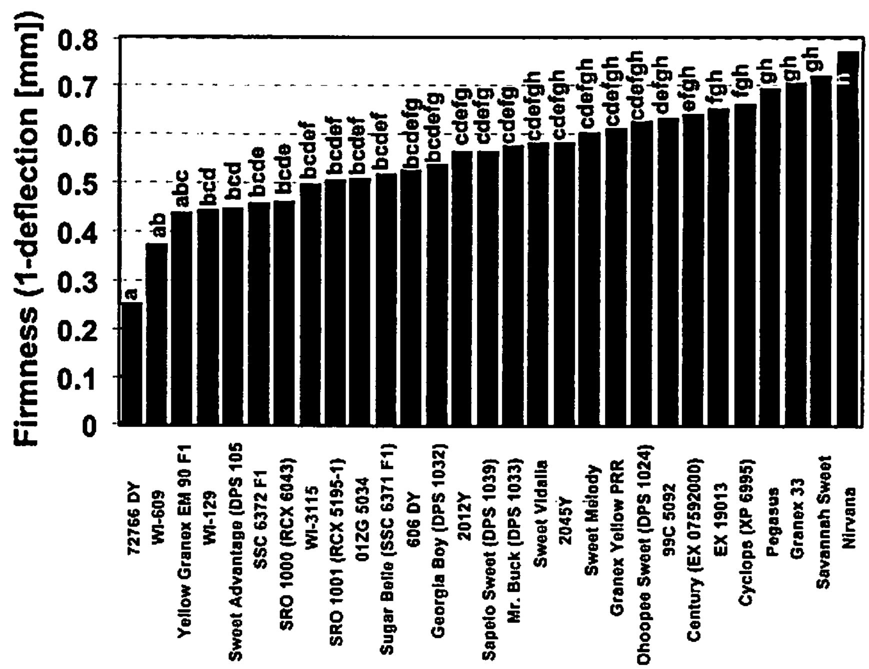

Figure 6. Mean values of firmness for different onion cultivars, 2003. Means with the same letter are not significantly different according to Fisher's LSD test (Steel and Torrie, 1960)($P = 0.05$).

THRIPS CONTROL IN ONIONS

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Introduction

In 2002-2003, insecticide efficacy trials were conducted to evaluate various chemicals for the control of thrips on onions in Georgia.

Materials and Methods

Two tests were conducted in Tift County and two at the Vidalia Onion Research Center (VORC). In Tift County, onions, var. Pegasus, were used in both tests. In the first test, part of the onions were direct seeded on 15th October, 2002 into four rows per bed at approximately two-three inches between plants and part were transplanted on 11th December, 2002. Standard cultural practices were applied to all onions as prescribed by the University of Georgia Cooperative Extension Service. All onions in the first test either direct seeded or transplanted, received the same treatments. For the second test in Tift County, 4 rows of Pegasus were transplanted on a single bed on 11th December, 2002. In both Tift County tests, insecticide applications were initiated once thrips numbers began to increase. Insecticide treatements were applied on 16 Jan, 1, 9, 14, 21, and 28 Apr 2003. Insecticide treatments (as described in Tables 1 and 2) were applied with a tractor mounted, compressed air sprayer delivering 61 GPA with three TX18 hollow cone tips per row. An unsprayed check was included in each test. Treatment plots were one bed of four rows by 35 feet and each treatment was replicated four times in a randomized complete block design. Total numbers of thrips per plant were counted each week on five plants per plot beginning on 2 Jan 2003.

Tests three and four (as described in Tables 3 and Table 4) were conduted at the VORC using a similar experimental design (plot size, replication, application methodology) to the tests in Tift County. The third test was conducted on Granex 33 onions and the fourth test was conducted on both Granex 33 and Savannah Sweet onions (two replications on each variety). All onions in both these tests were transplanted. Spray applications in both tests were on 13 Feb, 28 Mar, 2 and 15 Apr. The total number of thrips per plant were counted each week on each of five plants per plot beginning in early January.

Results and Discussion

For the tests in Tift County, Tobacco thrips, *Frankliniella fusca* (Hinds) and Western Flower thrips, *Frankliniella occidentalis* (Pergande) were the two dominant species, with both species in approximately equal proportions. The highest level of thrips occurred on the last sample date, which would have the least impact on yield. Thrips densities over all dates averaged only about 3 per plant in the untreated check. Thus, the impact of thrips on yield was not significant since at least 5 thrips per plant is needed to reduce onion yields. In the scouting samples, the best treatments overall were the TD 2402-02 and TD 2344-07 treatments at the 0.032 lb AI/a rate. However, there was some variability in the thrips data. For example the Warrior (lambda cyhalothrin) plus Penncap treatment had less thrips control at the beginning of the season but had greater control as observed on the last sample date. The high rates of Assail were significantly lower than the check on only one date, April 17, suggesting that there is some activity, but that the effect is not strong. There was no rate effect observed with the Assail treatments on thrips. Probably the most worrisome data from this trial was the lack of efficacy of Warrior, which has traditionally been a good treatment at the Tift County location. Even though thrips numbers were low, it was expected that there should be a greater than 50% control of thrips with the Warrior treatments in both tests, but this did not occur. If it had not been for the last sample date, this would have been a complete control failure with Warrior, indicating that resistance may be present. Yields in the first test were not significantly different between treatments because of the low thrips counts. Some of the observed yield variation was due to soil variability in the experimental block. In the second test, thrips densities were also low. Treatments did show some impact on thrips densities (Table 2), but the impact on yield was negligible.

For the tests at the VORC, thrips densities were extremely low, with populations barely detectable (data not presented). Insecticide treatments were applied despite the lack of thrips, and no significant differences were observed between treatments in terms of yield (Tables 3 and 4). This emphasizes the need to scout for thrips in order to avoid applying insecticides when unnecessary.

Table 1. Total thrips scouted per 5 plants and onion yield in 2003, Tift county (Test #1).

Treatment	Amount product/acre	January 21	April 11	April 17	May 7	Over all dates	Number of good bulbs per 10ft x 2 rows
1. TD 2344-07 .83E	0.032 lbAI/a	0.25b	2.00a	1.25 ab	2.5bc	1.53c	11.5a
2. TD 2344-07 .83E	0.039 lbAI/a	0.75b	1.00a	0.75b	4.5abc	2.17abc	18.1a
3. TD 2402-02 .83E	0.032 lbAI/a	1.00b	2.50a	0.75b	5.5abc	1.50c	24.5a
4. Assail	1.1 fl oz prod/a	0.25b	3.00a	2.50ab	2.0bc	1.69cb	13.6a
5. Assail	1.7 fl oz prod/a	2.25a	2.25a	0.75b	10.3a	2.81ab	20.1a
6. Assail	2.2 fl oz prod/a	0.75b	3.25a	0.75b	8.0ab	2.31abc	7.63a
7. Warrior	3 oz prod/a	0.50b	2.00a	2.25ab	4.3abc	1.78bc	17.6a
8. Warrior + Penncap	3 oz prod/a + 2 pt prod/a	0.75a	3.25a	2.00ab	1.5c	2.06abc	20.6a
9. Untreated Check		1.25ab	3.25a	3.00a	8.3ab	3.22a	16.9a

* Means within columns followed by the same letter not significantly (treatment effect *P*>0.1, LSD *P*>0.05).

Table 2. Total thrips scouted per 5 plants and onion yield in 2003, Tift County (Test #2).

Treatment	Amount product/acre	Total thrips per 5 plants on 4/11/03	Total thrips per 5 plants averaged over all sample dates	Jumbo bulbs per 10 ft of bed (4 rows)	Marketable number of bulbs per 10 ft of bed (4 rows)	Marketable weight (lb) of bulbs per 10 ft of bed (4 rows)
5. Untreated Check		9.75 a	4.46 a	0.0 a	63.5 a	21.1 a
4. Boron 2lb/a single application		5.75 ab	2.71 b	0.5 a	52.3 b	16.0 a
3. Novaluron 16 oz prod/a		5.00 b	3.07 ab	0.5 a	46.5 b	14.3 a
2. Novaluron 12 oz prod/a		4.75 b	2.29 b	0.5 a	44.8 b	15.1 a
1. Warrior 3 oz prod/a		2.50 b	2.11 b	1.3 a	52.8 ab	18.1 a

* Means within columns followed by the same letter not significantly (treatment effect $P<0.05$, LSD $P<0.05$).

Table 3. Total onion yield in 2003, VORC (Test #3).

Treatment	Amount product/acre	Jumbo+Large bulb wt (lbs) per center 7 ft of bed	Small bulb wt (lbs) per center 7 ft of bed	Marketable number of onion bulbs per 7 ft of bed (4 rows)	Marketable weight (lbs) of onion bulbs per 7 ft of bed
1. Assail 1.1 fl oz prod/a		12.7 a	1.89 ab	47 a	20 a
2. Assail 1.7 fl oz prod/a		7.44 a	0.98 c	38 a	14 a
3. Assail 2.2 fl oz prod/a		11.8 a	1.16 bc	49 a	20 a
4. Novaluron 16 oz prod/a		13.8 a	0.93 c	46 a	20 a
5. Untreated Check		12.9 a	2.00 a	49 a	20 a

* Means within columns followed by the same letter not significantly (treatment effect P>0.05, LSD P>0.05).

** Thrips number were very low throughout this test and no significant numbers were recorded.

Table 4. Total thrips scouted per 5 plants and onion yield in 2003, VORC (Test #4).

Treatment / Amount product/acre	Total number of sprays	Total thrips per 5 plants averaged over last 4 sample dates	Jumbo + large onion bulb wt (lbs) per 7 ft of bed (4 rows)	Total number of clean onion bulbs per 7 ft of bed
1. Untreated Check	0	0.33 a	13.6 a	47.3 a
2. Boron 2lb/a single application	1	1.25 a	12.1 a	47.0 a
3. Boron 2lb/a single application	1	0.58 a	12.6 a	47.8 a
4. Novaluron 12 oz prod/a	4	0.17 a	10.2 a	39.0 a
5. Novaluron 16 oz prod/a	4	1.08 a	14.0 a	40.0 a
6. Lannate LV 3 pt prod/a	4	0.58 a	17.5 a	62.8 a
7. threshold of 1 thrips/plant not reached till end of test	0	0.58 a	10.4 a	36.5 a
8. threshold of 2 thrips/plant not reached till end of test	0	2.00 a	13.6 a	41.8 a
9. threshold of 5 thrips/plant not reached at all	0	0.83 a	13.1 a	44.0 a
10. Warrior 3 oz prod/a +Penncap 2 pt prod/a calendar	5	0.67 a	13.6 a	41.0 a

* Means within columns followed by the same letter not significantly (treatment effect P<0.05, LSD P<0.05).

EVALUATION OF ONION CULTIVARS FOR RESISTANCE TO PINK ROOT DURING SEASONS 2001-2002 AND 2002-2003

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Introduction

Pink root, caused by Phoma terrestris, is a soilborne pathogen that reduces the yield and quality of sweet onions (*Allium cepa*) produced in Georgia. The fungus has a wide host range, reducing the potential impact of crop rotation as a means of reducing populations of P. terrestris in soil. Fumigation with metam sodium has proven effective in controlling disease and increasing yields; however, the high cost of the material limits its use. Resistance to pink root has been identified in onion germplasm, but little is known about the levels of resistance to pink root in the cultivars of sweet onion that are commonly planted in Georgia. The purpose of the current study was to evaluate the most common cultivars of sweet onion for resistance to pink root, along with a several experimental cultivars that may be released for use in Georgia in the future. The relationship between maturation type (early, mid-, or late-season) and disease severity was also examined.

Materials and Methods

Experiments were conducted during the 2001-2002 and 2002-2003 seasons at Bland Farms, located in Tattnall Co., GA in a field with a history of multiple years of onion cultivation. Guidelines established by the University of Georgia Cooperative Extension Service were followed for land preparation, fertility, weed management, insect control, and foliar disease management. Onion transplants were set on 26 Nov 01 and 3 Dec 02 at a plant spacing of 5.25 in. on four-row beds (shaped on six-ft centers) with a 12-in. row spacing. Plots were 50-ft long, and the test was laid out as a randomized complete block with 31 treatments (cultivars) and 4 replications. On 16th April, 2002 and 24th April, 2003, 10 plants per plot were pulled and the root systems examined for symptoms of pink root. Disease severity was rated on a 0 to 10 scale where 0=no symptoms, 5=50% of root system discolored or decayed, and 10=100% root discoloration or loss. The experiments were not harvested.

Results and Discussion

Overall disease severity in 2002 was moderate in the experiment but sufficient to allow for differences in susceptibility to pink root to be observed among cultivars. Early maturing cultivars 'Sweet Advantage' and 'Southern Belle' were most susceptible to pink root, followed by 'WI-3115' and 'Sugar Belle F1' (table 1). Two of the more widely grown cultivars in GA, 'Sweet Vidalia' and 'Sweet Melissa', were moderately susceptible to pink root. The majority of the cultivars with the highest disease ratings were early maturing types, while the majority of the cultivars least susceptible to pink root matured later. Cultivars such as 'Pegasus', 'Sweet Melody', and 'Yellow Granex PRR (pink root resistant)' were the least susceptible to pink root; however, the PRR cultivar supplied by Asgrow appeared to be more susceptible to the disease than 'Yellow Granex PRR' supplied by Sunseeds.

In 2003, disease severity was less than in 2002, but susceptibility to pink root followed similar trends in both years. Cultivars '72766 DY' and '606 DY' were the most susceptible early maturing types (table 2). Cultivars such as 'DPS 1032' (Georgia Boy) and 'Nirvana' had more severe symptoms of pink root than 'DPS 1033' (Mr. Buck) and 'Yellow Granex EM90'. Of the late maturing cultivars, 'Granex Yellow PRR' was more susceptible to pink root than 'Cyclops', 'Pegasus', 'EX 19103', and 'SRO 1001'. Three cultivars were not evaluated due to poor stands in plots: 'Southern Honey', 'Sweet Melody', and 'Granex 33'.

In both years of the study, the majority of the cultivars with the highest disease ratings were early maturing types while the cultivars least susceptible to pink root matured later. A significant, decreasing linear relationship between days to maturity, across all cultivars, and susceptibility to pink root was observed (data not shown). This finding may be confounded by differences in maturity of onions at the time of evalutaion of roots. Sumner et al. (1997) found that the severity of symptom expression on onion roots infected by *P. terrestris* increased as onions matured. The use of later maturing varieties with resistance to pink root may provide advantages in fields where disease severity has been high; however, cultivars that mature later in GA have more problems with bacterial diseases due to warmer temperatures and should be managed accordingly.

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Table 1. Susceptibility of onion cultivars with different maturity dates to pink root, caused by *Phoma terrestris*, Bland Farms (2002).

Cultivar	Producer	Maturity date	Pink root rating (0-10 scale)*	
WI-609	Wannamaker	17 Apr	2.6	b
WI-3115	Wannamaker	17 Apr	3.6	a
Sweet Advantage	D. Palmer Seed	17 Apr	4.1	a
Southern Belle	D. Palmer Seed	17 Apr	4.1	a
99C 5092	Sakata	22 Apr	0.7	e
Nirvana (1027)	Sunseeds	22 Apr	1.1	de
DPS 1032	D. Palmer Seed	22 Apr	1.6	cd
SSC 6371 F1	Shamrock	22 Apr	1.8	c
Sweet Vidalia	Sunseeds	22 Apr	2.7	b
Sugar Belle F1 (SSC 6371)	Shamrock	22 Apr	3.8	a
EX 07592001	Seminis/Asgrow	29 Apr	0.7	f
RCX 6043	Sunseeds	29 Apr	0.8	ef
RCX 5195-1	Sunseeds	29 Apr	1.0	de
PS 7092	Seminis/Petoseed	29 Apr	1.0	de
Savannah Sweet	Seminis/Petoseed	29 Apr	1.1	cde
Southern Honey	D. Palmer Seed	29 Apr	1.2	cd
EX 07592000	Seminis/Asgrow	29 Apr	1.3	cd
Rio Bravo	Sunseeds	29 Apr	1.5	bc
Sweet Melissa	Sunseeds	29 Apr	1.8	b
DPS 1024	D. Palmer Seed	29 Apr	2.6	a
DPS 1039	D. Palmer Seed	29 Apr	2.7	a
Granex 33	Seminis/Asgrow	29 Apr	2.9	a
Pegasus	Seminis/Asgrow	6 May	0.5	e
Liberty	Bejo Seed Co.	6 May	0.7	de
DPS 1033	D. Palmer Seed	6 May	0.8	cde
EX 19013	Sunseeds	6 May	0.9	bcde
Sweet Melody	Sunseeds	6 May	1.0	bcd
Yellow Granex PRR Sunseed	Sunseeds	6 May	1.0	bcd
Numex Chaco	Lockhart	6 May	1.1	bc
Cyclops (XP 6995)	Seminis/Asgrow	6 May	1.2	b
Yellow Granex PRR Asgrow	Seminis/Asgrow	6 May	2.5	a

* Means in each maturity group followed by the same letter do not differ significantly as determined by Fisher's least protected significant difference test (P= 0.05); 0 to 10 rating scale where 0=no symptoms on root system, 5=50% of root system discolored or decayed, and 10=100% root discoloration or loss.

Table 2. Susceptibility of onion cultivars with different maturity dates to pink root, caused by *Phoma terrestris*, Bland Farms (2003).

Cultivar	Producer	Maturity date	Pink root rating (0-10 scale)[b]	
72766 DY	Shaddy	09 Apr	1.5	a
606 DY	Shaddy	09 Apr	1.2	a
SSC 33076	Shamrock	09 Apr	0.4	b
WI-129	Wannamaker	09 Apr	0.3	b
WI-609	Wannamaker	16 Apr	0.6	a
WI-3115	Wannamaker	16 Apr	0.5	ab
Sweet Advantage	D. Palmer Seed	16 Apr	0.4	ab
99C 5092	Sakata	16 Apr	0.2	b
Sugar Belle F1 (SSC 6371)	Shamrock	23 Apr	0.6	a
SSC 6372 F1	Shamrock	23 Apr	0.5	a
01ZG 5034	Sakata	23 Apr	0.4	a
2045Y	K&B Development	02 May	0.3	a
Sweet Vidalia	Sunseeds	02 May	0.2	a
Ohoopee Sweet (DPS 1024)	D. Palmer Seed	02 May	0.2	a
Sapelo Sweet (DPS 1039)	D. Palmer Seed	02 May	0.1	a
Georgia Boy (DPS 1032)	D. Palmer Seed	07 May	0.4	a
Nirvana	Sunseeds	07 May	0.3	ab
2012Y	K&B Development	07 May	0.1	bc
Savannah Sweet	Petoseed	07 May	0.1	bc
Century (EX 07592000)	Seminis	07 May	0.08	c
Mr. Buck (DPS 1033)	D. Palmer Seed	07 May	0.05	c
SRO 1000 (RCX 6043)	Sunseeds	07 May	0.03	c
Yellow Granex EM90 F1	Emerald Seeds	07 May	0.03	c
Granex Yellow PRR	Seminis	14 May	0.3	a
EX 19013	Seminis	14 May	0.1	b
Cyclops (XP 6995)	Seminis/Asgrow	14 May	0.1	b
Pegasus	Seminis/Asgrow	14 May	0.08	b
SRO 1001 (RCX 5195-1)	Sunseeds	14 May	0.05	b
Southern Honey	D. Palmer Seed	poor germ[a]	--	--
Sweet Melody	Sunseeds	poor germ	--	--
Granex 33	Seminis/Asgrow	poor germ	--	--

[a]Poor germ=poor germination, no data collected for variety.
[b]Means in each maturity group followed by the same letter do not differ significantly as determined by Fisher's least protected significant difference test (P= 0.05); 0 to 10 rating scale where 0=no symptoms on root system, 5=50% of root system discolored or decayed, and 10=100% root discoloration or loss.

TESTING EXPERIMENTAL FUNGICIDES FOR THE CONTROL OF FOLIAR DISEASES AND BOTRYTIS NECK ROT ON SWEET ONIONS

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Introduction

Botrytis neck rot (BNR) causes significant losses in onions that stored in controlled atmosphere or refrigerated rooms. It is believed that infection of the onions takes place in the field prior to harvest and disease develops over the period that the onions are stored, resulting in a decrease in the number of marketable onions taken out of storage. An experiment was conducted to evaluate fungicides applied during the growing season for the control of post-harvest BNR, as well as Botyritis leaf blight (BLB), caused by *Botrytis squamosa*; Purple Blotch (PB), caused by *Alternaria porri*; and Stemphylium Leaf Blight (SLB), caused by *Stemphylium vesicarium*. The latter two diseases can occur simultaneously and have nearly identical symptomology; therefore, they were evaluated as one complex in this experiment.

Materials and methods

Trials were conducted at the Vidalia Onion and Vegetable Research and Education Center (VOVREC) in Lyons, GA and at the University of Georgia's Horticultural Farm, at the Coastal Plain Experiment Station, Tifton, Georgia. Onions (Allium cepa 'Savannah Sweet' at VOVREC, 'Sweet Melissa' at the Horticultural Farm) were transplanted into four-row beds on December 16-17th, 2002. Beds were spaced on six-foot centers, and row spacing on individual beds was 12 inches. Plant spacing within rows was six inches. Fertility, weed, and insect control was carried out according to guidelines published by the Georgia Cooperative Extension Service. Each plot consisted of a single 20-foot bed with a five-foot buffer between plots. The experimental design was a randomized complete block with four or five replications.

Fungicide applications were initiated on January 31, 2003 and continued on a 7 day spray schedule until April 17-18 for a total of 12 applications. All materials were applied with a CO_2-powered backpack sprayer using a 4-nozzle spray boom with 18-inch nozzle spacing. Hollow cone nozzles (TSX-18) were used, and application volume was 40 gallons per acre (GPA). Cuprofix Disperss 20DF was applied bi-weekly at a rate of 3 lb/A to all fungicide treatments to suppress bacterial diseases, and all fungicide treatments were tank-mixed with Bravo WeatherStik 720SC at 1.5 pt/A. The center two rows of each plot were harvested on May 7-8th and onions were cured for 72 hours at 100° F before weighing and grading. Following the grading process, onions were stored for five months at 38° F, and then removed and evaluated for the presence of BNR.

Results and Discussion

Cold temperatures in January contributed to significant levels of BNR at both locations. Epidemics of Stemphylium leaf blight (caused by *S. vesicarium*), complexed with Purple blotch (caused by *Alternaria porri*), were of lesser severity in 2003 than in 2002 at both locations.

In general, the fungicides used in this experiment significantly reduced the severity of Botrytis leaf blight (BLB) and the Purple blotch/Stemphylium leaf blight complex (PB/SLB) (table 1). Each fungicide treatment, aimed primarily for control of BNR, included Bravo WeatherStik 720SC at 1.5 pt/A and was expected to be effective against BLB and PB/SLB.

No significant difference in yield between any treatments was observed at VOVREC (table 2). However, at the Horticultural Farm, BAS 516 38WG (Pristine) at 16 oz/A and Elevate 50WDG, both tank-mixed with Bravo WeatherStik, had significantly higher total yields than the untreated check. All fungicide treatments except TD 2448 3.34SC had higher numbers of jumbo-grade onions than the untreated check.

Evaluation of onions from VOVREC and the Horticultural Farm that had been stored for five months showed that BAS 516 had significantly less BNR than the untreated check or the other fungicide treatments (table 3). Onions treated with BAS 516 from VOVREC showed a five-fold reduction in BNR compared to the untreated check, while those from the Horticultural Farm had nearly 10 times less BNR. Elevate 50WDG was also effective against BNR on onions grown at the Horticultural Farm. The severity of pink root was also reduced by BAS 516 38WG at the Horticultural Farm.

Summary and Conclusions

In conclusion, the BAS 516 38WG, which will be marketed as Pristine in 2004, appears to have potential as a management tool for both foliar and post-harvest diseases of sweet onions. Further work should be considered to identify optimal rates, application timings, and performance with currently registered fungicides, such as Rovral.

Table 1. Severity of Botrytis leaf blight and Purple blotch/Stemphylium leaf blight in sweet onions treated with fungicides at the Vidalia Onion and Vegetable Research Farm (VOVREC - Reidsville) and Hort Hill (Tifton), 2003.

			Disease severity (AUDPC)[b]			
	Application		VOVREC		Hort Hill	
Material	**rate/A**	**timing[a]**	**BLB[c]**	**PB/SLB[c]**	**BLB[c]**	**PB/SLB[c]**
Untreated Check	--	--	7.40 a	7.84 a	2.28 a	6.12 a
Bravo Weatherstik 720SC	1.5 pt	A-L	3.28 c	4.87 b	0.95 b	4.06 b
Cuprofix Disperss 20DF	3 lb	BDFHJL				
Elevate 50WDG	1 lb	A-L	4.51 b	5.50 b	0.99 b	4.44 b
Bravo Weatherstik 720SC	1.5 pt	A-L				
Cuprofix Disperss 20DF	3 lb	BDFHJL				
TD 2448 3.34SC	9.6 fl oz	A-L	2.91 cd	4.74 b	0.61 b	4.09 b
Bravo Weatherstik 720SC	1.5 pt	A-L				
Cuprofix Disperss 20DF	3 lb	BDFHJL				
BAS 516 38WG	16 oz	A-L	2.31 cd	3.67 b	0.67 b	3.67 b
Bravo Weatherstik 720SC	1.5 pt	A-L				
Cuprofix Disperss 20DF	3 lb	BDFHJL				
Rovral 4SC	1.5 pt	A-L	2.01 d	3.68 b	0.86 b	3.93 b
Bravo Weatherstik 720SC	1.5 pt	A-L				
Cuprofix Disperss 20DF	3 lb	BDFHJL				
		P-value[d]	<0.0001	0.0032	<0.0001	0.0003

[a]Applications made on a 7 day schedule, where A=application 1 and L=application 12.

[b]Disease severity calculated as the area under the disease progress curve (AUDPC). A total of 4-5 disease evaluations were made beginning on 3/20/03 (VOVREC) or 3/25/03 (Hort Hill) and ending 4/24/03 (VOVREC) or 5/02/03 (Hort Hill).

[c]BLB=Botrytis leaf blight, PB/SLB= complex of Purple blotch and Stemphylium leaf blight.

[d]Means followed by the same letter do not differ significantly as determined by Fisher's protected least significant difference test (*P* value listed for each variable).

Table 2. Total yield and yield of jumbo grade sweet onions following treatment with fungicides at the Vidalia Onion and Vegetable Research Farm (VOVREC - Reidsville) and Hort Hill (Tifton), 2003.

Material	Application rate/A	Application timing[a]	Yield (No. 40 lb boxes/A) VOVREC Total[b]	VOVREC Jumbo[b]	Hort Hill Total[b]	Hort Hill Jumbo[b]
Untreated Check	--	--	287 a	69 a	335 b	152 c
Bravo Weatherstik 720SC	1.5 pt	A-L	286 a	141 a	386 ab	245 ab
Cuprofix Disperss 20DF	3 lb	BDFHJL				
Elevate 50WDG	1 lb	A-L	290 a	83 a	446 a	286 ab
Bravo Weatherstik 720SC	1.5 pt	A-L				
Cuprofix Disperss 20DF	3 lb	BDFHJL				
TD 2448 3.34SC	9.6 fl oz	A-L	285 a	117 a	326 b	211 bc
Bravo Weatherstik 720SC	1.5 pt	A-L				
Cuprofix Disperss 20DF	3 lb	BDFHJL				
BAS 516 38WG	16 oz	A-L	307 a	151 a	458 a	308 a
Bravo Weatherstik 720SC	1.5 pt	A-L				
Cuprofix Disperss 20DF	3 lb	BDFHJL				
Rovral 4SC	1.5 pt	A-L	312 a	158 a	416 ab	269 ab
Bravo Weatherstik 720SC	1.5 pt	A-L				
Cuprofix Disperss 20DF	3 lb	BDFHJL				
		P-value[c]	0.98	0.39	0.06	0.01

[a]Applications made on a 7 day schedule, where A=application 1 and L=application 12.

[b]Total yield across all grades and yield of jumbo grade onions shown. Cultivar planted at VOVREC was 'Savannah Sweet'; cultivar planted at Hort Hill was 'Sweet Melissa'.

[c]Means followed by the same letter do not differ significantly as determined by Fisher's protected least significant difference test (*P* value listed for each variable).

Table 3. Percentages of marketable and Botrytis-infected sweet onions harvested at Vidalia Onion and Vegetable Research Farm (VOVREC - Reidsville) and Hort Hill (Tifton), 2003.

			Percentage of onions evaluated after 5 months in storage				
	Application		VOVREC		Hort Hill		
Material	rate/A	timing[a]	Marketable[b]	BNR[b]	Marketable[b]	BNR[b]	PR[c]
Untreated Check	--	--	40.5 b	39.5 ab	8.7 c	90.9 a	1.1 a
Bravo Weatherstik 720SC	1.5 pt	A-L	39.2 b	48.5 ab	25.8 bc	72.3 ab	0.9 a
Cuprofix Disperss 20DF	3 lb	BDFHJL					
Elevate 50WDG	1 lb	A-L	52.6 b	27.6 bc	31.1 b	65.0 b	0.8 a
Bravo Weatherstik 720SC	1.5 pt	A-L					
Cuprofix Disperss 20DF	3 lb	BDFHJL					
TD 2448 3.34SC	9.6 fl oz	A-L	41.3 b	52.0 a	21.1 bc	76.9 ab	1.1 a
Bravo Weatherstik 720SC	1.5 pt	A-L					
Cuprofix Disperss 20DF	3 lb	BDFHJL					
BAS 516 38WG	16 oz	A-L	82.4 a	7.1 c	83.3 a	9.5 c	0.2 b
Bravo Weatherstik 720SC	1.5 pt	A-L					
Cuprofix Disperss 20DF	3 lb	BDFHJL					
Rovral 4SC	1.5 pt	A-L	43.5 b	41.1 ab	22.7 bc	76.1 ab	0.8 a
Bravo Weatherstik 720SC	1.5 pt	A-L					
Cuprofix Disperss 20DF	3 lb	BDFHJL					
		P-value[d]	0.004	0.005	<0.0001	<0.0001	

[a]Applications made on a 7 day schedule, where A=application 1 and L=application 12.
[b]Marketable onions were those that showed no symptoms of post-harvest decay; BNR = percentage of onions with symptoms of Botrytis neck rot.
[c]Pink root rated at harvest (5/06/03) on a 0-5 scale where 0 = no symptoms (healthy roots) and 5 = complete loss of root system; mean of 10 bulbs per plot.
[d]Means followed by the same letter do not differ significantly as determined by Fisher's protected least significant difference test (*P* value listed for each variable).

EFFECTS OF SOIL SOLARIZATION AND TURNIP RESIDUE ON SOIL FUNGI, BACTERIA AND YIELD OF SWEET ONIONS IN GEORGIA

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Introduction

Sweet onion (*Allium cepa*) is susceptible to diseases caused by a number of soilborne pathogenic fungi and bacteria. These diseases cause serious yield losses annually in Georgia and have proven difficult to control with cultural practices and pesticides. In recent years, a great deal of work has been done on biofumigation as a means of suppressing soilborne pathogens in a number of vegetable crops. Biofumigation involves the incorporation into soil of plant material which then releases volatile, pesticidal compounds that act as fumigants upon degradation. Members of the mustard family produce particularly high levels of glucosinolates and have been used extensively in biofumigation studies. Glucosinolates generate isothiocyanates (ITC) as they are broken down in soil, and it is the ITC compounds that are toxic to soilborne pathogens. Solarization, the process of covering soil with clear plastic mulch to trap heat and raise soil temperatures to levels sufficient to inactivate organisms, has been shown to reduce populations of soilborne pathogens in several vegetable crops, including onion. The purpose of the current study was to evaluate biofumigation with turnip crop residues and solarization, alone and in combination, as a means to suppress soilborne bacterial pathogens of onions, including *Burkholderia cepacia* (causal agent of sour skin), and *Phoma terrestris*, causal agent of pink root of onion. Results from the 2002-2003 season are presented.

Materials and Methods

A cover crop of turnip was established in the Spring of 2002 in a field previously planted to onion. The turnip crop was incorporated on 22nd July 2002, and the area tarped with clear polyethylene mulch (CPM) for a period of three months to allow for solarization of the soil. Treatments included bare ground (untreated control), bare ground plus CPM, and bare ground plus turnip residue. In late October, CPM was removed and soil assayed for *Phoma terrestris*, pseudomonads, total fungal populations and total bacterial populations. Four additional samplings of soil were taken on a monthly basis. Onions were transplanted into the soil in early December, 2002 and grown according to Guidelines established by the University of Georgia Cooperative Extension Service. Onions were harvested in early May, 2003, were weighed and graded. The number of onions with basal rot, neck rot, sour skin, and center rot was evaluated on a subset of onions from each plot. Pink root was evaluated after undercutting on 25 onions per plot using 0-5 scale, where 0 = healthy roots and 5 = total discoloration of root system.

Results and Discussion

Significant effects of the combination of solarization and incorporation of turnip residues were observed on populations of soil fungi and on disease at the time of harvest (table 1). Total colony forming units (CFU) of *P. terrestris* were reduced by solarization, turnip residue, or the combination of solarization plus turnip residue compared to the untreated control. However, a significant reduction in pink root on harvested onions was observed only for the combination of solarization and turnip residue. The number of saprophytic soil fungi was reduced by solarization. No differences in populations of soil bacteria were observed between treatments (data not shown). Fewer basal rots occurred in onions grown in solarized soil, while no treatment effect was found for neck rot. The total number of bacterial rots, which included sour skin and center rot, was higher in solarized plots than for turnip residue or the untreated control.

Yields were highest for solarization combined with turnip residue (table 2). Although no differences were found for total number of bulbs per plot, solarization and solarization plus turnip residue produced a greater number of jumbo-grade onions than the untreated control. Conversely, more small-grade onions were found in the untreated control than for solarization plus turnip residue.

The results of this study provide evidence that solarization combined with the incorporation of turnip residue can be used to reduce populations of soilborne fungal pathogens along with the diseases they cause. Solarization did not prove effective against soilborne bacterial diseases, and in fact seemed to exacerbate the severity of disease. It is possible that the duration of the solarization process was not sufficient to inactivate bacterial pathogens present in the soil. This experiment will be repeated during the 2003-2004 season, and the solarization period during 2003 was begun earlier than in 2002 to increase the solarization period. Preliminary results suggest that populations of B. cepacia may be lower in solarized plots than in non-solarized plots.

Table 1. Effects of solarization and biofumigation with turnip crop residue on populations of soil fungi and on disease of harvested onions, 2002-2003 (Tifton, GA).

	Fungal populations (cfu)[a]		Pink Root	No. Neck	No. Basal	Total No.
Treatment	***P. terrestris***	**Total**	**(0-5)[b]**	**Rots[c]**	**Rots[d]**	**Bact. Rots[e]**
Control	37.3 a	16107 a	2.0 b	2.0 a	1.5 a	27.5 c
Solarization	5.0 b	7300 b	1.8 b	10.5 a	0.3 b	46.3 a
Turnip	8.0 b	13240 a	2.5 a	4.3 a	1.0 ab	30.0 bc
Solarization + Turnip	17.0 b	13280 ab	1.3 c	5.3 a	0.8 ab	40.3 ab

[a]Colony forming units (CFU) per gram of soil for either *Phoma terrestris* or total soil saprophytes.
[b]Pink root rated on a 0-5 scale where 0 = no symptoms of pink root and 5 = total discoloration of root system.
[c]Number of neck rots per sample unit of onions.
[d]Number of basil rots per sample unit of onions.
[e]Combined number of bacterial rots (sour skin and center rot) per sample unit of onions.

Means followed by the same letter do not differ significantly ($P \leq 0.05$) as determined by Fisher's protected least significant difference test.

Table 2. Effects of solarization and biofumigation with turnip crop residue on yield and grade of harvested sweet onions, 2003 (Tifton, GA).

	Yield and Grade of Bulbs (per plot)					
Treatment	**Weight (lbs)**	**Total No.**	**No. Jumbo**	**No. Large**	**No. Medium**	**No. Small**
Control	106.4 b	197.8 a	44.3 b	65.5 a	54.5 a	34.8 a
Solarization	112.2 ab	195.3 a	56.5 a	58.5 a	53.0 a	27.3 ab
Turnip	105.5 b	193.3 a	50.3 ab	58.8 a	54.0 a	30.3 ab
Solarization + Turnip	119.7 a	200.2 a	61.0 a	69.0 a	47.0 a	23.3 b

Means followed by the same letter do not differ significantly ($P \leq 0.05$) as determined by Fisher's protected least significant difference test.

MODELING A GENERIC POSTHARVEST HANDLING SYSTEM

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Introduction

A spreadsheet-based stochastic model was developed to track fruit numbers and fruit value for 1000 individually inspected items passing through a market chain all the way from growing in a farmer's field to arriving at the consumer. A typical marketing chain is shown in figure 1. Primary inputs in the way of both a pricing function and a pass fraction are required at each step of the chain: at the farmer; the packinghouse; the distribution center; the retail store; and the consumer.

Materials and Methods

A pricing constant based on cross sectional area and size of typical onions was evaluated, whereby repackaging, technology addition and both repackage and technology addition, were compared with a control having no repackaging or technology addition. Values of these coefficients were set to approximate the onion industry given associated research experience. It is suggested that as few as 25% of products entering the marketing chain arrive at the consumer.

Results and Discussion

Figures 2 through 4 show preliminary results of this study. Repacking and technology addition in the packinghouse tended to result in increased value at the retail level. Placing technology in the packinghouse did not result in increased value for the packinghouse. Vertical integration would be required for the overall operation involving technology addition in the packinghouse to be profitable. Technology addition and repackaging both limit the total number of fruit reaching the consumer. Technology and repackaging increase the value of product reaching the consumer, although under conditions evaluated herein, revenue received by the packinghouse declined, which would necessitate a vertical integration in order to access the increased value at the retail level. The model suggests that the early removal of fruit with latent damage in order to avoid increased transportation costs does not really benefit the consumer. Additional considerations such as food security would be required for the adoption of additional equipment to be expected early in the chain under current scenarios.

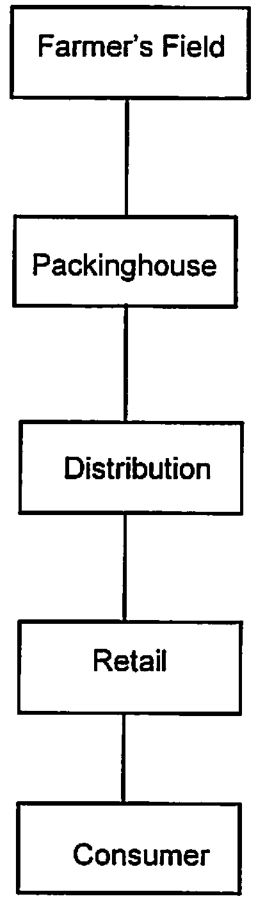

Figure 1. Simplified view of the post harvest handling system.

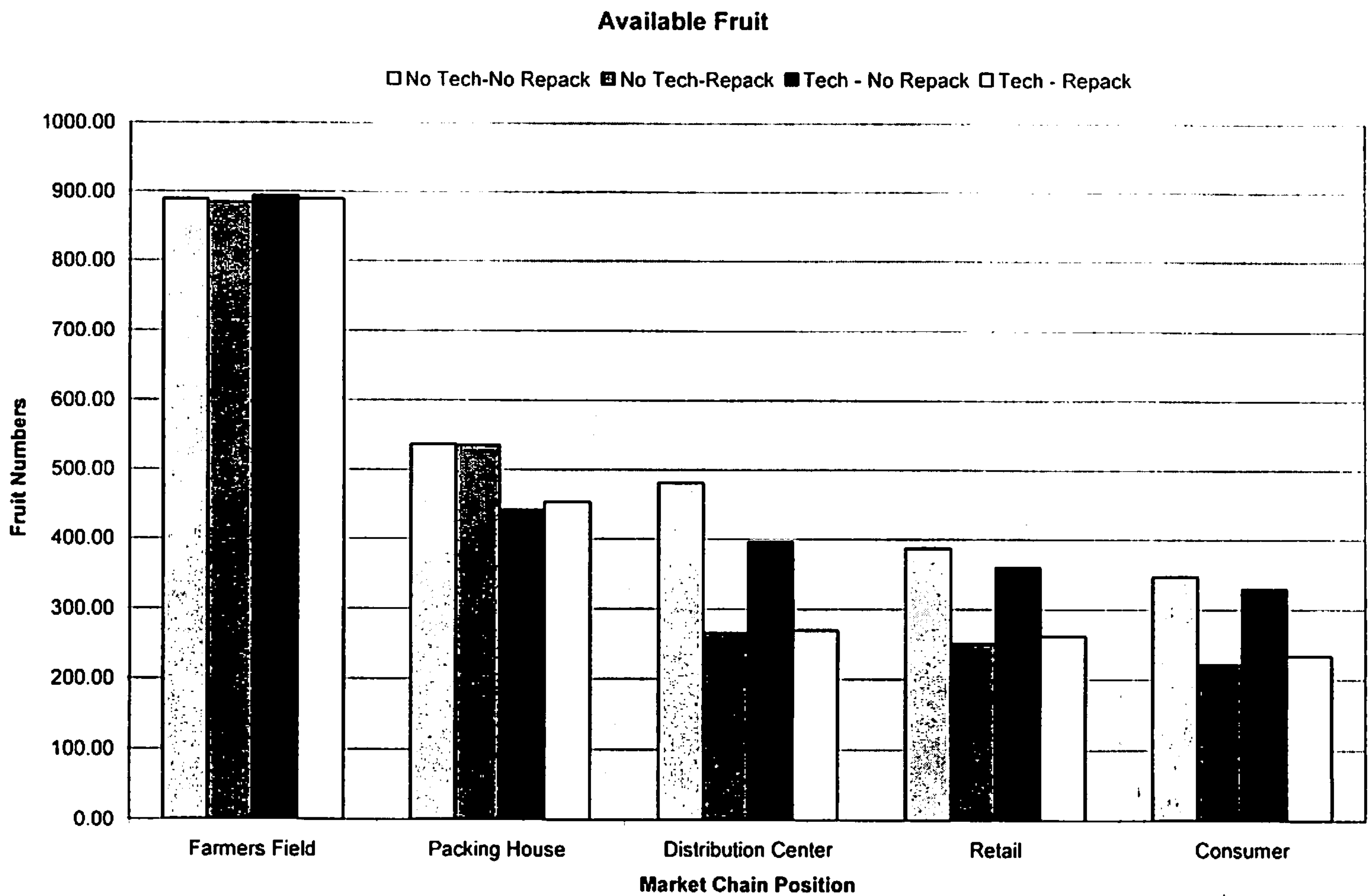

Figure 2. Fruit numbers per 1000 simulated fruits at the indicated steps for each technology-repack test trial, specifically for the cost factor of 0.001, 50 mm diameter ± 5 mm standard deviation.

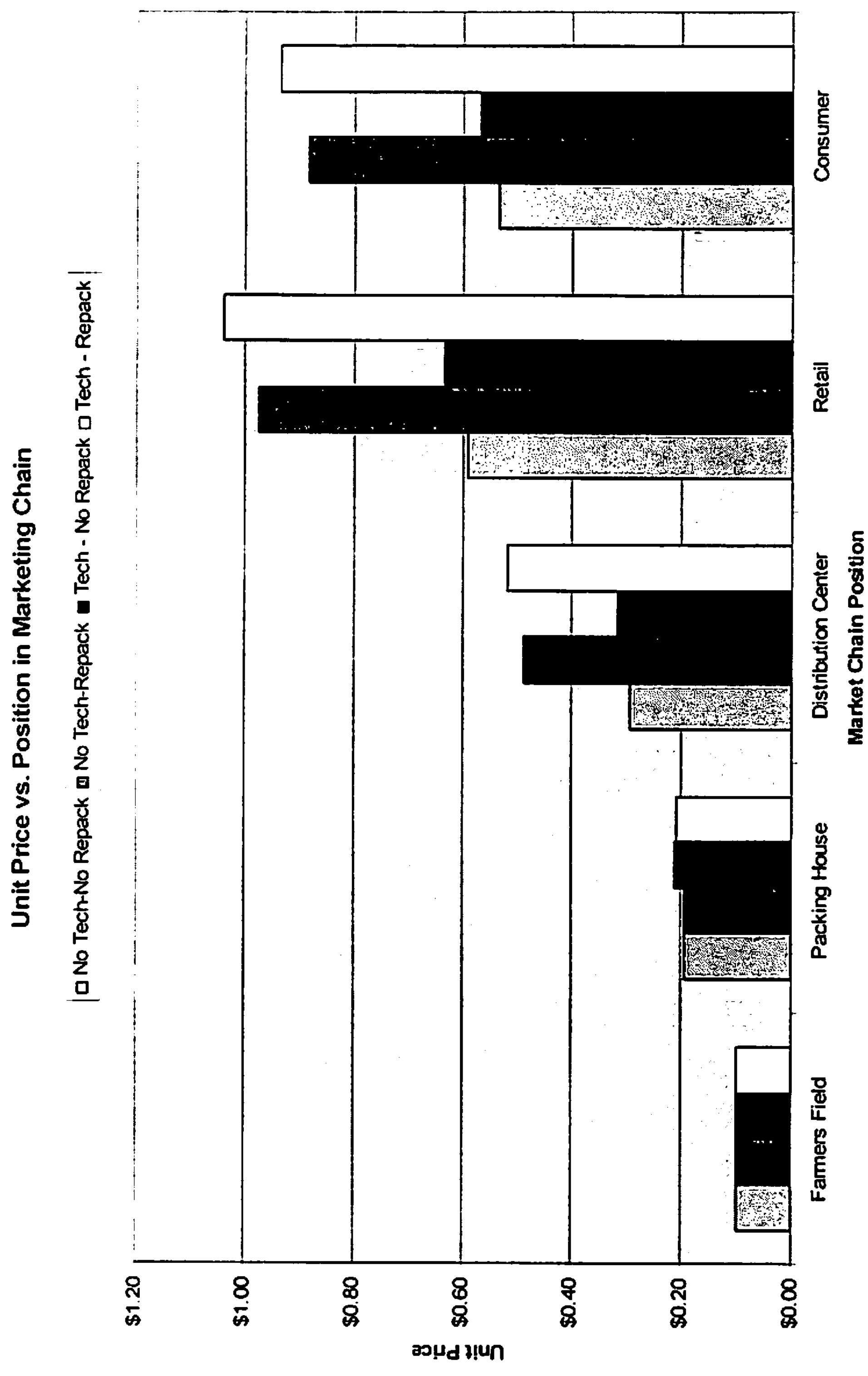

Figure 3. Unit value per fruit at the indicated steps for each technology-repack test trial, specifically for the cost factor of 0.001, 50 mm diameter ± 5 mm standard deviation.

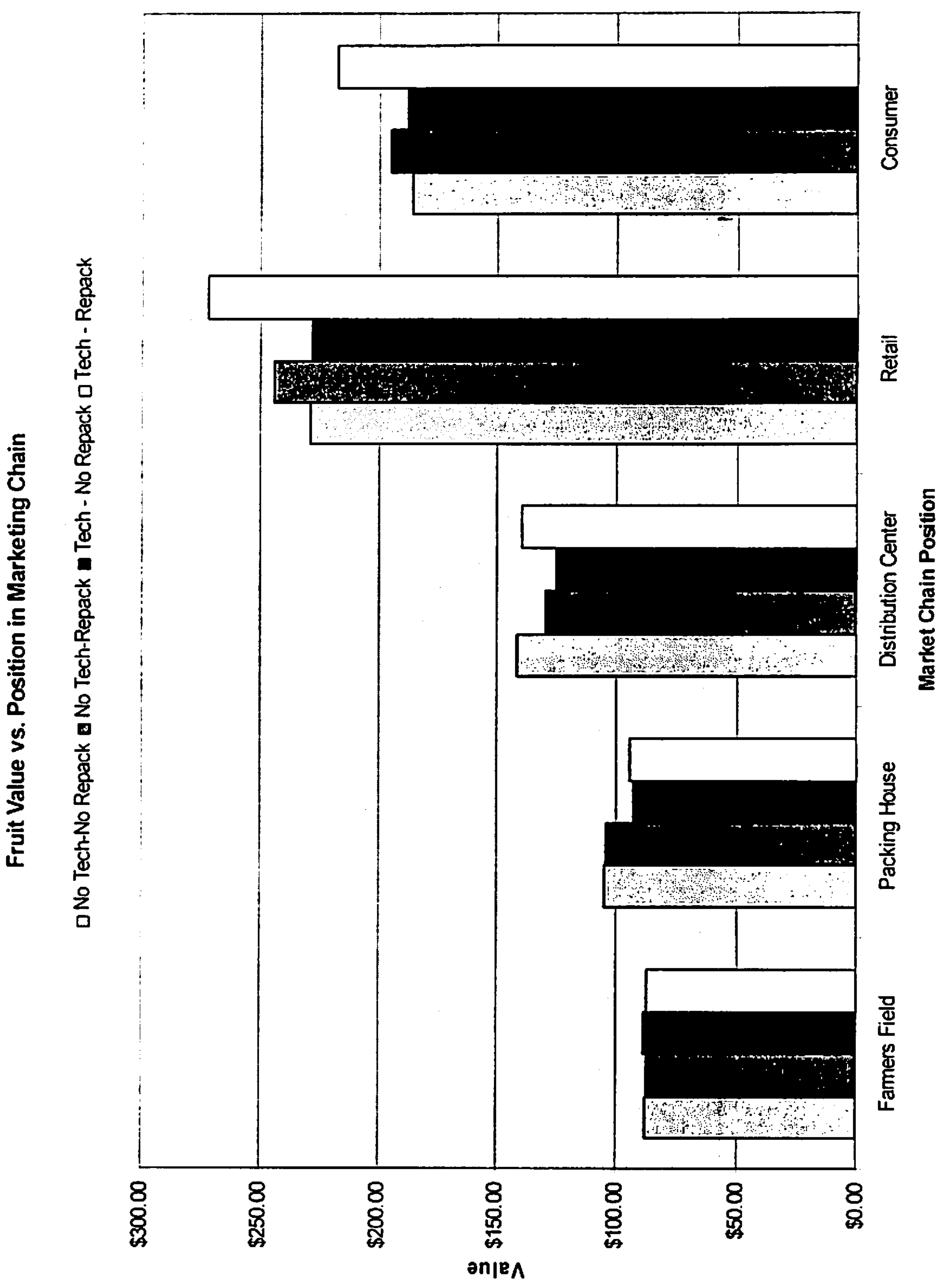

Figure 4. Sold value per original 1000 simulated fruits at the indicated steps for each technology-repack test trial, specifically for the cost factor of 0.001, 50 mm diameter ± 5 mm standard deviation.