2025 – 2026 Vidalia Onion Extension and Research Report

College of Agricultural & Environmental Sciences
UNIVERSITY OF GEORGIA

2025 - 2026 University of Georgia Vidalia Onion Extension and Research Report

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Much of this research presented in this report was sponsored by the Vidalia Onion Committee. We thank them for their support.

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UGA Onion Variety Trial Report 2025 - 2026 Crop Season

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Introduction

The University of Georgia (UGA) evaluates short day onion varieties to determine their performance characteristics in standardized growing practices. Variety entries for the trial are submitted by participating seed companies. These trials are conducted at the Vidalia Onion and Vegetable Research Center (VOVRC) located in Lyons, Georgia.

Materials and Methods

There were 47 variety entries in the 2025-2026 UGA onion variety trial conducted at VOVRC. After seed entries were received, seedbeds were established for transplant production by UGA staff at the research center. Prior to planting, the seedbeds received a fumigation treatment of metam sodium at 75 gallons per acre for weed and disease suppression. The seedbeds were planted on September 23, 2025, and transplants were set in the field on November 18, 2025. At harvest, onions were graded and yield data were collected. In addition, a 10-bulb sample of jumbo onions from each plot was submitted to the UGA Crop Quality Laboratory for flavor evaluation. Details regarding fertility management and fungicide applications for both the seedbeds and field trial are provided in **Tables 1, 2, 3,** and **4**. Each experimental plot measured 20 feet long by 6 feet wide and contained approximately 240 onion plants. Varieties were arranged in a replicated trial with four replications per entry. Harvest timing for each variety was determined by a committee based on crop maturity. The transplant density used in the trial was equivalent to 87,120 plants per acre. The variety entries evaluated in the trial are listed in **Table 5**.

Table 1. Fertilizer applications in seedbed

Date	Product Applied
September 1, 2025	200 lb/acre of 5-10-15 (Preplant incorporated)
October 7, 2025	200 lb/acre of 5-10-15
October 14, 2025	200 lb/acre of 5-10-15
October 30, 2025	200 lb/acre of 10-10-10
November 5, 2025	100 lb/acre of 10-10-10

Note: Total lbs/A applied: 60 (N) - 90 (P_2O_5) - 120 (K_2O) - 54 (S) - 51 (Ca). All fertilizer applications were applied with a First Products brand drop spreader.

Table 2. Pesticide applications in seedbed

Date	Product Applied
August 12, 2025	Vapam HL (75 gal/acre)
October 6, 2025	Select Max (9 oz/acre)
October 30, 2025	Miravis Prime (11.4 oz/acre) + Badge SC (1 pt/acre)
November 4, 2025	Fontelis (24 oz/acre) + Badge SC (1 pt/acre)
November 11, 2025	Luna Flex (13.6 oz/acre) + Badge SC (1 pt/acre)

Table 3. Fertilizer applications in transplanted field

Date	Product Applied
December 17, 2025	150 lb/acre of 5-10-15
January 7, 2026	150 lb/acre of 5-10-15
January 15, 2026	150 lb/acre of 5-10-15
January 23, 2026	300 lb/acre of 5-10-15
February 9, 2026	300 lb/acre of 5-10-15
February 23, 2026	150 lb/acre of calcium nitrate

Note: Total lbs/A applied: 75 (N) – 105 (P_2O_5) – 157 (K_2O) – 28 (S) – 102 (Ca). Soil sample test results called for 125 -150 lb/acre nitrogen, 60 lb/acre of phosphorus, 90 lb/acre of potash, and 40 – 60 lb/acre of sulfur. All fertilizer applications applied with a First Products brand drop spreader. Sulfur content of 5-10-15 fertilizer applied was 2 – 3%, depending on formulation used.

Table 4. Pesticide applications in transplanted field

Date	Product Applied
Fungicides	
January 12, 2026	Miravis Prime (11.4 oz/acre) + Badge SC (1 pt/acre)
January 22, 2026	Luna Flex (13.6 oz/acre) + Badge SC (1 pt/acre)
January 29, 2026	Inspire Super (20 oz/acre) + Badge SC (1 pt/acre)
February 5, 2026	Bravo Weather Stik (1 pt/acre) + Badge SC (1 pt/acre)
February 12, 2026	Fontelis (24 oz/acre) + Badge SC (1 pt/acre)
February 17, 2026	Elisys (10 oz/acre)
February 26, 2026	Omega 500 (1 pt/acre) + Romeo (.75 lb/acre)
March 5, 2026	Inspire Super (20 oz/acre) + Badge SC (1 pt/acre) + Lifegard (2 oz/acre)
March 23, 2026	Luna Flex (13.6 oz/acre)
March 30, 2026	Elisys (10 oz/acre)
Insecticides	
February 17, 2026	Torac (24 oz/acre)
March 5, 2026	Radiant SC (10 oz/acre)
Herbicides	
November 27, 2025	Goal 2XL (1 qt/acre) + Prowl (1 qt/acre)

Table 5. Variety entries in the 2025-2026 UGA Vidalia onion variety trial.

Variety	Company	Type
Candy Kim	Solar	Yellow Granex
Candy Ann	Solar	Yellow Granex
Candy Joy	Solar	Yellow Granex
Fast Track	Vilmorin-Mikado	Yellow Granex
Reforma (EMY 55455)	Emerald	Yellow Granex
EMY 55855	Emerald	Yellow Granex
EMY 55186	Emerald	Yellow Granex
EMY 55673	Emerald	Yellow Granex
Sweet Magnolia	Seminis	Yellow Granex
Sweet Azalea	Seminis	Yellow Granex
Macon	Bejo	Yellow Granex
Shania (BGS 379 F1)	Bejo	Yellow Granex
369 (Sweet Tule)	Bejo	Yellow Granex
Maragogi	Bejo	Yellow Granex
Sapelo	DP Seeds	Yellow Granex
Georgia Boy	DP Seeds	Yellow Granex
DP 1407	DP Seeds	Yellow Granex
Early Sweet	DP Seeds	Yellow Granex
XON-404Y	Sakata	Yellow Granex
XON-106Y	Sakata	Yellow Granex
Vidora	Nunhems	Yellow Granex
Plethora	Nunhems	Yellow Granex

Variety	Company	Type
1014	Nunhems	Yellow Granex
Adhora (1011)	Nunhems	Yellow Granex
1012	Nunhems	Yellow Granex
1015	Nunhems	Yellow Granex
10258 (Miss Anabelle)	Hazera	Yellow Granex
A2801	Hazera	Yellow Granex
A2290	Hazera	Yellow Granex
A4184	Hazera	Yellow Granex
OSYF12-7091	Crookham	Yellow Granex
OSYF10-4021	Crookham	Yellow Granex
OSYF22-4022	Crookham	Yellow Granex
Gilmore 26	Pike's Seed	Yellow Granex
Dulciana	Nunhems	Yellow Grano
NUN 1216	Nunhems	Yellow Grano
Tacoma	Bejo	Yellow Grano
Revolution	Bejo	Yellow Grano
Naranco	Bejo	Yellow Grano
Red Sensation	Bejo	Red
Red Marvel	Bejo	Red
Chianti	DP Seeds	Red
Sofire	Nunhems	Red
Rosefire	Nunhems	Red
Mata Hari	Nunhems	Red
Monjablanca	Bejo	White
Isidea	Nunhems	White

Harvest Timing

Each variety was selected for harvest based on signs of weak tops and/or adequately sized bulbs. Participating seed companies reserve the right to specify the harvest timing or defining characteristics for their respective varieties. Varieties were clipped seven days after their dig date. Growing degree days (GDD) were used to assist in forecasting onion harvest maturity. GDD calculations were based on data from the UGA Weather Station located in Lyons, GA. A base temperature of 50°F with no upper temperature threshold was used to calculate GDD accumulation. The harvest schedule during the trial and the total GDD are shown in **Table 6**.

Table 6. Harvest schedule of 2025-2026 Vidalia onion variety trial.

Variety	Maturity	Transplanting Date	Digging Date	Days After Transplanting to Digging	Total GDD
Candy Joy, Candy Ann, Candy Kim, Fast Track, Early Sweet, 1407, Vidora	Early	November 18, 2025	April 1, 2026	134 days	1069
Maragogi, Tacoma, Red Sensation, Revolution, Naranco, Sapelo, 106Y, 404Y, 1015, Sofire, Adhora, Dulciana, 1012, Miss Anabelle, OSYF22-4022, OSYF12-7091, OSYF10-4021	Early - Main	November 18, 2025	April 7, 2026	140 days	1182
EMY 55855, EMY 55186, Reforma, EMY 55673, Sweet Magnolia, Sweet Azalea, Monjablanca, Shania, Red Marvel, 369, GA Boy, 1216, Plethora, Isidea, A4184, A2801, A2290	Main	November 18, 2025	April 15, 2026	148 days	1328
Macon, Chianti, Rosefire, 1014, Mata Hari, Gilmore 26	Late	November 18, 2025	April 27, 2026	160 days	1579

Results

The following **Tables 7** to **16** show field weights, marketable yields, colossal yields, jumbo yields, medium yields, and cull yield. For additional information regarding the performance of a given variety, please contact your Extension Agent or the Vidalia Onion and Vegetable Research Center. We would like to thank the participating seed companies as well as the Vidalia Onion Committee for their support in this trial.

Table 7. Vidalia onion field weights (40 lb. boxes/acre) measured before grading.

Variety	40 lb. boxes/acre	Tukey letters
1014	1914.82	a
Macon	1799.12	a
Gilmore 26	1792.31	a
1216	1586.99	b
Rosefire	1549.56	bc
Chianti	1542.75	bc
Mata Hari	1479.22	bcd
Sweet Magnolia	1471.28	bcd
Revolution	1446.33	bcde
404Y	1423.64	bcdef
369 (Sweet Tule)	1416.83	bcdefg
Plethora	1406.62	cdefg
Naranco	1405.11	bcdefg
Isidea	1395.28	cdefg
Monjablanca	1374.86	cdefgh
OSYF22-4022	1350.66	defghi
Shania	1343.10	defghi
Sweet Azalea	1343.10	defghi
EMY 55186	1321.55	defghij
Tacoma	1317.01	defghij
OSYF10-4021	1313.61	defghijk
EMY 55673	1301.13	defghijk
GA Boy	1301.13	defghijk
Maragogi	1296.59	defghijk
1015	1289.78	efghijk
1012	1288.65	efghijk
Early Sweet	1278.44	efghijkl
EMY 55455 (Reforma)	1273.90	efghijkl
Candy Kim	1272.01	efghijklm
106Y	1269.37	fghijkl
Adhora (1011)	1256.89	fghijklm
A4184	1252.35	fghijklm
Dulciana	1250.84	fghijklmn
EMY 55855	1243.27	ghijklmn
Vidora	1234.2	ghijklmn
Candy Ann	1232.69	ghijklmn
A2290	1209.24	hijklmn
1407	1208.11	hijklmn
A2801	1208.11	hijklmn
Red Marvel	1194.50	ijklmn
Fast Track	1187.69	ijklmn
Miss Anabelle (10258)	1184.29	ijklmn
Candy Joy	1149.12	jklmn
OSYF12-7091	1138.91	klmn
Sofire	1111.69	lmn
Sapelo	1086.73	mn
Red Sensation	1074.25	n

Note: Letters that are the same between varieties indicate that those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 8. Vidalia onion <u>total marketable yield</u> (40 lb. boxes/acre) measured <u>after grading</u>.

Variety	40 lb. boxes/acre	Tukey letters
1014	1837.69	a
Gilmore 26	1660.72	ab
Macon	1635.77	ab
Chianti	1517.79	bc
Rosefire	1501.91	bc
1216	1472.42	bcd
Mata Hari	1415.70	bcde
Revolution	1390.74	cdef
Naranco	1334.02	cdefg
404Y	1295.46	cdefgh
369 (Sweet Tule)	1293.19	cdefgh
Plethora	1293.19	cdefgh
1015	1252.35	defghi
Maragogi	1250.08	defghi
Adhora (1011)	1213.78	efghij
Tacoma	1211.51	efghij
Early Sweet	1206.97	efghij
OSYF22-4022	1200.92	efghij
Vidora	1197.90	efghij
Sweet Magnolia	1195.63	efghij
1012	1193.36	efghij
Candy Kim	1188.82	efghij
EMY 55186	1188.82	efghij
Isidea	1186.56	efghij
EMY 55673	1179.75	efghij

Variety	40 lb. boxes/acre	Tukey letters
106Y	1157.06	ghij
Candy Ann	1149.50	fghijk
EMY 55855	1147.99	ghij
GA Boy	1134.37	ghijk
Dulciana	1131.35	ghijkl
Fast Track	1125.30	ghijk
A4184	1120.76	ghijk
Shania	1116.22	ghijkl
Miss Anabelle (10258)	1102.61	hijkl
1407	1095.81	hijkl
A2801	1093.54	hijkl
Sweet Azalea	1091.27	hijkl
A2290	1059.51	ijkl
Monjablanca	1057.24	ijkl
Candy Joy	1048.16	ijklm
EMY 55455 (Reforma)	1014.13	jklm
OSYF12-7091	1000.52	jklm
OSYF10-4021	993.71	jklm
Sofire	916.57	klmn
Sapelo	887.08	lmn
Red Marvel	821.29	mn
Red Sensation	744.15	n

Note: Letters that are the same between varieties indicate that those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 9. Vidalia onion colossal yield (40 lb. boxes/acre) measured after grading.

Variety	40 lb. boxes/acre	Tukey letters
Macon	288.13	a
1014	283.59	a
Gilmore 26	226.88	a
Chianti	127.05	b
Sweet Magnolia	115.71	bc
404Y	86.21	bcd
Naranco	81.68	bcd
Rosefire	77.14	bcd
Mata Hari	69.58	bcd
1216	65.79	bcd
OSYF22-4022	57.48	bcd
106Y	52.18	bcd
OSYF10-4021	40.84	bcd
Plethora	38.57	bcd
Sweet Azalea	38.57	bcd
A4184	34.03	cd
Revolution	34.03	cd
EMY 55455 (Reforma)	27.23	cd
Isidea	24.96	d
OSYF12-7091	24.96	d
Shania	24.96	d
Candy Kim	24.20	cd
Vidora	21.18	cd
369 (Sweet Tule)	18.15	d

Variety	40 lb. boxes/acre	Tukey letters
Early Sweet	18.15	d
Monjablanca	18.15	d
1012	15.88	d
Adhora (1011)	15.88	d
GA Boy	15.88	d
Red Marvel	15.88	d
A2290	13.61	d
Miss Anabelle (10258)	13.61	d
EMY 55673	11.34	d
Sapelo	11.34	d
1407	9.08	d
EMY 55855	9.08	d
Fast Track	9.08	d
1015	6.81	d
A2801	6.81	d
Candy Ann	6.05	d
Tacoma	4.54	d
EMY 55186	2.27	d
Maragogi	2.27	d
Red Sensation	2.27	d
Sofire	2.27	d
Candy Joy	0	d
Dulciana	0	d

Note: Letters that are the same between varieties indicate that those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 10. Percent colossal size of total marketable yield measured after grading.

Variety	Percent Colossal	Tukey letters
Macon	17.47	a
1014	15.32	ab
Gilmore 26	13.56	abc
Sweet Magnolia	9.72	bcd
Chianti	8.40	cde
404Y	6.62	def
Naranco	5.44	defg
Rosefire	5.13	defg
Mata Hari	4.86	defg
OSYF22-4022	4.69	defg
106Y	4.49	defg
1216	4.40	defg
OSYF10-4021	4.09	defg
Sweet Azalea	3.56	efg
A4184	3.09	efg
Plethora	2.99	efg
EMY 55455 (Reforma)	2.65	fg
OSYF12-7091	2.42	fg
Revolution	2.45	fg
Shania	2.23	fg
Isidea	2.13	fg
Candy Kim	2.06	fg
Vidora	1.76	fg
Monjablanca	1.75	fg

Variety	Percent Colossal	Tukey letters
Red Marvel	1.63	fg
Early Sweet	1.50	fg
GA Boy	1.43	fg
369 (Sweet Tule)	1.39	fg
1012	1.35	fg
Adhora (1011)	1.31	fg
Sapelo	1.26	fg
A2290	1.24	fg
Miss Anabelle (10258)	1.18	fg
EMY 55673	0.96	fg
1407	0.82	g
Fast Track	0.80	g
EMY 55855	0.73	g
A2801	0.62	g
Candy Ann	0.54	fg
1015	0.54	g
Tacoma	0.37	g
Red Sensation	0.27	g
Sofire	0.26	g
EMY 55186	0.19	g
Maragogi	0.17	g
Dulciana	0	g
Candy Joy	0	g

Note: Letters that are the same between varieties indicate that those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 11. Vidalia onion jumbo yield (40 lb. boxes/acre) measured after grading.

Variety	40 lb. boxes/acre	Tukey letters
1014	1538.21	a
Gilmore 26	1408.89	ab
1216	1393.01	abc
Rosefire	1361.25	abcd
Chianti	1356.71	abcd
Macon	1336.29	abcde
Revolution	1327.22	abcdef
Mata Hari	1291.67	bcdefg
369 (Sweet Tule)	1234.20	bcdefgh
Plethora	1220.59	bcdefghi
Naranco	1200.17	bcdefghij
1015	1182.02	cdefghijk
Maragogi	1154.79	defghijk
404Y	1150.26	defghijk
1012	1134.37	efghijkl
EMY 55186	1116.22	fghijklm
Adhora (1011)	1111.69	ghijklm
EMY 55673	1102.61	ghijklmn
Isidea	1100.34	ghijklmn
Early Sweet	1098.08	ghijklmn
EMY 55855	1095.81	ghijklmn
Vidora	1089	ghijklmn
OSYF22-4022	1085.97	ghijklmn
Tacoma	1075.39	ghijklmn
GA Boy	1066.31	ghijklmn
Candy Ann	1058.75	ghijklmno
Candy Kim	1052.70	ghijklmno
106Y	1043.62	hijklmno
Sweet Magnolia	1043.62	hijklmno
Miss Anabelle (10258)	1030.01	hijklmno
A4184	1023.21	hijklmno
A2801	1018.67	ijklmno
Dulciana	1016.4	hijklmno
Shania	1016.4	ijklmno
A2290	1002.79	jklmno
Monjablanca	993.71	jklmno
Sweet Azalea	986.91	jklmno
Fast Track	982.37	klmno
1407	977.83	klmno
EMY 55455 (Reforma)	930.19	lmnop
Candy Joy	909.77	mnop
OSYF 10-4021	893.89	nop
OSYF 12-7091	834.9	op
Sapelo	741.88	pq
Sofire	737.34	pq
Red Marvel	726	pq
Red Sensation	608.02	q

Note: Letters that are the same between varieties indicate that those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 12. Percent jumbo size of total marketable yield measured after grading.

Variety	Percent Jumbo	Tukey letters
369 (Sweet Tule)	95.45	a
Revolution	95.43	a
EMY 55855	95.39	a
1012	94.99	ab
1216	94.68	ab
A2290	94.63	ab
1015	94.38	abc
Plethora	94.37	abc
GA Boy	93.96	abc
Monjablanca	93.95	abc
EMY 55186	93.87	abc
EMY 55673	93.48	abcd
Miss Anabelle (10258)	93.38	abcd
A2801	93.16	abcd
Isidea	92.67	abcde
Maragogi	92.26	abcde
Candy Ann	92.07	abcde
EMY 55455 (Reforma)	91.74	abcde
Adhora (1011)	91.57	abcde
Mata Hari	91.27	abcdef
A4184	91.21	abcdef
Shania	91.08	abcdef
Early Sweet	90.97	abcdef
Vidora	90.89	abcdef
Rosefire	90.63	abcdef
Naranco	90.46	abcdef
OSYF22-4022	90.41	abcdefg
Sweet Azalea	90.39	abcdef
106Y	90.19	abcdef
OSYF10-4021	89.99	abcdefg
Dulciana	89.77	abcdefgh
Chianti	89.36	abcdefgh
1407	89.21	abcdefgh
404Y	88.81	bcdefgh
Tacoma	88.76	bcdefgh
Candy Kim	88.53	bcdefghi
Red Marvel	88.22	cdefgh
Fast Track	87.29	defghi
Sweet Magnolia	87.27	defghi
Candy Joy	86.78	efghij
Gilmore 26	84.91	fghij
1014	83.79	ghij
Sapelo	83.75	ghij
OSYF12-7091	83.38	hij
Red Sensation	81.89	ij
Macon	81.83	ij
Sofire	80.49	j

Note: Letters that are the same between varieties indicate that those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 13. Vidalia onion medium yield (40 lb. boxes/acre) measured after grading.

Variety	40 lb. boxes/acre	Tukey letters
Sofire	176.96	a
OSYF12-7091	140.66	ab
Candy Joy	138.39	abc
Fast Track	133.86	abc
Red Sensation	133.87	abc
Sapelo	133.87	abc
Tacoma	131.59	abcd
Dulciana	114.95	bcde
Candy Kim	111.93	bcdef
1407	108.90	bcdef
Maragogi	93.02	bcdefg
Early Sweet	90.8	bcdefg
Vidora	87.73	bcdefgh
Adhora (1011)	86.21	cdefgh
Candy Ann	84.70	bcdefghi
Red Marvel	79.41	defghi
Shania	74.87	efghij
EMY 55186	70.33	efghij
A2801	68.06	efghijk
EMY 55673	65.79	efghijkl
Sweet Azalea	65.79	efghijkl
1015	63.53	efghijklm
A4184	63.53	efghijklm
Rosefire	63.53	efghijklm
106Y	61.26	efghijklm

Variety	40 lb. boxes/acre	Tukey letters
Isidea	61.26	efghijklm
404Y	58.99	efghijklm
Miss Anabelle (10258)	58.99	efghijklm
OSYF10-4021	58.99	efghijklm
OSYF22-4022	57.48	efghijklm
EMY 55455 (Reforma)	56.72	fghijklm
Mata Hari	54.45	efghijklm
GA Boy	52.18	ghijklm
Naranco	52.18	ghijklm
Monjablanca	45.38	ghijklm
1012	43.11	ghijklm
A2290	43.11	ghijklm
EMY 55855	43.11	ghijklm
369 (Sweet Tule)	40.84	ghijklm
Sweet Magnolia	36.30	hijklm
Chianti	34.03	hijklm
Plethora	34.03	hijklm
Revolution	29.49	ijklm
Gilmore 26	24.97	jklm
1014	15.88	klm
1216	13.61	lm
Macon	11.34	m

Note: Letters that are the same between varieties indicate that those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 14. Percent medium size of total marketable yield measured after grading.

Variety	Percent Medium	Tukey letters
Sofire	19.26	a
Red Sensation	17.84	ab
Sapelo	14.99	abc
OSYF12-7091	14.17	bcd
Candy Joy	13.22	bcd
Fast Track	11.91	cde
Tacoma	10.86	cdef
Dulciana	10.23	cdefgh
Red Marvel	10.15	cdefg
1407	9.97	defgh
Candy Kim	9.41	defghi
Maragogi	7.57	efghij
Early Sweet	7.53	efghijk
Candy Ann	7.39	efghijklm
Vidora	7.35	efghijklm
Adhora (1011)	7.12	efghijkl
Shania	6.69	fghijklm
A2801	6.22	fghijklmn
Sweet Azalea	6.05	fghijklmn
EMY 55186	5.94	fghijklmn
OSYF10-4021	5.92	ghijklmn
A4184	5.70	ghijklmno
EMY 55455 (Reforma)	5.61	ghijklmnop
EMY 55673	5.57	ghijklmnop
Miss Anabelle (10258)	5.44	ghijklmnop
106Y	5.32	ghijklmnop
Isidea	5.20	hijklmnop
1015	5.08	hijklmnop
OSYF22-4022	4.90	ghijklmnop
GA Boy	4.62	ijklmnop
404Y	4.57	ijklmnop
Monjablanca	4.30	ijklmnop
Rosefire	4.24	ijklmnop
A2290	4.14	ijklmnop
Naranco	4.10	ijklmnop
EMY 55855	3.88	jklmnop
Mata Hari	3.87	ijklmnop
1012	3.65	jklmnop
369 (Sweet Tule)	3.16	jklmnop
Sweet Magnolia	3.01	jklmnop
Plethora	2.64	klmnop
Chianti	2.24	lmnop
Revolution	2.12	mnop
Gilmore 26	1.53	nop
1216	0.92	op
1014	0.89	op
Macon	0.70	p

Note: Letters that are the same between varieties indicate that those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 15. Vidalia onion cull weights (40 lb. boxes/acre) measured after grading.

Variety	40 lb. boxes/acre	Tukey letters
Red Marvel	373.21	a
Red Sensation	330.10	ab
OSYF10-4021	319.89	ab
Monjablanca	317.63	abc
Sweet Magnolia	275.65	abcd
EMY 55455 (Reforma)	259.77	abcde
Sweet Azalea	251.83	abcdef
Shania	226.88	bcdefg
Isidea	208.73	bcdefgh
Sapelo	199.65	bcdefghi
Sofire	195.11	bcdefghij
Naranco	170.91	cdefghijkl
GA Boy	166.75	defghijk
Macon	163.35	defghijk
A2290	149.74	defghijkl
OSYF22-4022	149.74	defghijkl
OSYF12-7091	138.39	efghijkl
EMY 55186	132.72	efghijkl
A4184	131.59	efghijkl
Gilmore 26	131.59	efghijkl
404Y	128.18	efghijkl
369 (Sweet Tule)	123.65	fghijkl
EMY 55673	121.38	fghijkl
Dulciana	119.49	efghijkl
1216	114.57	ghijkl
A2801	114.57	ghijkl
Plethora	113.44	ghijkl
106Y	112.30	ghijkl
1407	112.30	ghijkl
Tacoma	105.50	ghijkl
Candy Joy	100.96	ghijkl
1012	95.29	ghijkl
EMY 55855	95.29	ghijkl
Candy Ann	83.19	ghijkl
Candy Kim	83.19	ghijkl
Miss Anabelle (10258)	81.68	hijkl
1014	77.14	hijkl
Early Sweet	71.47	ijkl
Mata Hari	63.53	hijkl
Fast Track	62.39	jkl
Revolution	55.58	kl
Rosefire	47.64	kl
Maragogi	46.51	kl
Adhora (1011)	43.11	kl
1015	37.43	kl
Vidora	36.30	kl
Chianti	24.96	l

Note: Letters that are the same between varieties indicate that those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 16. Percent culls of total field weights measured after grading.

Variety	Percent Culls	Tukey letters
Red Marvel	31.99	a
Red Sensation	30.76	ab
OSYF10-4021	24.34	abc
Monjablanca	23.12	abcd
EMY 55455 (Reforma)	20.33	bcde
Sweet Azalea	18.77	cdef
Sweet Magnolia	18.66	cdefg
Sapelo	18.18	cdefgh
Sofire	17.52	cdefghi
Shania	16.81	cdefghi
Isidea	15.00	cdefghij
GA Boy	12.82	defghijk
A2290	12.39	defghijkl
Naranco	12.09	defghijkl
OSYF12-7091	12.04	defghijkl
OSYF22-4022	11.14	defghijkl
A4184	10.59	efghijkl
EMY 55186	10.04	efghijkl
Dulciana	9.58	efghijkl
A2801	9.45	efghijkl
EMY 55673	9.31	efghijkl
1407	9.31	efghijkl
Macon	9.10	fghijkl
404Y	9.07	fghijkl

Variety	Percent Culls	Tukey letters
106Y	8.93	fghijkl
Candy Joy	8.80	fghijkl
369 (Sweet Tule)	8.74	fghijkl
Plethora	8.06	fghijkl
Tacoma	8.00	fghijkl
EMY 55855	7.62	ghijkl
1012	7.39	hijkl
Gilmore 26	7.35	hijkl
1216	7.25	hijkl
Miss Anabelle (10258)	6.89	ijkl
Candy Ann	6.71	ghijkl
Candy Kim	6.55	hijkl
Early Sweet	5.60	jkl
Fast Track	5.20	jkl
Mata Hari	4.26	jkl
1014	4.02	jkl
Revolution	3.85	kl
Maragogi	3.61	kl
Adhora (1011)	3.43	kl
Rosefire	3.08	kl
Vidora	2.96	kl
1015	2.89	kl
Chianti	1.62	l

Note: Letters that are the same between varieties indicate that those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

UGA Onion Variety Trial Quality Report 2025 – 2026 Crop Season

Daniel Jackson, Chris Tyson, Erin Jarrett, Jason Lessl, Jason Edenfield, Derrick Bowen, Aubrey Shirley, Chase Watts, Nick Ray, Steven Powell, Savannah Tanner, Ross Greene, and Eric Melby

Introduction

Each year the University of Georgia, Agricultural and Environmental Services Laboratories (AESL) evaluates the flavor-associated compounds in the short-day onions grown in the variety trial. These onion varieties are submitted by participating seed companies, grown at the Vidalia Onion and Vegetable Research Center (VOVRC), and once harvested and dried, are submitted to AESL for analysis of the pungency-related compounds; pyruvic acid, lachrymatory factor (LF), and methyl thiosulfinates (MT). Due to the association of Vidalia onions having low pungency and sweet flavor, this annual evaluation provides useful information about the relative flavor quality of these onion varieties. Furthermore, results are used to evaluate yellow Granex varieties before officially qualifying them to be grown as sweet Vidalia onions in the region. This publication summarizes the flavor analysis results from the 2025-2026 growing season, as well as comparing the performance of each variety over the past three growing seasons (2024, 2025, and 2026).

Materials and Methods

Forty-seven onion varieties were analyzed as part of the 2025-2026 variety trial. Each variety was grown at the VOVRC in quadruplicate plots. Harvested onions from each plot were graded, dried, and submitted to the lab individually. Cores taken from 10 onions within each replicate were composited and pressed to collect the onion juice, prior to analysis of pungency-related compounds within the extracted juice.

Results

Tables 1-3 compare the concentrations of flavor-associated compounds in onion varieties grown as a part of the 2025-2026 trial. As Vidalia onions are known for low pungency and sweet flavor, lower concentrations of pyruvic acid, lachrymatory factor, and methyl thiosulfinates indicate a superior flavor profile.

In this year's variety trial, the pyruvic acid (pungency) content ranged from 3.55-6.47 µmol/g, which is consistent albeit slightly higher than pungency measured in the previous two season's varieties trials. Lachrymatory factor ranged from 2.68-6.07 µmol/g, is a considerable increase over the 2024-2025 growing season when LF only ranges from 0.55-2.29 µmol/g. Finally, methyl thiosulfinates ranged from 3.05-39.50 nmol/g which is also an increase compared with the past two seasons. These increases in onion pungency are most likely attributable to the extremely low precipitation the Vidalia region received during the 2025-2026 growing season. Onion pungency is closely related to sulfur availability which increases when low precipitation

leads to reduced leching. The overall quality rankings for this year's variety trial are provided below (**Table 4**) along with the average rating of varieties grown over the past three seasons (**Table 5**).

For additional information regarding the performance of a given variety, please contact your Extension Agent or the Vidalia Onion and Vegetable Research Center. We would like to thank the participating seed companies and the Vidalia Onion Committee for their support for this trial.

Table 1. Pungency (pyruvic acid) content in onions submitted to the UGA Agricultural & Environmental Services Labs as a part of the 2025-2026 variety trial.

Variety	Pyruvic Acid (µmole/g)		Variety	Pyruvic Acid (µmole/g)	
Red Marvel	3.55	j	EMY 55186	4.76	bcdefghij
Sweet Magnolia	3.71	ij	369	4.78	bcdefghij
Nun 01012	3.76	hij	Candy Ann	4.81	bcdefghij
Miss Anabelle	3.96	ghij	Fast Track	4.95	bcdefghi
OSYF10-4021	4.05	fghij	Early Sweet	4.96	bcdefghi
OSYF22-4022	4.05	fghij	Sofire	4.97	bcdefghi
OSYF12-7091	4.13	efghij	Candy Joy	5.04	bcdefgh
404Y	4.17	defghij	GA Boy	5.14	bcdefg
Adhora	4.30	cdefghij	A2801	5.15	bcdefg
Plethora	4.32	cdefghij	Tacoma	5.15	bcdefg
Naranco	4.34	cdefghij	Mata Hari	5.15	abcdefg
Vidora	4.34	cdefghij	Sweet Azalea	5.15	abcdefg
Red Sensation	4.36	cdefghij	EMY 55673	5.17	abcdefg
Macon	4.38	cdefghij	A4184	5.22	abcdefg
106Y	4.38	cdefghij	Rosefire	5.27	abcdefg
Chianti	4.44	cdefghij	A2290	5.33	abcdef
Dulciana	4.45	cdefghij	Maragogi	5.38	abcde
1014	4.48	cdefghij	Revolution	5.45	abcde
Sapelo	4.49	cdefghij	Shania	5.45	abcd
NUN 01216	4.52	cdefghij	Candy Kim	5.56	abc
1015	4.56	cdefghij	Reforma	6.00	ab
Majablanca	4.57	cdefghij	EMY 55855	6.47	a
1407	4.62	cdefghij			
Isidea	4.64	cdefghij			
Gilmore	4.67	cdefghij			

Note: Similar letters between varieties indicate those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 2. Onion lachrymatory factor (propanethial S-oxide) content in onions submitted to the UGA Agricultural & Environmental Services Labs as a part of the 2025-2026 variety trial.

Variety	Lachrymatory Factor (µmole/g)		Variety	Lachrymatory Factor (µmole/g)	
Red Marvel	2.68	j	Dulciana	4.63	abcdefghi
Sweet Magnolia	2.99	ij	Maragogi	4.64	abcdefghi
Majablanca	3.13	hij	106Y	4.70	abcdefghi
Chianti	3.42	ghij	Tacoma	4.82	abcdefgh
404Y	3.62	fghij	EMY 55673	4.87	abcdefgh
OSYF12-7091	3.69	efghij	Vidora	4.88	abcdefgh
OSYF10-4021	3.93	defghij	1407	4.95	abcdefgh
NUN 01216	3.95	defghij	369	4.96	abcdefg
Macon	4.04	cdefghij	EMY 55186	5.02	abcdefg
Red Sensation	4.05	cdefghij	1015	5.05	abcdefg
Plethora	4.08	cdefghij	Early Sweet	5.09	abcdefg
1014	4.12	bcdefghij	Shania	5.11	abcdefg
OSYF22-4022	4.13	bcdefghij	Sofire	5.18	abcdefg
Fast Track	4.20	bcdefghij	Revolution	5.25	abcdef
Isidea	4.23	bcdefghij	A2290	5.27	abcdef
Mata Hari	4.25	abcdefghij	GA Boy	5.35	abcdef
Candy Kim	4.28	abcdefghij	Gilmore	5.36	abcdef
Candy Ann	4.33	abcdefghij	Rosefire	5.46	abcde
Sweet Azalea	4.33	abcdefghij	A4184	5.51	abcd
Adhora	4.34	abcdefghij	A2801	5.81	abc
Candy Joy	4.49	abcdefghij	Reforma	5.91	ab
Nun 01012	4.53	abcdefghi	EMY 55855	6.07	a
Naranco	4.53	abcdefghi			
Miss Anabelle	4.62	abcdefghi			
Sapelo	4.63	abcdefghi			

Note: Similar letters between varieties indicate those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 3. Methyl thiosulfinate content in onions submitted to the UGA Agricultural & Environmental Services Labs as a part of the 2025-2026 variety trial.

Variety	Methyl thiosulfinate (nmole/g)		Variety	Methyl thiosulfinate (nmole/g)	
Sweet Azalea	3.05	j	EMY 55855	12.13	cdefghij
Dulciana	3.75	ij	Shania	12.90	cdefghij
Sweet Magnolia	4.15	hij	Candy Ann	14.23	cdefghij
Revolution	5.48	hij	1015	14.28	cdefghij
Gilmore	5.53	hij	Red Marvel	14.40	cdefghij
A2801	6.00	ghij	Early Sweet	14.75	cdefghij
GA Boy	6.83	ghij	Candy Joy	15.53	bcdefghij
EMY 55673	6.93	ghij	Fast Track	16.08	bcdefghij
Reforma	7.60	ghij	Candy Kim	17.78	bcdefghij
Red Sensation	8.03	ghij	OSYF10-4021	17.80	bcdefghij
A2290	8.15	ghij	EMY 55186	18.43	bcdefghij
Majablanca	8.73	ghij	A4184	18.65	bcdefghi
369	9.03	ghij	Macon	19.28	bcdefgh
1407	9.08	ghij	404Y	21.00	bcdefg
Plethora	9.23	fghij	1014	21.43	bcdefg
Miss Anabelle	9.30	fghij	OSYF12-7091	24.63	abcdef
Tacoma	9.43	efghij	Chianti	24.80	abcde
Adhora	9.75	defghij	OSYF22-4022	24.88	abcd
Naranco	9.85	defghij	Sofire	27.00	abc
Maragogi	9.98	defghij	Rosefire	30.83	ab
Vidora	10.20	defghij	NUN 01216	30.93	ab
106Y	10.40	defghij	Mata Hari	39.50	a
Isidea	10.85	defghij			
Sapelo	11.15	defghij			
Nun 01012	12.03	cdefghij			

Note: Similar letters between varieties indicate those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

Table 4. Overall flavor quality ranking of the 2025-2026 variety trial onions ranked by lowest overall Pyruvic acid, Lachrymatory factor, and Methyl Thiosulfinates.

Variety	Rank	Variety	Rank
Sweet Magnolia	1	1014	12(t)
Red Marvel	2	1015	12(t)
Majablanca	3	EMY 55673	12(t)
Miss Anabelle	4(t^i)	OSYF22-4022	13(t)
Red Sensation	4(t)	Candy Joy	13(t)
OSYF10-4021	5	GA Boy	13(t)
Plethora	5	Tacoma	13(t)
Dulciana	5	EMY 55186	14(t)
Nun 01012	6	Early Sweet	14(t)
404Y	7(t)	A2290	14(t)
1407	7(t)	Revolution	14(t)
Isidea	7(t)	NUN 01216	15(t)
Sweet Azalea	7(t)	A2801	15(t)
Adhora	8(t)	Maragogi	15(t)
Gilmore	8(t)	Candy Kim	16
OSYF12-7091	9(t)	Shania	17
Naranco	9(t)	A4184	18
106Y	9(t)	Sofire	19(t)
Sapelo	9(t)	Reforma	19(t)
369	9(t)	Mata Hari	20
Vidora	10(t)	Rosefire	21(t)
Macon	10(t)	EMY 55855	21(t)
Chianti	10(t)		
Candy Ann	10(t)		
Fast Track	11		

Note: t^i = tied means varieties received the **same rank**

Table 5. Overall flavor quality ranking of yellow Granex variety trial onions harvested in three consecutive years (2024-2026) ranked in order of lowest to highest overall Pyruvic acid, Lachrymatory factor, and Methyl Thiosulfinates.

Variety	Rank	
Gilmore	c	1
Sweet Magnolia	bc	2(t)
A2801	bc	2(t)
Plethora	abc	3(t)
Fast Track	abc	3(t)
Sweet Azalea	abc	3(t)
1014	abc	3(t)
A2290	abc	3(t)
1407	abc	3(t)
Candy Ann	abc	3(t)
Vidora	abc	3(t)
Dulciana	abc	3(t)
Candy Joy	abc	3(t)
Macon	abc	3(t)
369	abc	3(t)
Early Sweet	abc	3(t)
Maragogi	abc	3(t)
Candy Kim	abc	3(t)
OSYF10-4021	abc	3(t)
Chianti	abc	3(t)
GA Boy	abc	3(t)
OSYF12-7091	ab	4(t)
Sapelo	ab	4(t)
Reforma	ab	4(t)
OSYF22-4022	a	5(t)
Sofire	a	5(t)

Note: Similar letters between varieties indicate those varieties are not significantly different according to Tukey test ($P \leq 0.05$).

2025–2026 Organic Vidalia Onion Variety Trial Summary

Ross Greene, Chris Tyson, Eric Melby, Chase Watts, Nick Ray, Jason Edenfield, Aubrey Shirely, Jonathan Smith, Savannah Tanner, Steven Powell, Lauren Stanley, and Tim Coolong

Introduction

A replicated organic onion variety trial was conducted during the 2025–2026 growing season in Evans County, Georgia. The objective of the trial was to evaluate the performance of commercially available and experimental Vidalia onion varieties under certified organic production conditions. Varieties were evaluated for marketable yield, bulb size distribution, and cull percentage.

Materials and Methods

The 2025–2026 Organic Vidalia Onion Variety Trial was conducted on a USDA-certified organic farm in Evans County, Georgia. Nine commercially available and experimental onion varieties were evaluated in replicated plots measuring 6 feet by 20 feet. Transplants were set on December 5, 2025, and harvested on April 16, 2026. The trial was managed using USDA National Organic Program (NOP) compliant production practices, including approved fertility, weed management, and disease management programs. Onions were harvested, graded, and evaluated for marketable yield, bulb size distribution, and cull percentage. Marketable yields were converted to 40-pound box equivalents per acre for comparison among varieties.

Results

Table 1. Marketable yield (40 lb. boxes/acre) for organic Vidalia onion variety trial.

Variety	Marketable Yield (40 lb. boxes/acre)	Tukey letters
Vidora	819.0	a
Early Sweet	757.8	ab
369	746.4	ab
1407	738.1	abc
Fast Track	664.7	abc
Candy Joy	619.4	abc
OSYF22-4022	576.3	bc
Adhora (1011)	537.7	bc
OSYF10-4021	487.8	c

Note: Means followed by the same letter are not significantly different according to Tukey's HSD Test (P = 0.0007).

Table 2. Bulb size distribution and cull percentage for organic Vidalia onion variety trial.

Variety	% Jumbo	% Medium	% Cull
Vidora	62.8	36.6	13.9
Early Sweet	61.8	37.9	11.0
369	28.1	71.9	9.3
1407	49.1	50.9	11.0
Fast Track	37.5	62.5	11.0
Candy Joy	47.5	51.6	18.9
OSYF22-4022	35.5	64.5	18.1
Adhora (1011)	11.6	88.4	11.1
OSYF10-4021	30.5	69.5	23.4

Conclusions

Marketable yields ranged from 487.8 to 819.0 boxes per acre. Vidora produced the highest marketable yield, followed by Early Sweet, 369, and 1407. Differences were also observed in bulb size distribution and cull percentages among varieties. Vidora and Early Sweet produced the highest percentages of jumbo onions, while Adhora (1011) and 369 seemed to produce a larger percentage of medium-sized bulbs. Cull percentages ranged from 9.3% to 23.4% of total yield. A complete report containing detailed trial results and production information will be released at a later date.

Effects of Calcium Nitrate Rates on Onion Yield and Bulb Quality 2025-2026 Crop Season

Ted McAvoy, Chris Tyson, Daniel Jackson, and Manisha Kumari

Introduction

The rate of calcium nitrate application was evaluated for its effects on onion yield and bulb quality under standardized growing practices at the Vidalia Onion and Vegetable Research Center (VOVRC) in Lyons, Georgia. This trial was conducted to determine whether different rates of calcium nitrate application affect marketable yield and bulb size distribution in short-day onion production.

Materials and Methods

A field experiment was established at the VOVRC in Lyons, Georgia, during the 2026 crop season. Five calcium nitrate application rates (0, 50, 100, 150, and 200% of the recommended calcium nitrate rate) were evaluated in a randomized complete block design with four replications. Onion transplants were managed according to standard Vidalia onion production practices. At harvest, total fresh weight was recorded prior to grading. Bulbs were graded following USDA standards: colossal (≥3¾ inches), jumbo (≥3 inches), and medium (≥2 inches). Unmarketable yield was calculated as the difference between pre-grade and total marketable weight. Representative bulb samples from each plot were submitted to the Agricultural & Environmental Services Laboratories, University of Georgia, Athens, GA, USA, for nutrient analysis and quantification of pyruvic acid, lachrymatory factor (LF), and methyl thiosulfinate (MT). Data were subjected to analysis of variance (ANOVA) using JMP statistical software, with means separated using Tukey's Honest Significant Difference (HSD) test at $P \leq 0.05$.

Results

Calcium nitrate application rate significantly affected pre-grade yield, marketable yield, jumbo-sized bulb yield, and bulb size distribution (**Tables 1, 2, and 3**). The 200% calcium nitrate rate produced the lowest pre-grade (868 boxes/acre) and marketable yields (841 boxes/acre), differing significantly from the 50% rate (995 and 971 boxes/acre, respectively). Increasing the calcium nitrate rate reduced jumbo-sized bulb yield and increased the proportion of medium-sized bulbs, with the 200% rate producing significantly more medium-sized bulbs (33.5%) and fewer jumbo-sized bulbs (66.5%) than the 50% and 100% rates. Unmarketable yield, percent marketable yield, and colossal-sized bulb yield were not significantly affected by calcium nitrate rate.

Calcium nitrate rate did not significantly affect bulb biochemical characteristics, including pyruvic acid, LF, or MT concentrations (**Table 4**). Application rate significantly affected bulb P, Ca, and S concentrations but did not influence N, K, or Mg concentrations (**Table 5**).

Phosphorus concentration was highest at the 0% and 50% calcium nitrate rates, whereas Ca and S concentrations generally increased with increasing calcium nitrate rate. Micronutrient concentrations, including Al, B, Cu, Fe, Mn, Na, and Zn, were not significantly affected by calcium nitrate rate (**Table 6**).

Table 1. Onion pre-grade yield and size distribution from the calcium nitrate rate trial.

Calcium nitrate rate (%)	Pre-grade[i] yield (40 lb. boxes/acre)	Colossal-sized[ii] yield (40 lb. boxes/acre)	Jumbo-sized[iii] yield (40 lb. boxes/acre)	Medium-sized[iv] yield (40 lb. boxes/acre)
0	960 ab[v]	0 a	708 ab	230 ab
50	995 a	3 a	771 a	197 b
100	968 ab	0 a	753 ab	191 b
150	911 bc	0 a	635 bc	245 ab
200	868 c	0 a	560 c	281 a
P value	0.0013	0.4609	0.0033	0.0457

[i]Pre-grade: total fresh weight of harvested onion bulbs before grading.
[ii]Colossal-sized: ≥3¾ inches.
[iii]Jumbo-sized: ≥3 inches.
[iv]Medium-sized: ≥2 inches.
[v]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%.

Table 2. Onion marketable, unmarketable, and percent marketable yield from the calcium nitrate rate trial.

Calcium nitrate rate (%)	Marketable yield[i] (40 lb. boxes/acre)	Unmarketable yield[ii] (40 lb. boxes/acre)	Percent marketable yield (%)	Percent unmarketable yield (%)
0	938 ab[iii]	23 a	97.6 a	2.4 a
50	971 a	24 a	97.6 a	2.4 a
100	944 a	24 a	97.5 a	2.5 a
150	880 bc	30 a	96.7 a	3.3 a
200	841 c	27 a	96.8 a	3.2 a
P value	0.0006	0.9421	0.8004	0.8004

[i]Marketable yield: colossal + jumbo + medium.
[ii]Unmarketable yield: Pre-grade-marketable.
[iii]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%.

Table 3. Percentages of colossal, jumbo, and medium-sized bulbs from the calcium nitrate rate trial.

Calcium nitrate rate (%)	Percent colossal of total marketable yield (%)	Percent jumbo of total marketable yield (%)	Percent medium of total marketable yield (%)
0	0.0 a	75.5 ab	24.5 ab
50	0.3 a	79.3 a	20.4 b
100	0.0 a	79.7 a	20.3 b
150	0.0 a	72.0 ab	28.0 ab
200	0.0 a	66.5 b	33.5 a
P value	0.4609	0.0147	0.0110

[i]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%.

Table 4. Compositional and biochemical characteristics of onion bulbs from the calcium nitrate rate trial

Treatment	Pyruvic acid (µmol/mL)	LF (µmol/mL)	MT (nmol/mL)
Very Early	3.2 a	3.5 a	12.2 a
Early	3.2 a	3.3 a	10.1 a
Normal	3.2 a	3.6 a	9.4 a
Late	3.2 a	3.7 a	8.8 a
Very Late	3.1 a	3.2 a	12.5 a
P value	0.9162	0.7373	0.9128

[i]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%. **Note: LF** = Lachrymatory Factor and **MT** = Methyl Thio Sulfinates.

Table 5. Macronutrient composition of onion bulbs from the calcium nitrate rate trial.

Treatment	N (% dw)	P (% dw)	K (% dw)	Ca (% dw)	Mg (% dw)	S (% dw)
Very Early	1.0 a	0.22 a	1.4 a	0.12 c	0.0	0.2 b
Early	1.1 a	0.22 a	1.5 a	0.13 bc	0.0	0.3 a
Normal	1.2 a	0.21 ab	1.4 a	0.14 ab	0.0	0.3 a
Late	1.2 a	0.21 ab	1.4 a	0.15 a	0.0	0.3 a
Very Late	1.2 a	0.20 b	1.4 a	0.15 a	0.0	0.3 a
P value	0.0651	0.0056	0.7361	0.0019	1.000	0.0003

[i]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%. [i]% dw = percentage dry weight basis.

Table 6. Micronutrient composition of onion bulbs from the calcium nitrate rate trial.

Treatment	Al (ppm dw[i])	B (ppm dw)	Cu (ppm dw)	Fe (ppm dw)	Mn (ppm dw)	Na (ppm dw)	Zn (ppm dw)
Very Early	0.0 a	15.2 a	3.6 a	25.2 a	13.4 a	74.9 a	4.9 a
Early	1.4 a	15.4 a	0.5 a	21.4 a	12.0 a	75.0 a	4.2 a
Normal	0.9 a	14.8 a	3.3 a	22.2 a	12.6 a	77.1 a	4.6 a
Late	0.0 a	15.4 a	0.1 a	21.4 a	13.1 a	71.0 a	5.7 a
Very Late	0.0 a	14.9 a	2.3 a	22.1 a	12.2 a	74.3 a	5.4 a
P value	0.2805	0.7549	0.3328	0.1663	0.1559	0.7378	0.6541

[i]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%. [i]ppm dw = parts per million on a dry weight basis.

Conclusions

The application rate of calcium nitrate influenced onion yield and bulb size distribution. The 200% calcium nitrate rate reduced pre-grade and marketable yields and increased the proportion of medium-sized bulbs. The 50% and 100% calcium nitrate rates produced the highest marketable yields and the greatest proportion of jumbo-sized bulbs, indicating that excessive calcium nitrate application may reduce yield and desirable bulb size in short-day onion production. Application rate did not affect bulb biochemical characteristics or micronutrient composition. Although P, Ca, and S concentrations were significantly affected by calcium nitrate rate, most nutrient and biochemical characteristics remained unchanged across treatments. Overall, moderate calcium nitrate application rates maintained high marketable yield and jumbo-grade bulb production in short-day onion production.

Effects of Biochar and Fertilizer Rates on Onion Yield and Bulb Quality 2025-26 Crop Season

Ted McAvoy, Chris Tyson, Daniel Jackson, and Manisha Kumari

Introduction

Biochar and fertilizer rate interactions were evaluated for their effects on onion yield and bulb quality under standardized growing practices at the Vidalia Onion and Vegetable Research Center (VOVRC) in Lyons, Georgia. This trial was conducted to determine whether varying biochar application rates, in combination with different fertilizer inputs, can maintain or improve marketable yield and bulb size distribution in short-day onion production.

Materials and Methods

A field experiment was established at the VOVRC in Lyons, Georgia, during the 2025-26 crop season. Nine treatments consisted of three biochar application rates (0, 10, and 20 tons/acre) combined with three nitrogen fertilizer rates (50%, 75%, and 100% of the recommended rate), arranged in a randomized complete block design with four replications. Biochar was incorporated into the soil during the previous growing season as a one-time soil amendment; therefore, no additional biochar was applied during the 2025-26 crop season.

Onion transplants were managed according to standard Vidalia onion production practices. At harvest, total fresh weight was recorded prior to grading. Bulbs were graded following USDA standards: colossal (≥3¾ inches), jumbo (≥3 inches), and medium (≥2 inches). Unmarketable yield was calculated as the difference between pre-grade and total marketable weight.

Representative bulb samples from each plot were submitted to the Agricultural & Environmental Services Laboratories, University of Georgia, Athens, GA, USA, for nutrient analysis, analysis, and quantification of pyruvic acid, lachrymatory factor (LF), and methyl thiosulfinate (MT). Data were subjected to analysis of variance (ANOVA) using JMP statistical software, with means separated using Tukey's Honest Significant Difference (HSD) test at $P \leq 0.05$.

Results

Fertilizer rate significantly affected pre-grade yield and marketable yield, as well as bulb size distribution, whereas biochar rate had no significant effect on yield or bulb size distribution (**Tables 1, 2, and 3**). The 50% fertilizer rate produced significantly lower pre-grade (898 boxes/acre) and marketable yields (870 boxes/acre) than the 75% and 100% rates, which did not differ from one another. The reduced fertility level also shifted size grade distribution toward a higher proportion of medium-sized bulbs (33.4%) and a lower proportion of jumbo-sized bulbs (66.6%) relative to the higher fertilizer rates. Percent marketable yield was consistently high across all treatments and did not differ significantly. Biochar application had no significant effect on yield or bulb quality at any evaluated rate, and no fertilizer-by-biochar interaction was detected.

Bulb compositional and biochemical characteristics were also evaluated (**Table 4**). Fertilizer rate had no significant effect on pyruvic acid or LF but significantly increased MT concentration, with the 75% and 100% fertilizer rates producing higher concentrations than the 50% rate. Biochar significantly affected pyruvic acid concentration, with lower values observed at the 10 and 20 ton/acre biochar rates compared with the untreated control, while no significant effects were detected for LF or MT.

Fertilizer rate significantly influenced bulb macronutrient concentrations (**Table 5**). Increasing fertilizer from 50% to 100% of the recommended rate increased bulb N, P, K, Ca, and S concentrations, while Mg concentration tended to decrease. Biochar had minimal effects on macronutrient composition, although P and Mg concentrations were slightly higher at the 10 ton/acre biochar rate. Micronutrient composition was also affected primarily by fertilizer rate (**Table 6**). Concentrations of B, Fe, Mn, and Zn increased with increasing fertilizer rate and were generally highest at the 100% fertilizer rate. Within the micronutrients, the effects of biochar were limited, with significant differences observed only in B concentration. A significant fertilizer × biochar interaction was detected for Mo concentration; however, this response was limited to a slight increase in the 50% fertilizer and 10 ton/acre biochar treatment combination.

Table 1. Pre-grade weight and bulb size grades of onion from the biochar treatment trial.

Treatment	Pre-grade[i] yield (40 lb. boxes/acre)	Colossal-sized[ii] yield (40 lb. boxes/acre)	Jumbo-sized[iii] yield (40 lb. boxes/acre)	Medium-sized[iv] yield (40 lb. boxes/acre)
Fertilizer (F)				
50%	898 b[v]	0 a	581 b	290 a
75%	937 a	0 a	657 a	259 ab
100%	936 a	1 a	659 a	250 b
Biochar (B)				
0 ton/acre	921 a	0 a	618 a	278 a
10 ton/acre	932 a	0 a	642 a	260 a
20 ton/acre	919 a	1 a	637 a	260 a
Significance				
F	0.0006	0.3827	0.0014	0.0203
B	0.3682	0.3827	0.5012	0.3651
F x B	0.1263	0.4269	0.3701	0.4511

[i]Pre-grade: total fresh weight of harvested onion bulbs before grading.
[ii]Colossal-sized: ≥3¾ inches.
[iii]Jumbo-sized: ≥3 inches.
[iv]Medium-sized: ≥2 inches.
[v]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%.

Table 2. Marketable, unmarketable, and percent marketable yield from the biochar treatment trial.

Treatment	Marketable[i] yield (40 lb. boxes/acre)	Unmarketable[ii] yield (40 lb. boxes/acre)	Percent marketable yield (%)	Percent unmarketable yield (%)
Fertilizer (F)				
50%	870 b[iii]	28 a	96.9 a	3.1 a
75%	916 a	22 a	97.7 a	2.3 a
100%	909 a	27 a	97.1 a	2.9 a
Biochar (B)				
0 ton/acre	895 a	26 a	97.2 a	2.8 a
10 ton/acre	902 a	30 a	96.8 a	3.2 a
20 ton/acre	898 a	21 a	97.7 a	2.3 a
Significance				
F	0.0002	0.6091	0.5352	0.5352
B	0.7864	0.4715	0.4625	0.4625
F x B	0.2361	0.4246	0.4085	0.4085

[i]Marketable yield: colossal + jumbo + medium.
[ii]Unmarketable yield: Pre-grade-marketable.
[iii]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%.

Table 3. Percent of colossal, jumbo, and medium-sized fruit from the biochar treatment trial.

Treatment	Percent colossal of total marketable yield (%)	Percent jumbo of total marketable yield (%)	Percent medium of total marketable yield (%)
Fertilizer (F)			
50%	0.0 a[i]	66.6 b	33.4 a
75%	0.0 a	71.6 a	28.4 b
100%	0.1 a	72.1 a	27.8 b
Biochar (B)			
0 ton/acre	0.0 a	68.7 a	31.3 a
10 ton/acre	0.0 a	70.9 a	29.1 a
20 ton/acre	0.1 a	70.7 a	29.2 a
Significance			
F	0.3827	0.0070	0.0065
B	0.3827	0.4017	0.3890
F x B	0.4269	0.3803	0.4127

[i]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%.

Table 4. Biochemical characteristics of onion bulbs from the biochar treatment trial.

Treatment	Pyruvic acid (µmol/mL)	Lachrymatory factor (µmol/mL)	Methyl thiosulfinate (nmol/mL)
Fertilizer (F)			
50%	4.72 a	3.78 a	4.47 b
75%	3.77 a	3.84 a	8.16 a
100%	3.53 a	3.82 a	10.61 a
Biochar (B)			
0 ton/acre	4.89 a	3.81 a	6.56 a
10 ton/acre	3.48 b	3.72 a	7.86 a
20 ton/acre	3.66 b	3.91 a	8.82 a
Significance			
F	0.054	0.9576	<.0001*
B	0.0165*	0.6325	0.1325
F x B	0.1246	0.7863	0.3018

[i]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%.

Table 5. Macronutrient composition of onion bulbs from the biochar treatment trial.

Treatment	N (% dw)[i]	P (% dw)	K (% dw)	Ca (% dw)	Mg (% dw)	S (% dw)
Fertilizer (F)						
50%	1.01 c[ii]	0.19 c	1.24 c	0.13 b	0.095 a	0.19 c
75%	1.24 b	0.21 b	1.40 b	0.14 a	0.089 b	0.25 b
100%	1.39 a	0.26 a	1.54 a	0.15 a	0.094 ab	0.28 a
Biochar (B)						
0 ton/acre	1.20 a	0.21 b	1.37 a	0.13 a	0.09 b	0.24 a
10 ton/acre	1.22 a	0.23 a	1.43 a	0.15 a	0.097 a	0.25 a
20 ton/acre	1.22 a	0.22 ab	1.38 a	0.14 a	0.092 ab	0.24 a
Significance						
F	<.0001	<.0001	<.0001	0.0017	0.0267	<.0001
B	0.7389	0.0134	0.0918	0.0994	0.0141	0.197
F x B	0.3477	0.273	0.3341	0.576	0.1782	0.5931

[i]% dw = percent dry weight.
[ii]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%.

Table 6. Micronutrient composition of onion bulbs from the biochar treatment trial.

Treatment	Al (ppm dw)[i]	B (ppm dw)	Cu (ppm dw)	Fe (ppm dw)	Mn (ppm dw)	Mo (ppm dw)	Na (ppm dw)	Ni (ppm dw)	Zn (ppm dw)
Fertilizer (F)									
50%	0.09 b[ii]	12.55 c	0.0 a	16.52 b	8.93 c	0.02 a	71.07 a	0.00 a	1.65 c
75%	4.00 a	15.79 b	2.93 a	23.08 a	13.74 b	0.00 a	70.11 a	0.03 a	6.81 b
100%	0.70 ab	18.44 a	3.84 a	23.24 a	16.61 a	0.00 a	71.38 a	0.00 a	9.41 a
Biochar (B)									
0 ton/acre	2.05 a	14.95 b	2.65 a	21.31 a	13.16 a	0.00 a	70.6 a	0.00 a	6.32 a
10 ton/acre	1.30 a	16.43 a	2.69 a	21.3 a	13.57 a	0.02 a	71.78 a	0.03 a	6.24 a
20 ton/acre	1.44 a	15.41 b	1.42 a	20.23 a	12.55 a	0.00 a	70.18 a	0.00 a	5.31 a
Significance									
F	0.0411	<.0001	0.1795	<.0001	<.0001	0.0767	0.8899	0.3827	<.0001
B	0.8783	0.0014	0.7884	0.6688	0.3772	0.0767	0.8327	0.3827	0.2268
F x B	0.9836	0.1175	0.3297	0.8302	0.6086	0.0451	0.4775	0.4269	0.8995

[i]ppm dw = parts per million on a dry weight basis.
[ii]Means followed by the same letter are not significantly different based on Tukey's HSD test at 95%.

Conclusions

Fertilizer rate was the primary factor influencing onion yield, bulb size distribution, bulb biochemical characteristics, and nutrient composition in this study. Applying 75% of the recommended fertilizer rate produced marketable yields and bulb size distribution comparable to the 100% rate, indicating that fertilizer inputs may be reduced without compromising productivity. In contrast, the 50% fertilizer rate reduced pre-grade and marketable yields and increased the proportion of medium-sized bulbs. Higher fertilizer rates increased the concentrations of several macro- and micronutrients, including N, P, K, S, B, Fe, Mn, and Zn, and also increased MT concentration, demonstrating improved bulb nutritional and biochemical characteristics with higher fertilizer inputs. Biochar application had no significant effect on yield, marketable yield, or bulb size distribution and had only minor effects on bulb biochemical characteristics, reducing pyruvic acid concentration without affecting LF or MT, while producing limited changes in nutrient composition.

These results suggest that a 75% fertilizer rate may provide a practical balance between maintaining high onion productivity and reducing fertilizer inputs. Under the field conditions of this study, biochar application provided limited agronomic benefits for short-day onion production.

Evaluation of Preharvest Fungicide Applications for Reducing Postharvest Black Mold

Tarjan Bhandari, Chris Tyson, Bhabesh Dutta, and Jake Fountain

Introduction

Issues with black mold (*Aspergillus niger*) in onions occur under exacerbating environmental conditions, particularly high humidity and elevated temperatures typically later in the growing season leading up to harvest and in storage (Tyson, 2019). This is particularly concerning in years with higher yields which see black mold occurrence in onions stored for long periods of time outside in temporary holding areas at packing houses due to limited processing capacity. Here, we investigated (1) whether preharvest fungicide applications could reduce or delay the onset of black mold in suboptimal postharvest storage, and (2) whether onion variety and season length influences black mold incidence and severity.

Materials and Methods

The study was conducted at the Vidalia Onion and Vegetable Research Center (VOVRC) during the 2025-26 season. The trial included three varieties: Vidora (early), Sweet Magnolia (mid), and Macon (late). A split-plot design with four replications was used. Variety was used as the main plot factor, and fungicide treatment as the sub-plot factor. Eight fungicide treatments (**Table 1**) along with a water-treated control were applied at label rates weekly for two weeks leading up to undercutting and harvest.

Table 1. Fungicides examined in the study.

Fungicide	Active Ingredient(s)	FRAC Code	Rate
Miravis Prime	Pydiflumetofen and Fludioxonil	7 and 12	11.4 oz/ac
Luna Flex	Fluopyram and Difenconazole	7 and 3	13.6 oz/ac
Pristine	Boscalid and Pyraclostrobin	7 and 11	18.5 oz/ac
Quadris Top	Azoxystrobin and Difenconazole	11 and 3	14 oz/ac
Quilt Xcel	Azoxystrobin and Propiconazole	11 and 3	21 oz/ac
Aprovia Top	Difenconazole and Benzovindiflupyr	3 and 7	10.5 oz/ac
Inspire Super	Difenconazole and Cyprodinil	3 and 9	20 oz/ac
Switch	Cyprodinil and Fludioxonil	9 and 12	14 oz/ac

Three bags of 25 onions were collected from each plot and stored in bins in a room with no cooling and limited airflow. Black mold incidence and severity were evaluated weekly for three weeks after harvest. Disease incidence was recorded as the percentage of onions showing visible black mold signs. Disease severity was rated on a 0-10 scale based on the proportion of visible onion surface area affected by black mold, where 0-10 corresponds to 0-100% of the onion surface area affected.

Results

Analysis of variance revealed that black mold disease incidence and severity were significantly affected by the main effects of variety, storage week, and their interaction (**Table 2**).

Table 2. Analysis of variance for black mold incidence and severity.

Source	df	Disease Incidence		Disease Severity	
		F value	P value	F value	P value
Variety	2	18.3688	0.0028	27.0910	0.0009
Fungicides	8	2.0466	0.0527	0.9025	0.5193
Week	2	42.9825	<0.0001	67.9857	< 0.0001
Variety x Fungicides	16	1.6671	0.0735	1.1566	0.3233
Variety x Week	4	16.8359	<0.0001	17.1691	<0.0001
Fungicides x Week	16	0.9548	0.5086	1.5153	0.0998
Variety x Fungicides x Week	32	1.0383	0.4212	0.9074	0.6137

Black mold incidence and severity increased during temporary storage. Across all fungicide treatments and varieties, average disease incidence increased from 28.6% in week 1 to 43.6% in week 3 (**Figure 1A**). Disease severity also increased from 6.83% in week 1 to 10.93% in week 3 (**Figure 1B**).

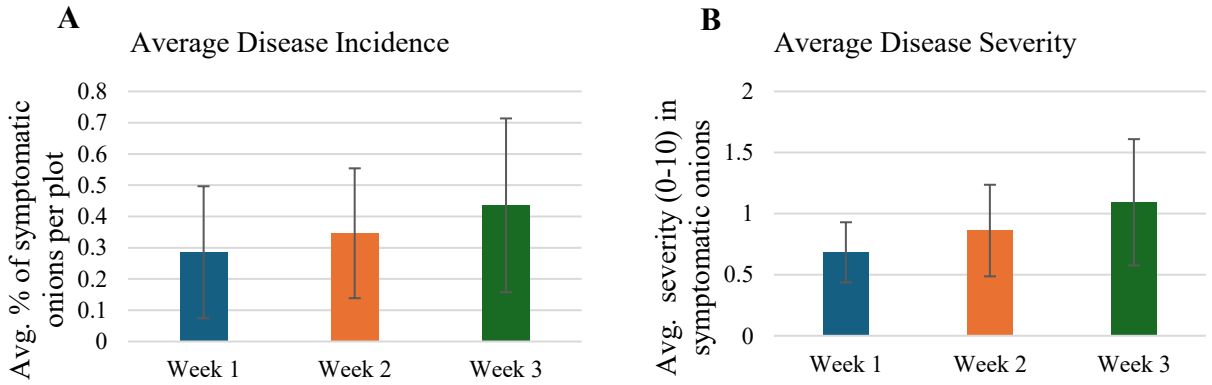


Figure 1. Average black mold incidence (**A**) and severity (**B**) across all treatments and varieties

Variety had a strong effect on black mold development. Macon showed the highest disease levels during storage, reaching 74.0% incidence and 15.95% severity by week 3 (**Figure 2**), suggesting that this late-season variety was at greater risk when onions are held for extended periods before grading or packing. Sweet Magnolia had lower disease levels than Macon, but incidence and severity still increased over time. Vidora had comparatively lower disease development and did not show the same strong increase by week 3.

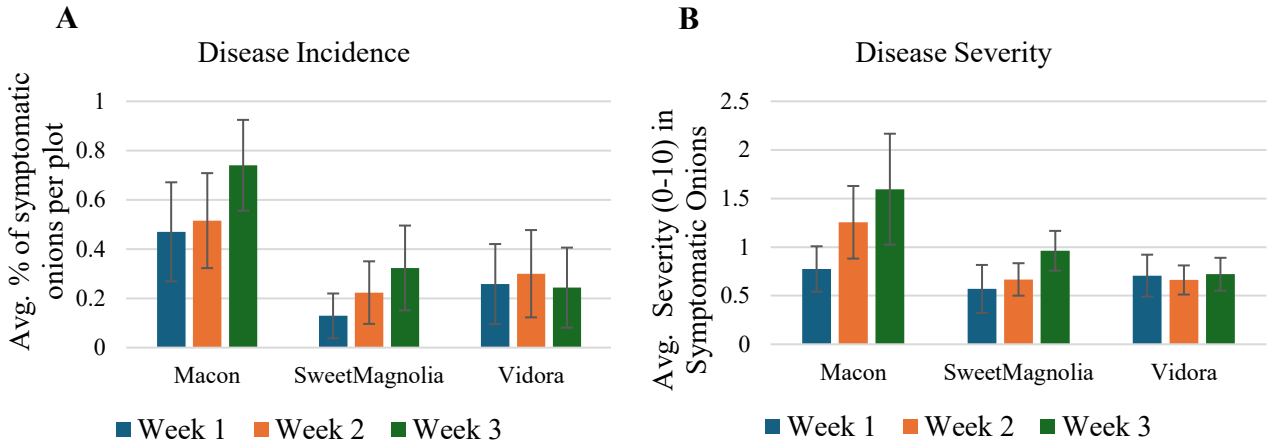


Figure 2. Black mold incidence (**A**) and severity (**B**) for each variety across all treatments for each week.

Fungicide performance differed by variety and storage week (**Figure 3**). In Macon, Luna Flex and Aprovia Top reduced early disease development (both incidence and severity), while Quilt Xcel had the lowest week 3 severity and was significantly less than the non-treated control (NTC). In week 3, Aprovia Top and Luna Flex had numerically lower severity, though not significantly. Regardless of treatment, Macon developed high disease levels by week 3. Therefore, we recommend avoiding excessive pre-curing storage times at the packing shed with Macon/late season varieties and the use of group 3 and 7 fungicides to reduce incidence for short-term postharvest storage.

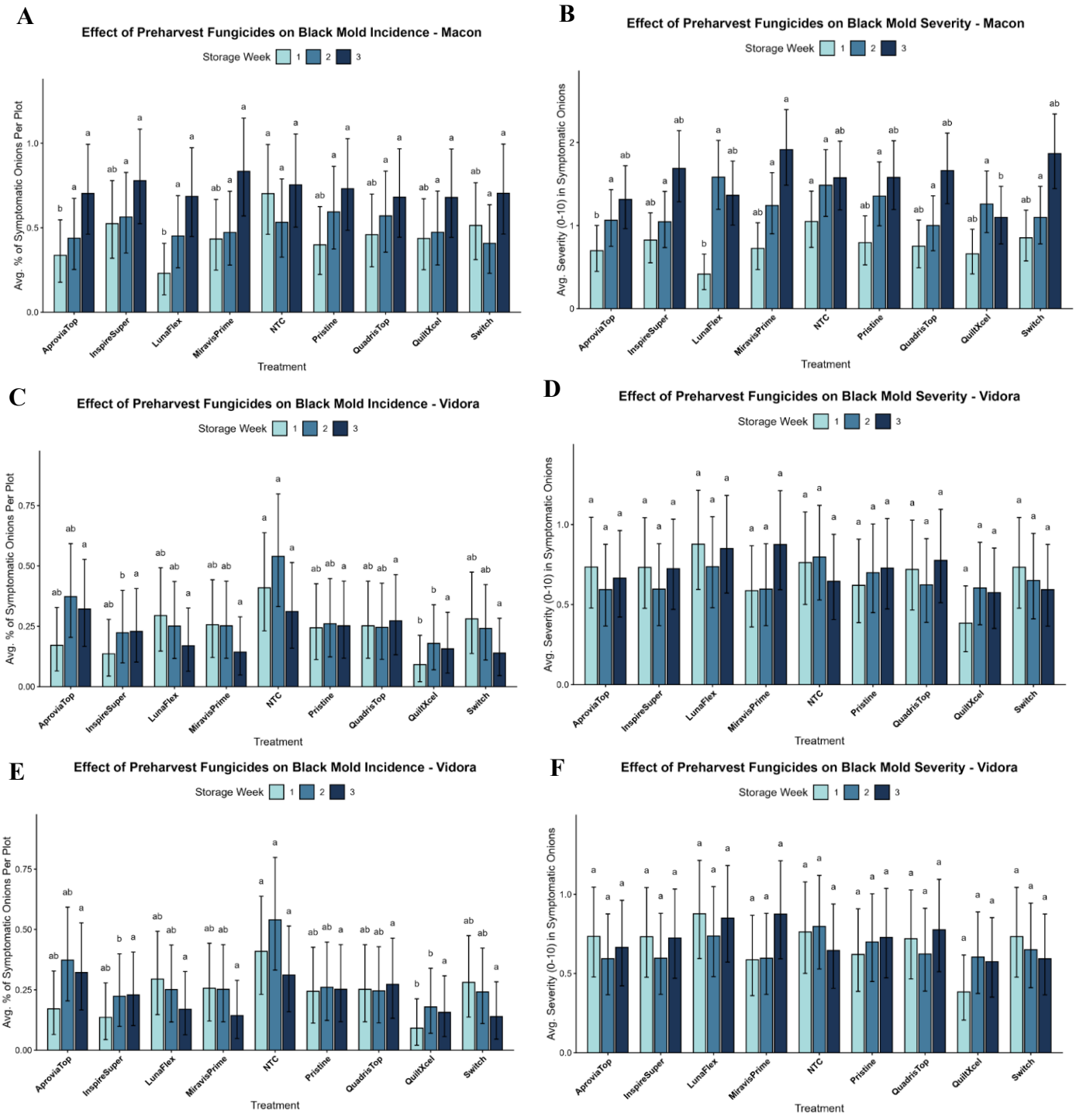


Figure 3. Effect of preharvest fungicides on black mold incidence (**A, C, E**) and severity (**B, D, F**) in Vidalia onion varieties Macon (**A, B**), Sweet Magnolia (**C, D**), and Vidora (**E, F**) during three weeks of suboptimal storage. Within each storage week, treatments sharing the same letter are not significantly different according to Tukey's HSD test (p = 0.05).

Conclusions

Managing black mold proliferation in storage is a consistent challenge faced by the Vidalia onion industry. This study found that storage duration in suboptimal conditions and variety had greater effects on black mold than fungicide treatment. Macon was the highest-risk variety under the temporary storage conditions used in this study compared to Sweet Magnolia and Vidora and should be cured and handled as quickly as possible after harvest. This is likely not the result of genetic susceptibility to black mold, but due to more conducive environmental conditions later in the season for black mold growth and development. Some preharvest fungicide treatments showed promise for reducing black mold incidence and severity for 1 - 2 weeks in postharvest storage. Quilt Xcel showed the most consistent potential, particularly for Vidora and for limiting late severity in Macon. Aprovia Top and Luna Flex also showed early benefits in Macon. However, no fungicide consistently controlled black mold across all varieties and storage weeks. Preharvest fungicides should therefore supplement, rather than replace, rapid postharvest handling, curing, cooling, airflow, and good storage management. Additional replications of this experiment in coming seasons will allow us to make actionable recommendations regarding the potential of preharvest fungicides to delay or reduce black mold issues.

References

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Evaluation of Fungicides to Manage Stemphylium Leaf Blight on Onion in Georgia, 2026

Bhabesh Dutta, Michael Foster, and Michael Danahoos

Four rows of 'Vidora' onion were transplanted into 6-ft beds (panels) on November 18 at the Vidalia Onion and Vegetable Research Center, Lyons, GA. The fertility and insecticide programs were consistent with the University of Georgia Extension Service recommendations. Experimental design consisted of a randomized complete block with four replications. Treated plots were 20-ft long and were separated on each side by non-treated border panels. Plots were separated by a 3 ft bare-ground buffer within the row. Treatments were applied with a backpack sprayer calibrated to deliver 40 gal/A at 75 to 80 psi through TX-18 hollow cone nozzles. Treatment applications were made on Feb 24, Mar 11 and 25, and Apr 1, 2026. Plots were irrigated once a week using overhead irrigation. Natural inoculum was relied upon. Disease severity was assessed on Mar 19, Mar 30 and Apr 6, 2026 as percentage leaf area with symptoms per plot. Area under disease progress curve (AUDPC) was calculated using disease severity ratings from the three assessment periods. Data were analyzed in the software ARM (Gylling Data Management, Brookings, SD) and means compared using the Fisher's protected LSD test at $P \leq 0.05$. The mean rainfall received during Dec (2025) and Apr (2026) was 0.09 in. and 0.003 in., respectively. The average high and low temperatures for the month of Dec (2025) were 62° and 42° F, respectively and for the month of Apr (2026) were 83° and 57° F, respectively.

Stemphylium leaf blight symptoms first appeared on Mar 19 with similar level of disease severity observed for the non-treated check and the fungicide-treated plots (**Table 1**). Disease progressed over a three-week period and reached 95.0% (disease severity) on Apr 6, in non-treated plots, which were significantly higher than the fungicide-treated plots. Disease severity in other treatments increased gradually but was significantly lower than the non-treated check. Interestingly, based on the final disease ratings, except for non-treated check, significant differences among the treatments were not observed. Similarly, AUDPC values were not significant among fungicide treatments; however, they were significantly lower than the non-treated plots. We did not observe phytotoxicity with any of the treatments.

Table 1. Effect of fungicide programs on Stemphylium leaf blight disease severity.

Treatment and rate of product per acre	Application No.[z]	Mean disease severity (%) on 19 Mar[y]	Mean disease severity (%) on 30 Mar	Final disease severity (%) on 6 Apr	**Area under disease progress curve (AUDPC)[w]**
Rovral 1.5 pt/acre	1,3,5,7	42.5	60.0 b	70.0 b[x]	1018.8 b
Luna Flex 12 fl oz/acre	1,3,5,7	37.5	60.0 b	75.0 b	1008.8 b
Omega 500 1 pt/acre	1,3,5,7	40.0	55.0 b	65.0 b	942.5 b
Miravis Prime 11.4 fl oz/acre	1,3,5,7	40.0	52.5 b	62.5 b	911.3 b
Pinion 3 qt/acre	1,3,5,7	50.0	57.5 b	72.5 b	1046.3 b
Elysis 10 fl oz/acre	1,3,5,7	37.5	47.5 b	62.5 b	852.5 b
Revylok 4.5 fl oz/acre	1,3,5,7	45.0	60.0 b	72.5 b	1041.3 b
Inspire Super 20 fl oz/acre	1,3,5,7	32.5	52.5 b	65.0 b	878.8 b
Non-treated check	-	57.5	82.5 a	95.0 a	1391.3 a
P-values		0.3033	0.0003	0.0012	0.0049

[z]Application dates were 1= Feb 24; 3= Mar 11; 5= Mar 25; 7= Apr 1.
[y]Disease severity was rated on a 0 to 100 scale (0 = no infection and 100 = 100% of leaf area infection) on 19 Mar, 30 Mar, and 6 Apr.
[x]Means followed by the same letter in each column are not significantly different according to Fischer's LSD at $P<0.05$.
[w]AUDPC was calculated from ratings taken on 19 Mar, 30 Mar, and 6 Apr.

Assessment of Fungicide Programs for Stemphylium Leaf Blight Management on Onion in Georgia, 2026

Bhabesh Dutta, Michael Foster, and Michael Danahoo

On Nov 19, 2025, four rows of 'Vidora' onion were transplanted into 6-ft beds (panels) on at the Vidalia Onion and Vegetable Research Center, Lyons, GA. The fertility and insect pest management practices were consistent with the University of Georgia Extension Service recommendations. The study was arranged in a randomized complete block design with four replications for each treatment. The treated plots were 20 ft in length and were separated on each side by non-treated border panels, with a 3 ft bare-ground buffer within the row. Treatments were applied with a backpack sprayer calibrated to deliver 40 gal/A at 75 to 80 psi through TX-18 hollow cone nozzles. Treatment applications were made on Feb 24, Mar 11 and 25, and Apr 1, 2026. Plots were irrigated weekly using overhead irrigation system. Natural field inoculum was used as the source of infection. Disease severity was assessed on Mar 19 and 30, and Apr 6, 2026 as percentage leaf area with symptoms per plot. Area under disease progress curve (AUDPC) was calculated using disease severity ratings from the three assessment periods. Data were analyzed in the software ARM (Gylling Data Management, Brookings, SD) and means compared using the Fisher's protected LSD test at $P \leq 0.05$. The mean rainfall received during Dec (2025) and Apr (2026) was 0.09 in. and 0.003 in., respectively. The average high and low temperatures for the month of Dec (2025) were 62° and 42° F, respectively and for the month of Apr (2026) were 83° and 57° F, respectively.

Stemphylium leaf blight symptoms were first appeared on Mar 19, with significantly higher disease severity were observed in non-treated check (56.1%) than in the fungicide-treated plots (**Table 1**). Initially disease severity was significantly lower for fungicide programs that initiated with Miravis Prime or Elysis followed by Inspire super and Luna Flex, compared to non-treated check. Disease progressed over a three-week period and reached 100% (disease severity) on Apr 6, in non-treated plots at the end of the trial. During the same period, disease severity in other treatments (fungicide programs) also increased gradually but were significantly lower than the non-treated check. Interestingly, significant differences among treatments (fungicide programs) were not observed. The AUDPC values were not significant among treatments (fungicide programs); however, they were significantly lower than the non-treated plots. Phytotoxicity was not observed with any of the treatments used.

Table 1. Effect of fungicide programs on Stemphylium leaf blight disease severity.

Treatment and rate of product per acre	Application No.[z]	Initial disease severity (%) on 19 Mar[y]	Mean disease severity (%) on 30 Mar	Final disease severity (%) on 6 Apr	**Area under disease progress curve (AUDPC)[w]**
Miravis Prime 11.4 fl oz/acre Inspire Super 20 fl oz/acre Luna Flex 12 fl oz/acre	1-4 2-5 3-6	27.3 b	57.5	68.8 b[x]	1035.6 b
Elysis 10 fl oz/acre Inspire super 20 fl oz/acre Luna Flex 12 fl oz/acre	1-4 2-5 3-6	29.2 b	50.0	60.0 b	935.0 b
Elysis 10 fl oz/acre Inspire super 20 fl oz/acre Miravis Prime 11.4 fl oz/acre	1-4 2-5 3-6	34.5 ab	55.0	65.0 b	1035.0 b
Revylok 4.5 fl oz/acre Inspire Super 20 fl oz/acre Luna Flex 12 fl oz/acre	1-4 2-5 3-6	39.7 ab	60.0	72.5 b	1146.25 b
Priaxor 8 fl oz/acre Inspire Super 20 fl oz/acre Luna Flex 12 fl oz/acre	1-4 2-5 3-6	34.8 ab	55.0	65.0 b	1035.0 b
Non-treated check	-	56.1 a	77.5	100.0 a	1541.3 a
P-values		0.041	0.058	0.0001	0.006

[z]Application dates were 1= Feb 24; 2= Mar 11; 3= Mar 25; 4= Apr 1.
[y]Disease severity was rated on a 0 to 100 scale (0 = no infection and 100 = 100% of leaf area infection) on Mar 19, Mar 30 and Apr 6.
[x]Means followed by the same letter in each column are not significantly different according to Fischer's LSD at $P<0.05$.
[w]AUDPC was calculated from ratings taken on Mar 19, Mar 30 and Apr 6.

Scalable “Infection Free” Onion Center Rot Resistance Screening

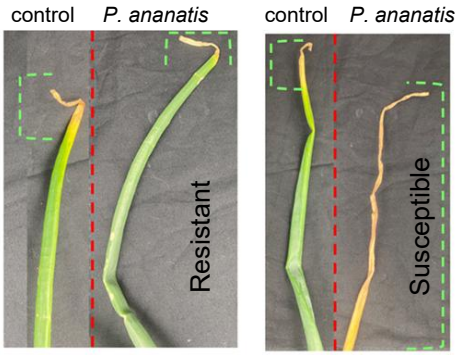
Brian Kvitko and Amol Nankar

Introduction

Since the late 1990s, Onion Center Rot has been a persistent and economically significant disease in Vidalia onion production. It is mainly caused by *Pantoea ananatis*, which produces the herbicidal toxin pantaphos, leading to foliar and bulb lesions that enable bacterial colonization. Despite integrated strategies, biocontrol, copper bactericides, thrips control, and cultural practices, control remains difficult.



https://tinyurl.com/mut8ftjp



Recent progress includes identification of a resistant long-day onion line, DPLD 19-39, from screening over 900 accessions. Building on this, Dr. Nankar’s breeding program is actively working to introgress pantaphos resistance into short-day Vidalia cultivars. A major bottleneck is reliable rapid phenotyping of large onion populations; inoculation-based screening risks pathogen spread and depends on conducive environmental conditions.

To address this, we proposed developing a toxin-based, infection-free assay using pantaphos directly. We have developed *Pantoea* strains that can produce the toxin in culture. We propose to optimize protocols to use the toxin directly to screen onion seedlings for pantaphos resistance.

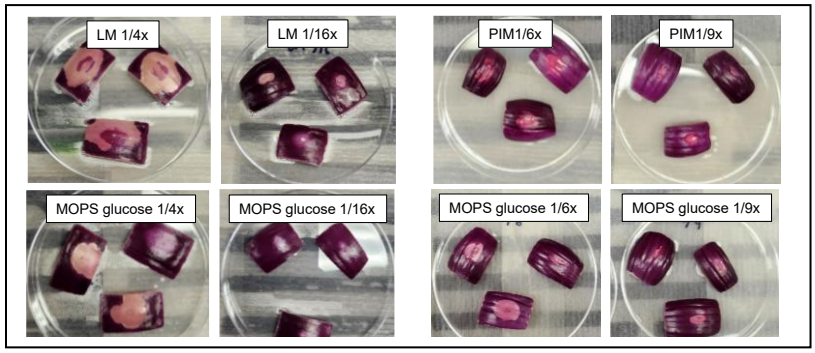
Material and Methods

Working with the UGA Biofermentation and Expression Facility, we tested multiple media formulations in small-scale (0.5 L) fermentations. The media included: [1] modified LB (LM), a standard rich medium commonly used in our lab; [2] phosphonate induction medium (PIM), developed by a University of Illinois lab that originally purified pantaphos; and [3] a commercially available defined minimal medium (MOPS glucose) similar to PIM. We have previously used MOPS glucose to study regulation of phosphonate toxin production genes.

After fermentation, bacterial cells were removed by centrifugation, and the supernatant was sterilized by filtration through a 0.2 µm filter. To determine which spent medium contained the

highest relative concentration of pantaphos, we tested a dilution series of each medium using a modified version of our standard red onion scale necrosis (RSN) assay.

Results



Based on the RSN bioassay results, the highest relative concentration of pantaphos toxin accumulated in LM spent medium, followed by MOPS glucose. Surprisingly, PIM, previously used for pantaphos purification, performed worse than MOPS glucose.

Although LM yielded the highest relative toxin levels, the spent medium often became viscous and sticky, making it more difficult to filter than MOPS glucose or PIM. In addition, as a rich medium, LM raised concerns about promoting the growth of undesirable microbes when applied to onion seedlings during screening. For these reasons, we elected to use MOPS glucose moving forward. The bioassay results also indicate that MOPS glucose spent medium can be diluted up to five-fold while still retaining necrosis activity. Although our original plan was to screen DPLD 19-39 and other elite breeding cultivars. Dr. Nankar is still in the process of bulking seed, and sufficient quantities are not yet available. Instead, we will use TG 1015Y, which can be purchased in bulk and has been used previously in our infection screening assays.

Conclusions

We developed a scalable, infection-free screening approach for onion center rot resistance using pantaphos-containing spent medium, with MOPS glucose identified as the optimal production medium due to its balance of toxin yield, and handling considerations. The assay remains effective after dilution, supporting efficient large-scale phenotyping. This platform provides a practical alternative to inoculation-based screening and will facilitate evaluation of breeding populations as seed availability improves.

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Novel Chemistry use for Vidalia Onions

Aubrey Shirley, Stanley Culpepper, Jonathan Smith, and Chris Tyson

Introduction

Vidalia onion production is considerably more labor-intensive than onion production in many other regions of the United States. The ability to direct-seed onions could significantly reduce labor requirements and production costs. However, one of the largest barriers to direct-seeded production is severe weed pressure, particularly from cutleaf evening primrose and wild radish. Sulfuric acid is used as a herbicidal treatment in other crops and onion-producing regions of the United States. Texas onion growers currently use postemergence, over-the-top applications of sulfuric acid for weed control. Sulfuric acid acts as a contact desiccant, similar to paraquat, while generally causing limited injury to established onion plants.

Materials and Methods

A randomized complete block trial was established to evaluate the efficacy and crop safety of sulfuric acid in direct-seeded onions. The sulfuric acid treatment was applied at 45 gallons of water per acre at a 50/50 mixture. Two additional products were evaluated: Homeplate®, a capric- and caprylic-acid product, and a vinegar-based product. These treatments were applied over the top of the onions, although their labels specify applications to row middles. Treatment rates were selected through consultation with weed-control specialists and product distributors and through a review of available product labels. A Texas weed-control specialist indicated that onion growers typically apply sulfuric acid as a 50% solution at approximately 50 gallons per acre, beginning when onions reach the two-leaf stage. In this trial, delaying treatment until the two-leaf stage was impractical because of the high population and rapid development of wild radish present in the plots (**Figure 1**).



Figure 1. Wild Radish infestation in trial plots

Onions were direct-seeded on October 15, 2025. Nortron® was applied on October 16, and onion emergence occurred on October 27. The first postemergence treatments were applied on October 31, when the onions were at the flag-leaf stage. Two additional plots received their initial postemergence treatment on November 13, when the onions had reached the one-true-leaf stage. Subsequent treatments were applied at either weekly or biweekly intervals,

depending on the assigned treatment program. Crop-injury ratings were collected weekly by Dr. Stanley Culpepper, UGA Extension vegetable weed specialist. After the onions reached the two-leaf stage, Goal® was applied approximately every two weeks as part of the standard weed-management program.

Results

From the first application, successful weed control was evident. See **Figure 2**. Below is the comparison of a control and a treated plot after spraying the sulfuric acid product.

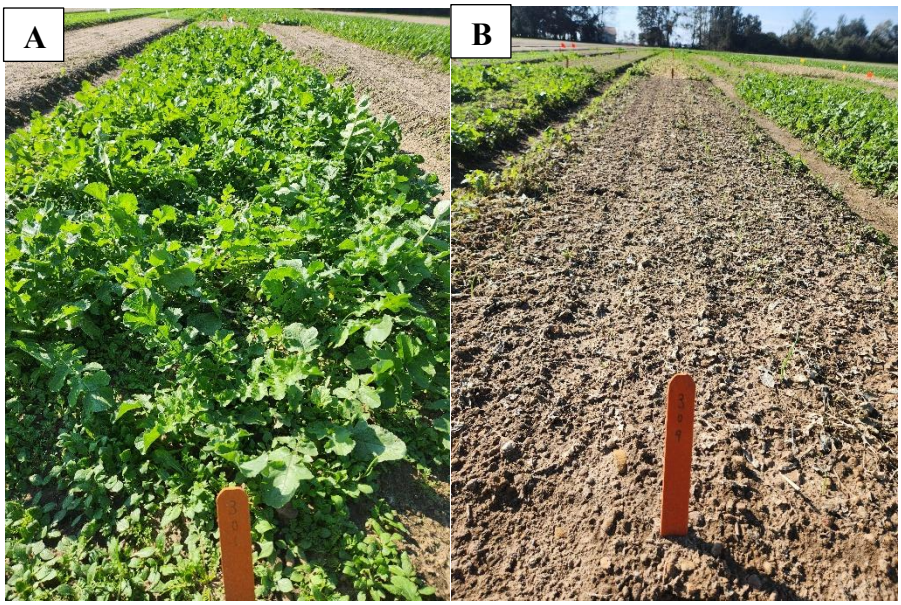


Figure 2. Wild Radish infestation in control (**A**) and after spraying sulfuric acid (**B**).

Similar results were achieved with the capric acid and with a lesser extent the vinegar products, see **Figure 3**.

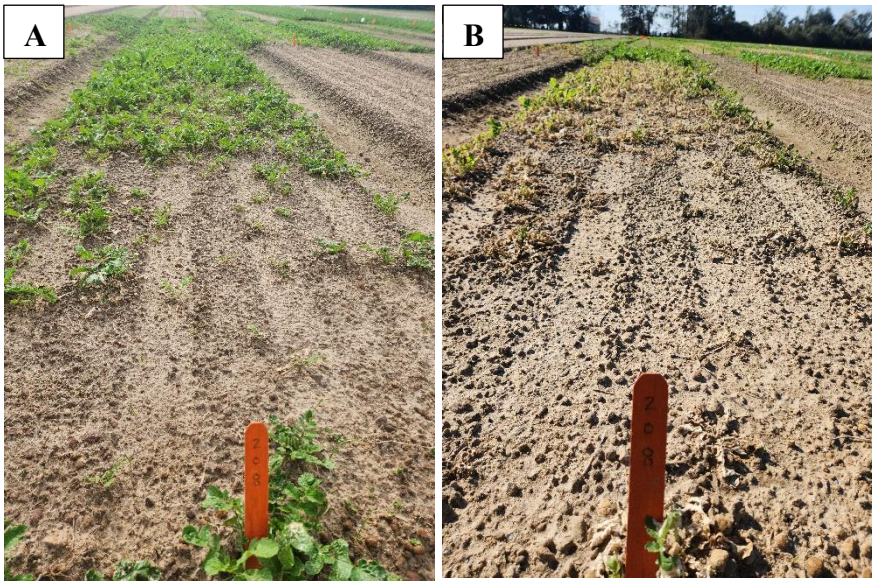


Figure 3. Wild Radish infestation before (**A**) and after (**B**) of Homeplate application.

The earlier application (flag leaf stage) was detrimental to the survival of young onion plants. This led to abandoning the Homeplate and vinegar trials. The only surviving plots were the sulfuric acid treatments. There was much more injury from the sulfuric acid on the younger plants than the more mature. However, yield was not significantly different between the two treatments, with both being significantly different from the control (**Figure 4**).

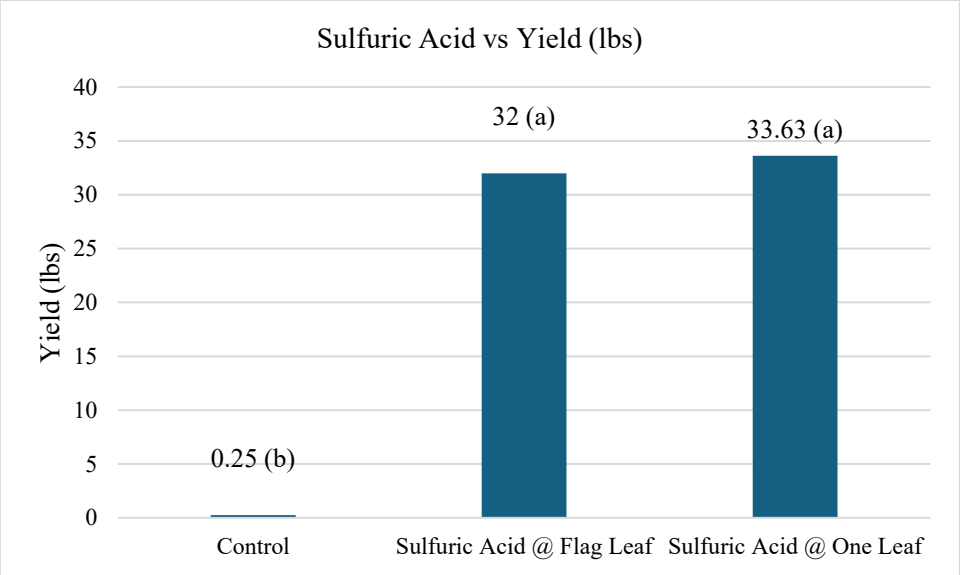


Figure 4. Effect of sulfuric acid application timing on crop yield.

Even with no statistically significant differences between both treatments, onion death within these plots were between 30 to 40%, and substantially higher with the Homeplate product.

Another potential issue with using sulfuric acid was the pH. This product has an extremely low pH below 1. With our mineral soils, acidification could become an issue as it relates to flavor and additional liming requirements. **Figure 5**, shows the pH values of the one- and six-inch depths, pre-trial.

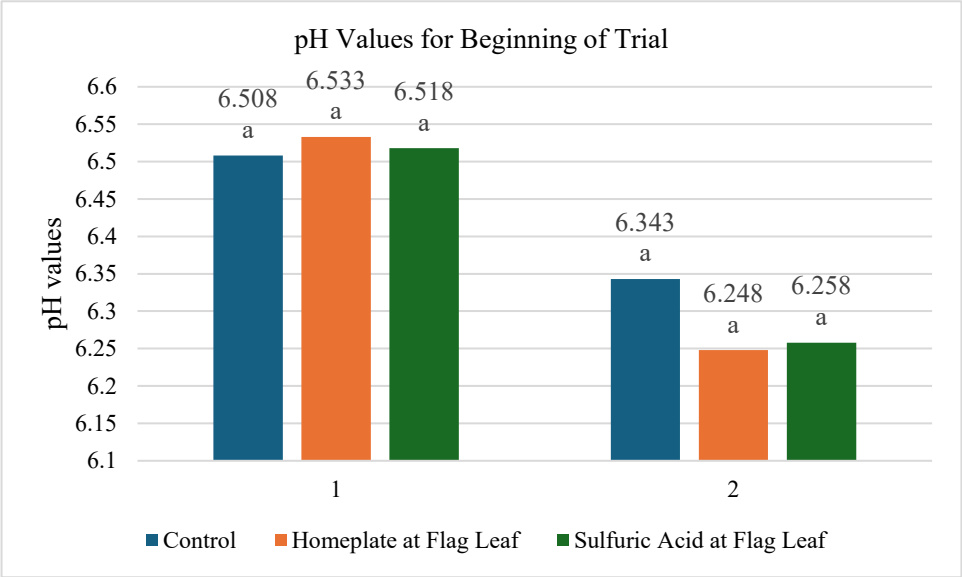


Figure 5. pH Values at 1-inch and 6-Inch for control, Homeplate, and sulfuric acid

There was no statistical difference between control and treatments. However, after harvest, the sulfuric acid treatment beginning at one leaf stage showed significant drop in pH as compared with the control (**Figure 6**).

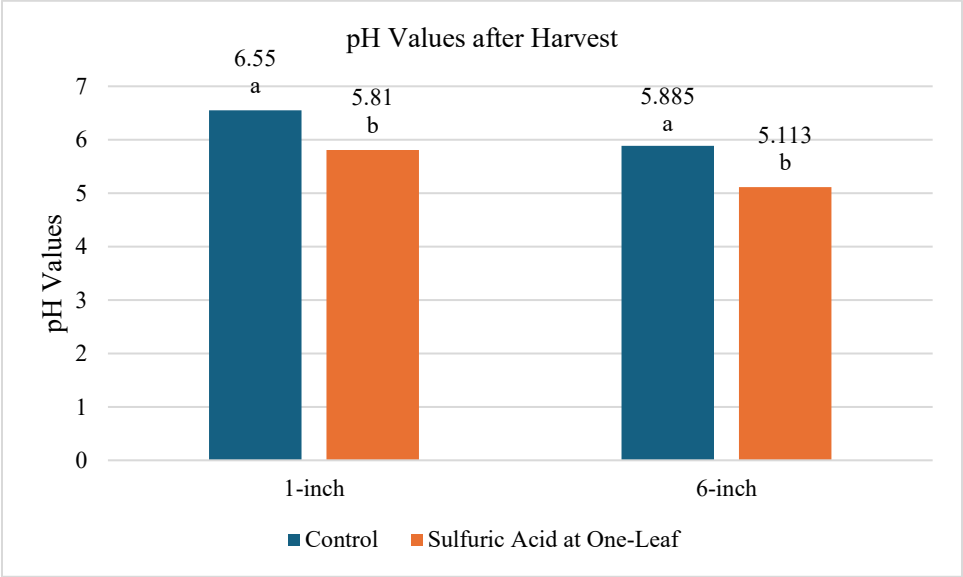


Figure 6. pH Values at 1-inch and 6-Inch for control and sulfuric acid

Conclusions

This is the first year of a multi-year study. From the information presented, sulfuric acid looks promising. However, there are several aspects that need further investigation. The greatest of which is application timing. We see from the data that yields were significantly lower than a traditional transplanted onion. For example, yield ranges from twenty-foot plots in the variety trial typically ranges from 100 to 140 pounds. The 'successful' plots in this study only yielded around 33 pounds.

Interestingly, it should be noted that spraying the 50% solution seemed to have a pre-emergence effect on the plots. New germination of wild radish as well as other weeds were delayed and reduced when compared to the other treatments. This was probably from the low pH. The effect lasted about two weeks,

Early in the study, a 50% solution was sprayed, but as the experiment evolved, we found that lowering the concentration to 25% worked equally well. We also achieved better coverage due to lower viscosity of the mixture.

Next year, we plan to study the pre-emergence activity of sulfuric acid, as well as post-emergence application timing. Once onions reach the two- to three-leaf stage, crop injury appears to be minimal. However, waiting to spray until the onions reach this stage may reduce yield.

Development of an Autonomous Laser-Based Robotic System for Sustainable Weed Management in Vidalia Onions

Muneeb Elahi Malik and Md Sultan Mahmud

Introduction

Vidalia onion production requires selective weed control because onions have slow early canopy development and limited ability to suppress weeds. Season-long weed interference can reduce yield by as much as 96% in direct-seeded onion systems (Bond, 1996). Transplanted systems reduce establishment risk, but weeds can still emerge within the crop row where cultivation and herbicide placement are constrained. This project evaluated a nonchemical robotic laser system designed to injure weeds at the leaf emergence point, which is the growth region near the plant crown. A 60 W, 450 nm blue diode laser was mounted on a delta parallel robot to deliver short, controlled laser exposures to individual weeds. The objective was to determine whether targeted laser exposure could produce reliable weed injury and mortality under field conditions while defining the exposure range needed for future Vidalia onion applications.

Materials and Methods

The robotic system used a delta robot mounted on a mobile frame as shown in **Figure 1**. The robot carried a 60 W blue diode laser that operated at 450 nm. This wavelength was selected because green plant tissue absorbs blue light well. The laser heated only the treated spot, so the system could target individual weeds without touching the crop.

The laser was aimed at the leaf emergence point. This point is the growth center near the weed crown. Damaging this point can stop new growth, even when some leaves remain green. This approach also reduces the treated area, which can help limit energy use and crop exposure.

Before field testing, the robot was checked with a 5 mW green alignment laser and a printed calibration grid. The robot moved to 100 unique target locations. The observed laser spot was compared with the commanded position at each location. This test measured whether the robot could place the laser accurately enough for small weed targets.

The study used Brassica rapa 'Twister' as a model broadleaf weed. Plants were selected for similar size, with an average canopy width of 10.0 ± 1.5 cm and height of 5.0 ± 1.5 cm.

Five laser exposure times were tested at a fixed power of 60 W. The treatments were 0, 0.5, 1.0, 2.0, and 3.0 seconds. The 0 second treatment was the untreated control. Each treatment included 10 plants, for a total of 50 plants. Weed response was checked before treatment and at 24 hours, 36 hours, 48 hours, and 10 days after treatment. Measurements included chlorophyll content, visible injury, canopy width, plant height, and final mortality. These measurements helped separate short-term burn from lasting weed control.

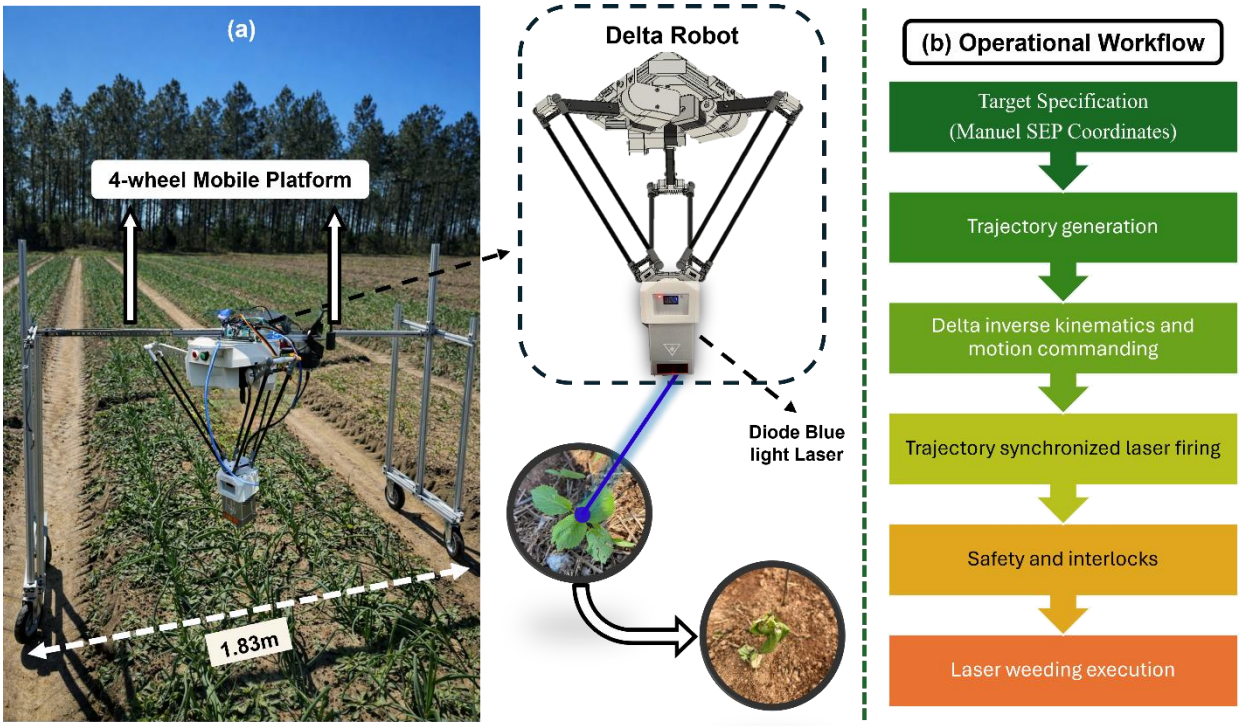


Figure. 1. (**a**) Delta robot and 60 W, 450 nm blue diode laser positioned over a weed target in a Vidalia onion bed. (**b**) Operational workflow of the system.

Results

The response of weeds to increasing laser exposure at 60 W is summarized in **Table 1**. The delta robot placed the laser with high accuracy during the target test. Across 100 target locations, the mean radial error was 0.83 mm. This error was small compared with the size of the weed crown. The result supports the use of the robot for precise laser placement. Laser exposure increased weed injury as treatment time increased. The 3.0 second treatment gave the strongest response, with 90% mortality at 10 days. The 2.0 second treatment gave 60% mortality. The 1.0 and 0.5 second treatments caused visible injury, but many plants recovered.

Table 1. Summary of weed response to increasing laser exposure at 60 W.

Laser exposure	Approximate energy per weed	Main injury response	10 d mortality	Practical interpretation
0 s	0 J	No laser injury	0%	Untreated reference
0.5 s	30 J	Visible injury with recovery	10%	Sublethal under tested conditions
1.0 s	60 J	Moderate injury with regrowth	20%	Insufficient for reliable control
2.0 s	120 J	Strong chlorophyll loss and canopy contraction	60%	Severe injury, but incomplete kill
3.0 s	180 J	Rapid decline and sustained collapse	90%	Most reliable treatment tested

Chlorophyll readings confirmed that the strongest treatments caused lasting plant stress as also shown in **Table 1**. At 10 days, the 3.0 second treatment reduced chlorophyll content by 92%. The 2.0 second treatment reduced chlorophyll content by 59%. Lower exposure times caused injury, but the plants recovered more often. Practically these results mean that a 3.0 second exposure at 60 W gave the most reliable single-pass control. A 2.0 second exposure caused strong injury, but it did not kill enough plants for dependable control. Shorter exposures should not be used as stand-alone treatments under these conditions.

Conclusions

A delta robot carrying a 60 W, 450 nm blue laser controlled small broadleaf weeds in field testing. Field experiments validated that the more powerful the laser, the better it kills the weeds. 3.0 second treatment gave the best result, with 90% mortality at 10 days. The 2.0 second treatment caused strong injury, but some weeds recovered. The 0.5 and 1.0 second treatments were not dependable for control. The robot also placed the laser accurately during target testing, with a mean error of 0.83 mm. These results show that robotic laser weeding has potential for selective in-row weed control in Vidalia onion production. Future work should test common onion weeds, measure crop safety, expand bed coverage, and add automatic weed detection.

References

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Ecorobotix ARA High-Precision Sprayer Evaluation for Weed Control, Crop Safety, and Yield in Vidalia Onion

Luan Pereira de Oliveira, Regimar Garcia dos Santos, and Christopher Tyson

Introduction

Vidalia onion production requires effective weed control while reducing crop injury and unnecessary herbicide use. Conventional broadcast herbicide applications spray the entire field area, while high-precision sprayers can apply herbicide only where needed. This trial evaluated the **Ecorobotix ARA ultra-high-precision sprayer** for weed control, onion phytotoxicity, marketable yield, and unmarketable bulbs.

Materials and Methods

The research trial was established on January 8, 2025. The Ecorobotix ARA was compared with a conventional broadcast application using Prowl and Goal 2XL.

Treatments evaluated:

- **Treatment 1**: Ecorobotix ARA + Prowl + Goal 2XL (Applied using the "All but the crop" setting.) at 32 fl oz per acre for both herbicides.
- **Treatment 2**: Conventional broadcast Prowl + Goal 2XL at 32 fl oz per acre for both herbicides.
- **Control** (No herbicide applied)

The "All but the crop" setting means that the sprayer recognized the onion crop and sprayed the surrounding area, including weeds and soil, while avoiding direct spraying on the crop. The Safety Zone setting allows the machine to decide whether to spray a weed based on the distance between the weed and the crop.

According to the data provided by the Ecorobotix ARA, spot application reduced spray volume compared with target broadcast application. Target broadcast required 27 gallons, while spot application used 11 gallons. This resulted in a chemical reduction of approximately 59% (**Table 1**).

Table 1. Chemical reduction from Ecorobotix ARA spot application compared with target broadcast application.

Target broadcast	Spot-applied	Percent Reduction
27 gal/acre	11 gal/acre	59.25%

Phytotoxicity and weed counts were collected at 14, 30, and 44 days after application. A 10 sq ft frame was used to evaluate crop phytotoxicity and weed count in each plot. Each plot was 100 ft long and 19 ft wide, with three onion beds. Only the center bed was used for data collection. Five random assessments were collected for phytotoxicity and weed counts. Yield was collected from a 15 ft section in the center onion bed.

Results

The Ecorobotix ARA + Prowl + Goal 2XL treatment showed lower phytotoxicity (colored bars) than the conventional broadcast treatment and the glufosinate treatments (**Figure 1**). This indicates that the ARA spot application may reduce crop injury when used with Prowl and Goal 2XL under the "All but the crop" setting.

Weed counts (red line) showed similar weed control among Ecorobotix ARA and conventional broadcast treatments when using Prowl and Goal 2XL and higher weed counts per 10 square ft at the control treatment.

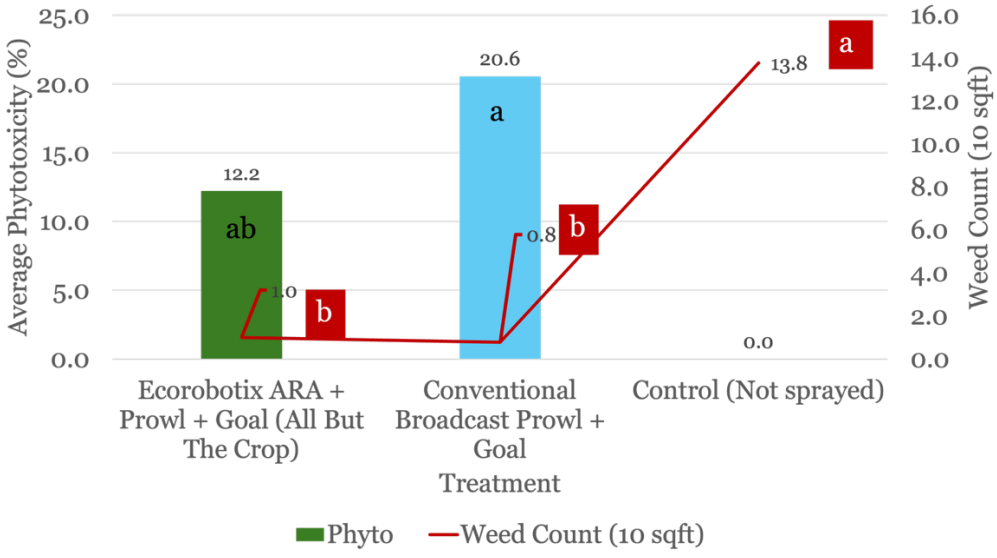


Figure 1. General phytotoxicity and weed counts among treatments. Bars represent phytotoxicity, and the line represents weed count. Different letters indicate significant differences among treatments.

Phytotoxicity and weed control changed across the evaluation dates. Phytotoxicity was generally higher at 14 days after application than at 30 and 44 days after application (DAA). Higher phytotoxicity was observed in the conventional broadcast treatment. The treatments with lower phytotoxicity at 14 days after application were Ecorobotix ARA + Prowl + Goal 2XL using the "All but the crop" setting and control. Weed control was similar for the conventional broadcast treatment and Ecorobotix ARA + Prowl + Goal 2XL at 14, 30, and 44 days after application. The untreated control showed the highest weed pressure at 44 days after application as illustrated in **Figure 2**.

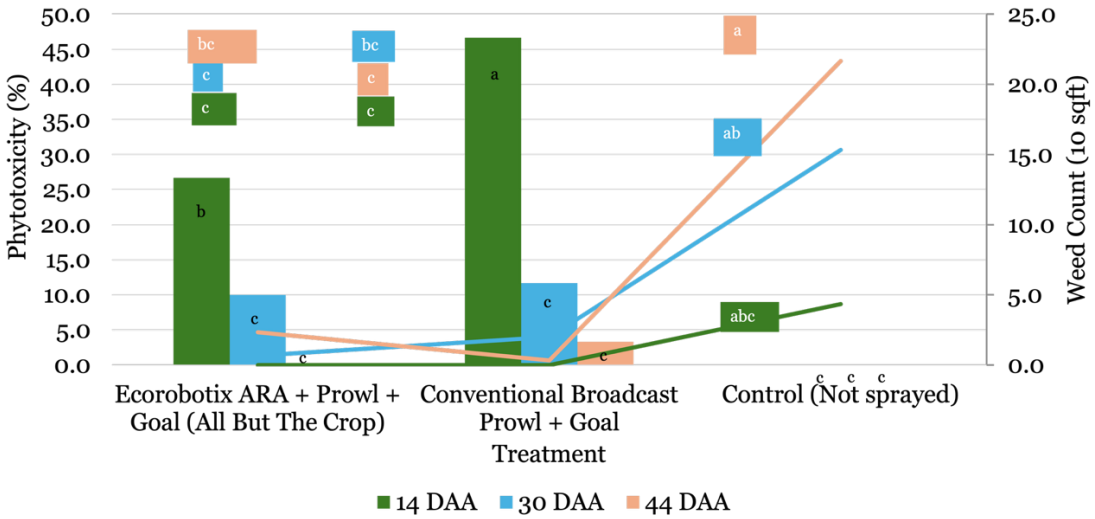


Figure 2. Phytotoxicity and weed counts at 14, 30, and 44 days after application among treatments. Bars represent phytotoxicity, and lines represent weed counts. Different letters indicate significant differences among treatments.

Marketable yield results showed that statistical differences were mainly observed between treatments and the untreated control (**Figure 3**). Although the Ecorobotix ARA spot application and the conventional broadcast treatment were statistically similar, the Ecorobotix ARA + Prowl + Goal 2XL treatment produced approximately 2,600 lbs/acre more marketable yield than the broadcast treatment. Average bulb size also differed among treatments. Treatments 1 and 2 produced larger bulb size compared to treatment 3.

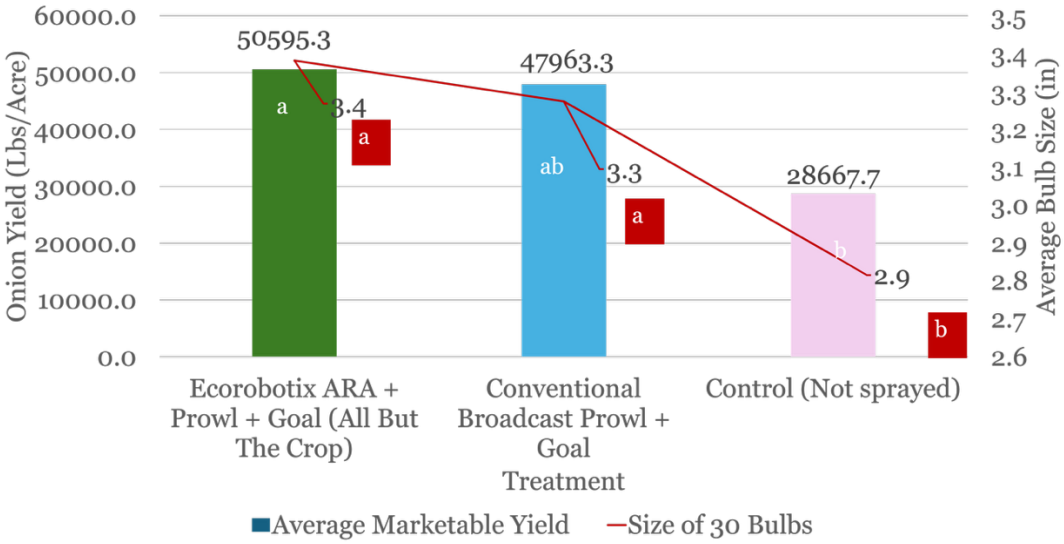


Figure 3. Marketable yield and average bulb size among treatments. Bars represent marketable yield, and the line represents average bulb size. Different letters indicate significant differences among treatments.

Conclusions

These results suggest that the Ecorobotix ARA may help reduce herbicide use while supporting weed control and yield in Vidalia onion production. The Safety Zone feature still needs further evaluation, especially for contact herbicides such as glufosinate. Additional research is also needed to determine economic return, field efficiency, and the best herbicide programs for use with the Ecorobotix ARA.

If you have any questions about the methods and/or results from these trials, please contact Dr. Luan Oliveira at luan@uga.edu or +1 229 386 3377.

Mechanical Harvesting Impacts on Georgia Short-Day Onions: Postharvest Quality and Bruising Assessment

Taiwo A. Owolanke, Ted McAvoy, Angelos Deltsidis

Introduction

Short-day Vidalia-type onions are highly perishable and are especially vulnerable to mechanical damage during harvesting, handling, and curing. Because these bulbs have soft tissue and delicate skins, impact damage can reduce market quality and storability, creating losses for growers and handlers. Mechanical harvesting systems are still being developed for short-day onions, and the effects of drop height, surface padding, calcium management, and varietal differences on bruising are not always well understood. This study evaluated how simulated mechanical harvesting conditions, calcium nitrate rate, and cultural practices such as maturity and curing influenced bruising severity and postharvest quality traits among Vidalia onion varieties. The goal was to identify management factors and postharvest handling conditions that reduce bruising and help maintain bulb quality during mechanical harvesting of Short-day Vidalia-type onions. This information aims to improve mechanical harvesting systems for these onions.

Materials and Methods

The study was conducted at the Vidalia Onion Research Laboratory (VORL), Tifton, GA, United States to evaluate onion bruising and postharvest quality under simulated mechanical harvesting conditions using a low-cost wooden drop platform to simulate mechanical bruising and damage that occur during harvest and handling. Five commercial varieties of Vidalia onions (Vidora, Sapelo, Sweet Magnolia, Red Maiden, and Monjablanca) were grown and harvested from the Vidalia Onion and Vegetable Research Center in Lyons, Georgia at two different harvest maturity stages: when 80% of the tops had fallen and 80% of the tops after one week, cured or dried for 1 day and 7 days after harvest on the field. Bulbs were dropped from 3, 4, and 6 feet onto either a padded or non-padded harvest-large tote bin to simulate the impacts that may occur as onions move through harvesting, transfer, and handling operations with the dropped bulb held overnight at 20°C for bruise development before evaluation. Resulting damage or bruising severity was classified as no damage, minor damage, or serious damage based on the number of bruised or soft fleshy scales, in reference to the USDA unmarketable classification for onion bulbs. Bruise depth was measured in millimeters using a digital vernier caliper, bruise layers were counted, and bulb firmness and total soluble solids (TSS) were used as quality indicators. Firmness was measured using a TA-XT Plus Texture Analyzer with a 4-inch-diameter flat-cylinder plate in a compression test, and TSS was measured using a digital refractometer.

A separate part of the study assessed how calcium nitrate rates affect the bulb quality of Vidora onions. Five rates (0, 76, 152, 228, and 304 lb/acre) were applied in two split applications, spaced two weeks apart, beginning at bulb swelling in the field. Bulbs were dropped similarly

from 3, 4, and 6 feet onto either a padded or non-padded harvest-large tote bin, held overnight at 20°C for bruise development before evaluation. Bruise depth, bruise layers, firmness, and TSS were measured across these treatments to determine whether nutrient management influenced onion susceptibility to bruising and quality loss. The study also compared onion varieties at two harvest maturities, after 1 day and after 7 days of field curing, to determine how varietal differences, harvest maturity, and curing duration affected bruise depth. These procedures were intended to reflect practical conditions that growers and handlers encounter and to identify management factors that could help reduce postharvest losses and make mechanical harvesting of short-day onions practical.

Results

Bruising response

Bruise severity increased with drop height and was generally higher on the non-padded surface (**Table 1**; **Figure 1**). At the drop-height level, from 3 ft to 6 ft, bruise depth and bruise layers increased, with the 6 ft treatment showing the most serious damage. The control bulbs had much lower bruise depth and bruise layers than the dropped bulbs. Across surfaces, the non-padded treatment produced substantially deeper bruises and more bruise layers than the padded treatment. Damage incidence followed a similar pattern, with fewer undamaged bulbs and more seriously damaged bulbs as drop height increased, especially on the non-padded surface (**Figure 1**). Overall, higher drop height and lack of padding led to greater bruising severity, indicating that mechanical damage was influenced by impact intensity and padding.

Table 1. Main effects of drop height, control versus dropped, and surface on impact bruising in Vidalia onions during the 2025 harvest season, averaged across variety, maturity, and curing.

Treatment	Factor	Bruise Depth (mm)	Bruise layers (counts)
3 ft	Drop Height	6.39 a	1.57 a
4 ft		8.00 b	1.92 b
6 ft		13.25 c	3.11 c
Control	Control vs Dropped	2.74 a	0.74 a
Dropped		9.21 b	2.20 b
Non-Padded	Surface	13.44 b	3.15 b
Padded		5.07 a	1.25 a

Bruise depth and bruise layers are presented as means. Different letters within a column indicate significant differences among treatments at $P<0.05$.

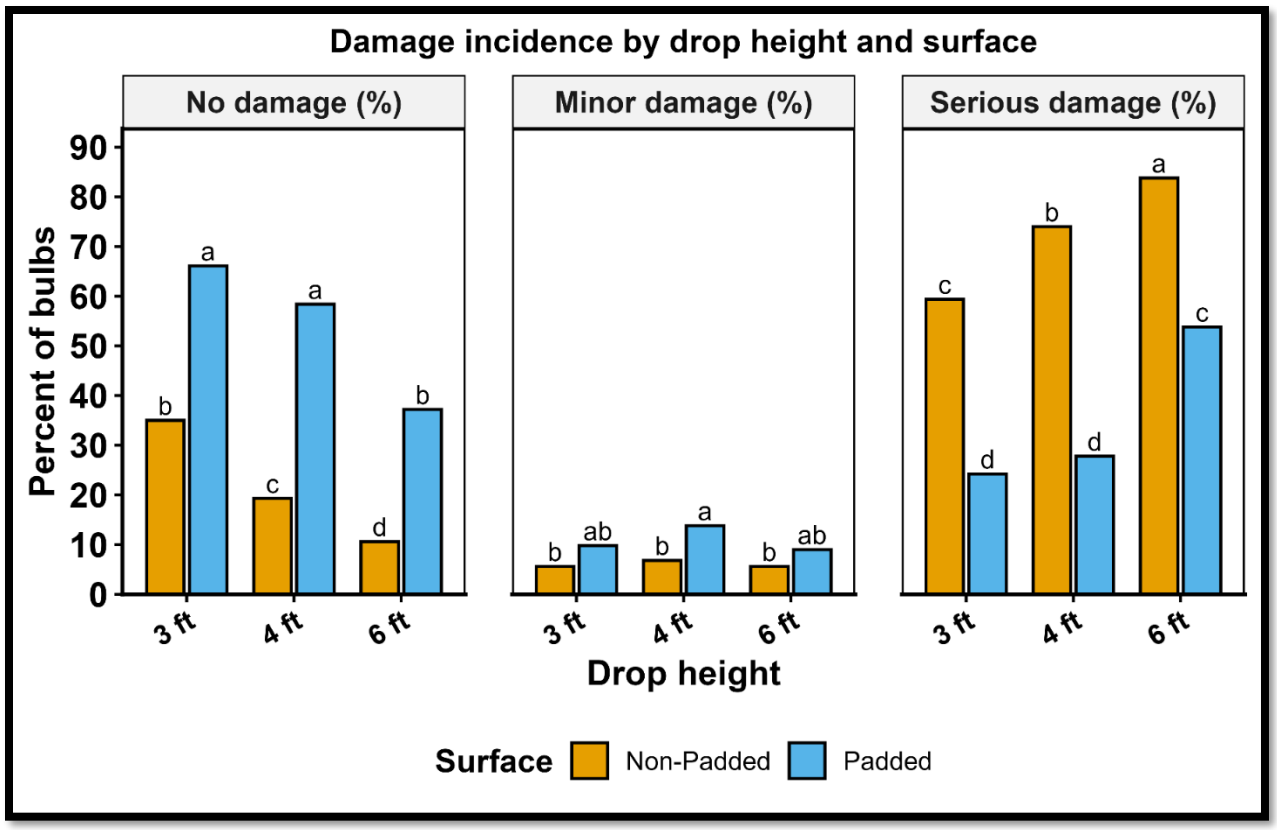


Figure 1. Impact bruising categories of onions by drop height and surface, averaged across variety, maturity, and curing duration during the 2025 harvest season. Bars show the percentage of bulbs in each bruising severity class for each treatment combination. Bruising severity was classified using the USDA unmarketable standard: no damage = 0, minor damage = 1, and serious damage = 2 or more bruised or soft fleshy scales. The severity classes were analyzed separately, and different letters indicate significant differences within each damage category.

Onion quality

In contrast to bruising response, onion quality traits were only slightly affected by treatment. TSS remained largely unchanged across drop heights and between surfaces (**Figure 2**), while firmness showed a small decline with increasing drop height from 3 ft to 6 ft and was lower on the non-padded surface than on the padded surface (**Figure 3**). Padded onions were firmer than non-padded onions. Overall, these results indicate that the drop conditions had a much stronger effect on bruising than on internal bulb quality.

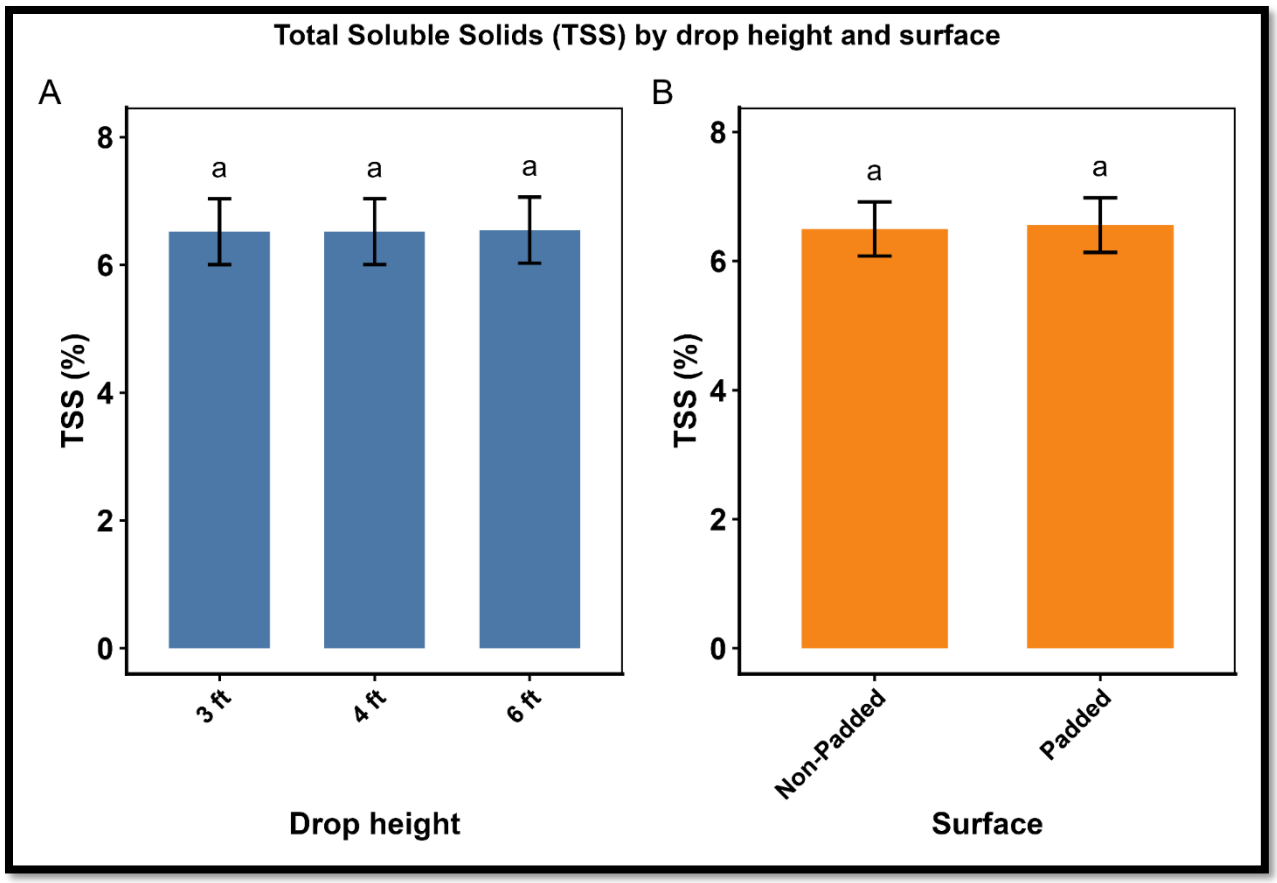


Figure 2. Means of onion firmness by drop height and surface treatment. Panel A shows bulb firmness by drop height, and panel B shows bulb firmness by surface treatment. Bars show average means, and error bars show standard error. Drop height x surface interaction was not significant; the main effects are shown. Different letters indicate significant differences within each factor at $P < 0.05$.

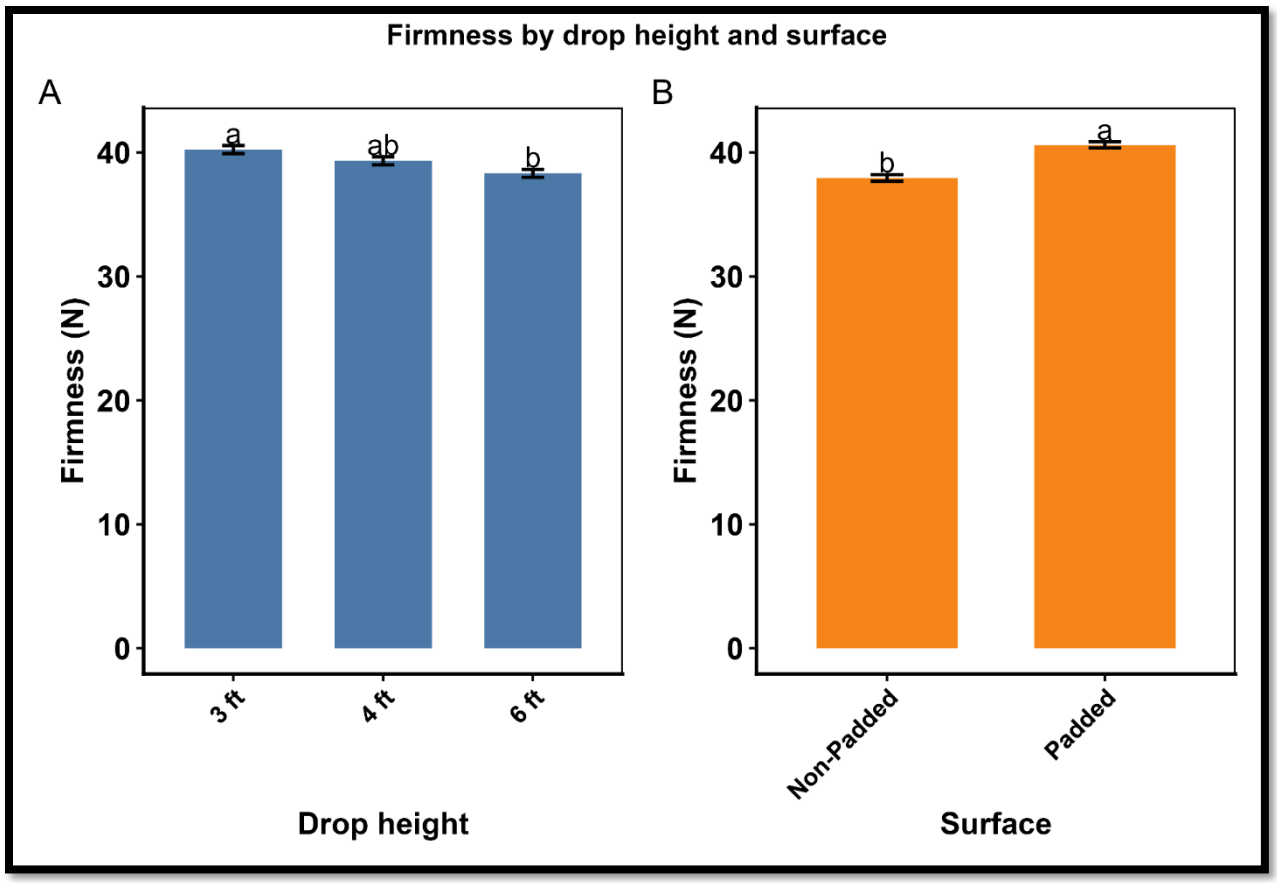


Figure 3. Means of onion total soluble solids (TSS) by drop height and surface treatment. Panel A shows TSS by drop height, and panel B shows TSS by surface treatment. Bars show average means, and error bars show standard error. Neither the main effects nor the drop height x surface interaction were significant; the main effects are shown. Different letters indicate significant differences within each factor at $P < 0.05$.

Calcium nitrate rate

Calcium nitrate rate affected bruise depth, bruise layers, and TSS, while bulb firmness did not differ among treatments (**Table 2**). Onions receiving 152 lb/acre had the lowest bruises and fewest bruise layers, along with the highest TSS, indicating the most favorable combination of reduced damage and internal quality. In contrast, the lowest (0 lb/acre) and highest (228-304 lb/acre) rates produced deeper bruises, more bruise layers, and lower TSS, indicating that both very low and very high rates were less desirable than the moderate 152 lb/acre rate.

Table 2. Main effects of calcium nitrate rate on bruise and postharvest quality parameters in Vidora onion, averaged across drop height and impact surface during the 2025 harvest season

Calcium Nitrate Rate (kg/ha)	Bruise Depth (mm)	Bruise layers (counts)	Firmness (N)	TSS (%)
0	7.83 c	1.52 cd	34.2 a	7.09 ab
76	4.32 b	1.01 b	33.8 a	7.20 ab
152	2.54 a	0.62 a	34.1 a	7.42 b
228	6.66 c	1.46 c	33.4 a	7.00 ab
304	8.29 c	1.78 d	33.8 a	6.75 a

Bruise depth, bruise layers, firmness, and total soluble solids (TSS) are presented as means across drop height and surface conditions. Different letters within a column indicate significant differences among calcium nitrate rates at $P<0.05$.

Variety response across maturity and curing

Bruise depth varied among varieties and changed with maturity and curing period (**Figure 4**). Monjablanca generally showed the highest bruise depth, while Vidora consistently had the lowest. The other varieties fell in between, but their ranking shifted somewhat between the 1-day and 7-day curing periods and between the two harvest maturity stages. Overall, the results show that both variety and postharvest handling conditions influenced bruising susceptibility.

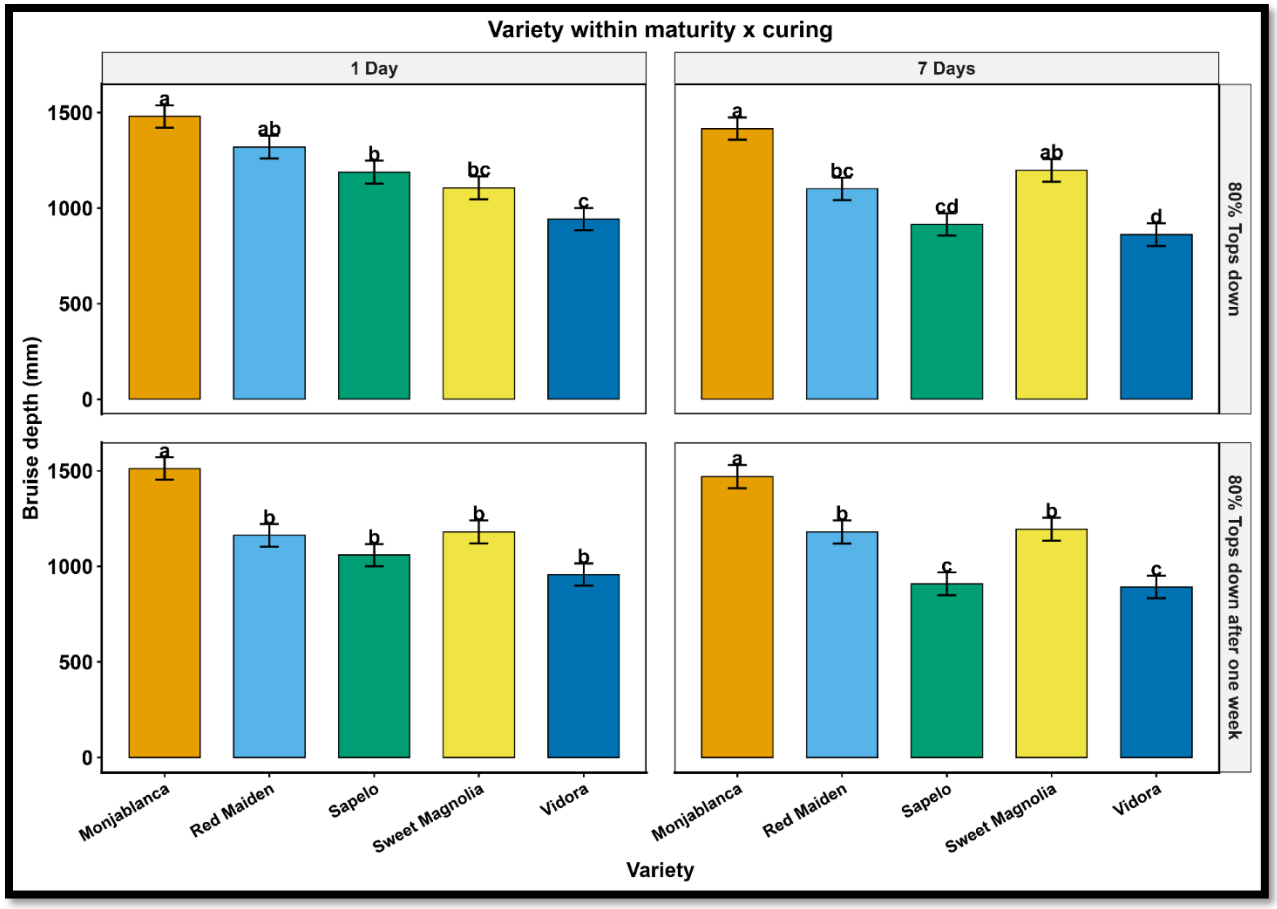


Figure 4. ART-based estimated marginal means of bruise depth (mm) for Vidalia onion varieties within each maturity and curing duration combination during the 2025 harvest season. Bars show model-adjusted means, and error bars show standard errors. Different letters indicate significant differences among varieties within each maturity x curing combination at $P < 0.05$.

Conclusions

Overall, the study showed that onion bruising was influenced mainly by drop height and surface condition, with higher drops and non-padded surfaces causing deeper bruises, more bruise layers, and more serious damage bulbs. Firmness showed only small changes under the impact treatments, while total soluble solids remained largely unchanged, indicating that internal quality was less sensitive to impact than bruising severity. Calcium nitrate rate and varietal differences also influenced bruising and quality, but their effects were smaller than the impact conditions, reinforcing that impact intensity and padding were the main factors influencing bruising.

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Optimizing Mechanical Harvesting Operations to Reduce Bruise Damage in Vidalia Onions

Aleena Rayamajhi, Md Sultan Mahmud, Luan Pereira de Oliveira, and Christopher Tyson

Introduction

Mechanical harvesting can reduce labor requirements for Vidalia onion production; however, impacts occurring during harvesting and handling may cause internal bruising that reduces bulb quality, storage life, and market value. The severity of bruising depends on both impact conditions and the susceptibility of individual onion varieties. Understanding where damaging impacts occur during harvest operations and identifying varieties that are more resistant to bruising can help growers reduce losses and improve harvest efficiency. An Impact Recording Device (IRD), a small spherical electronic sensor that measures impact forces, was used to quantify impacts experienced by onions during harvesting. The objective of this study was to evaluate bruise susceptibility of commercial Vidalia onion varieties under controlled impact conditions and identify impact-prone locations within a commercial mechanical harvesting system using impact-sensing technology.

Materials and Methods

Two complementary experiments were conducted to evaluate mechanical damage in Vidalia onions. The overall approach is illustrated in **Figure 1**. The first experiment consisted of controlled pendulum impact tests designed to determine bruise susceptibility among onion varieties, maturity stages, and drying conditions. Five commercial Vidalia onion varieties (Vidora, Sapelo, Sweet Magnolia, Red Maiden, and Monja Blanca) grown at the Vidalia Onion and Vegetable Research Center in Lyons, Georgia, were evaluated. Onions were harvested at two maturity stages (80% tops down and one week after 80% tops down) and tested either immediately after harvest or after seven days of drying. Impacts were applied using a pendulum system onto a flat steel surface for one batch and a padded surface for another. Ten onions were tested per treatment, and each onion was impacted twice on opposite sides. Parallel tests were conducted using both non-instrumented onions for bruise assessment and IRD-instrumented onions for impact measurements, allowing relationships between impact severity and bruise development to be established. Bruise development was evaluated 24 hours after impact.

The second experiment involved field measurements using IRDs within a commercial mechanical harvester to identify impact-prone locations during harvest operations. The Macon variety of onion field was used for this experiment. Mechanical harvesting impacts were evaluated using a Univerco onion harvester. IRDs were inserted into onions and passed through the harvester during normal operation. Twelve replicated passes were conducted while harvesting at approximately 1.5 mph. The Univerco harvester was divided into three sections: (1) collection and elevating belts, (2) grading belt and clipper section, and (3) final conveyor transfer into the

field bin. Impact magnitude (Max G) was recorded throughout the harvesting process to identify locations with the greatest potential for bruise damage.

Data from both experiments were integrated to identify critical impact thresholds, determine bruise-resistant varieties, and develop recommendations for reducing mechanical damage during harvesting and handling. The overall experimental framework is illustrated in **Figure 1**.

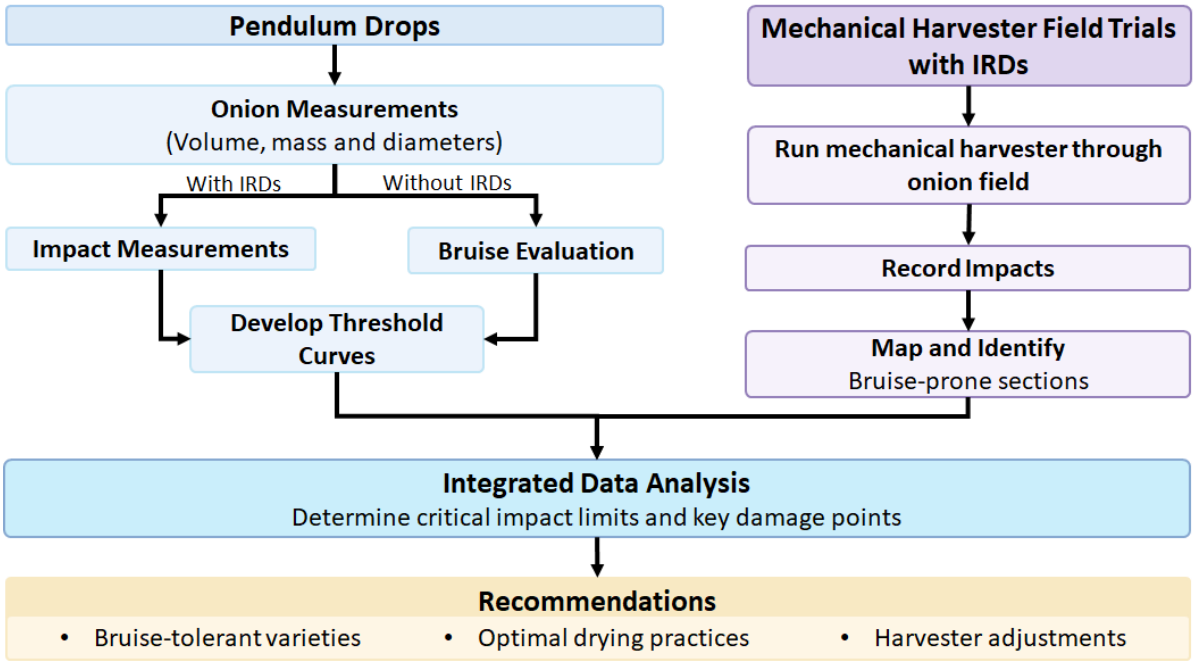


Figure 2. Overview of the experimental framework used to evaluate bruise susceptibility and mechanical harvesting impacts in Vidalia onions.

Results

The pendulum experiment informed that bruise severity increased as impact energy increased across all varieties. Higher drop heights consistently produced greater bruise incidence and bruise depth than lower drop heights. Flat steel surfaces resulted in more bruising than padded surfaces, demonstrating the importance of cushioning during handling operations. Later-maturity onions generally showed greater bruise susceptibility than onions harvested earlier, and the effects of drying varied among varieties. Overall, padded surfaces reduced both bruise incidence and bruise depth regardless of variety or maturity stage. Varietal differences were observed. Vidora and Sweet Magnolia consistently showed lower bruise susceptibility and better tolerance to impacts, whereas Monja Blanca was the most bruise-susceptible variety, particularly at later maturity stages. Sapelo and Red Maiden showed intermediate responses. Across all varieties, the combination of higher drop heights and steel impact surfaces produced the greatest damage.

Figure 2 and **3** show the damage percentage profiles at different drop heights, impact surfaces, and treatment combinations for all five varieties.

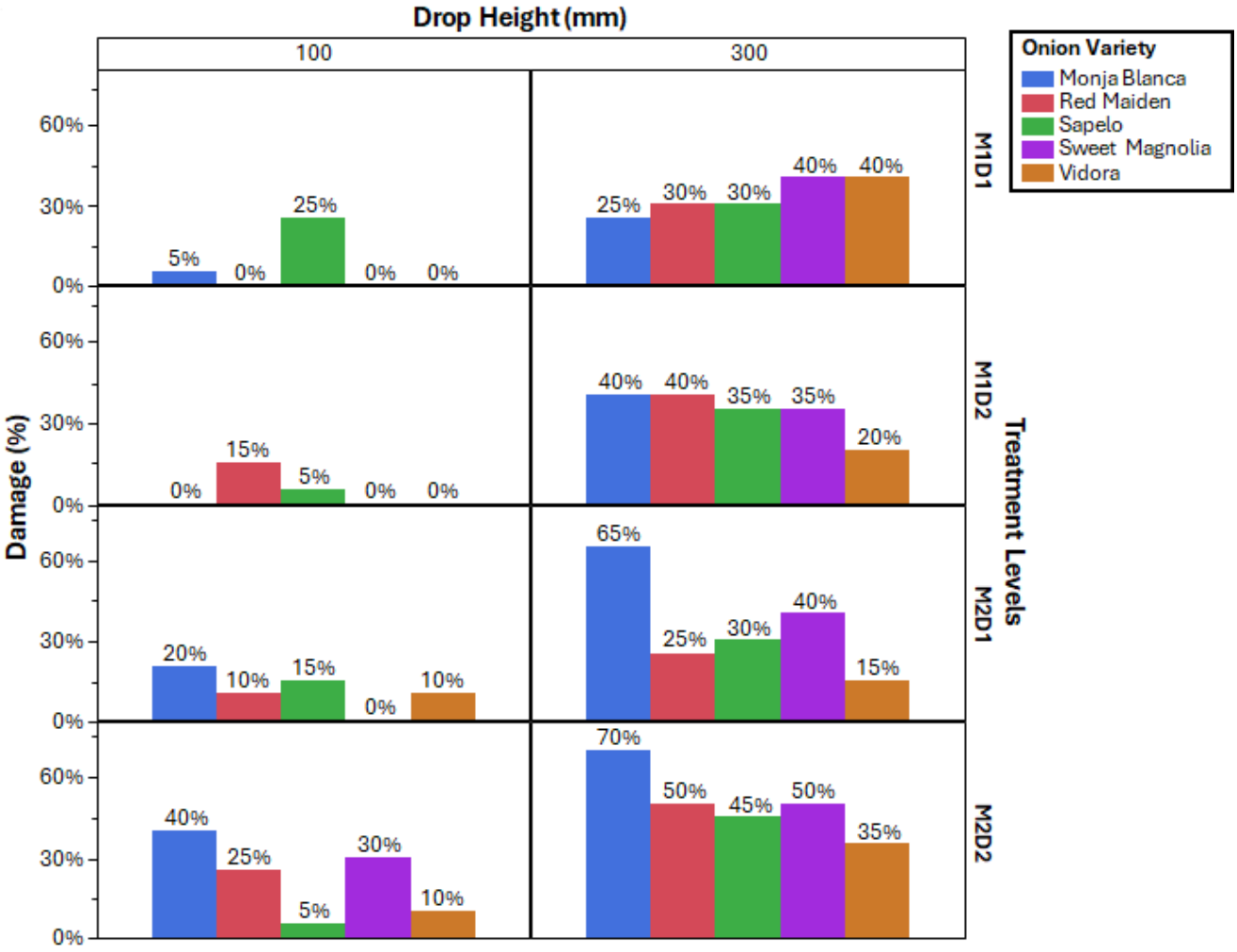


Figure 3. Damage percentage profiles for five varieties (Monja Blanca, Red Maiden, Sapelo, Sweet Magnolia, and Vidora) at four different treatment levels (M1D1, M1D2, M2D1, M2D2; M1: 80% tops down, M2: one week after 80% tops down, D1: no drying, D2: 7 days drying) and two drop heights (100 mm and 300 mm) when impacted on a flat steel surface.

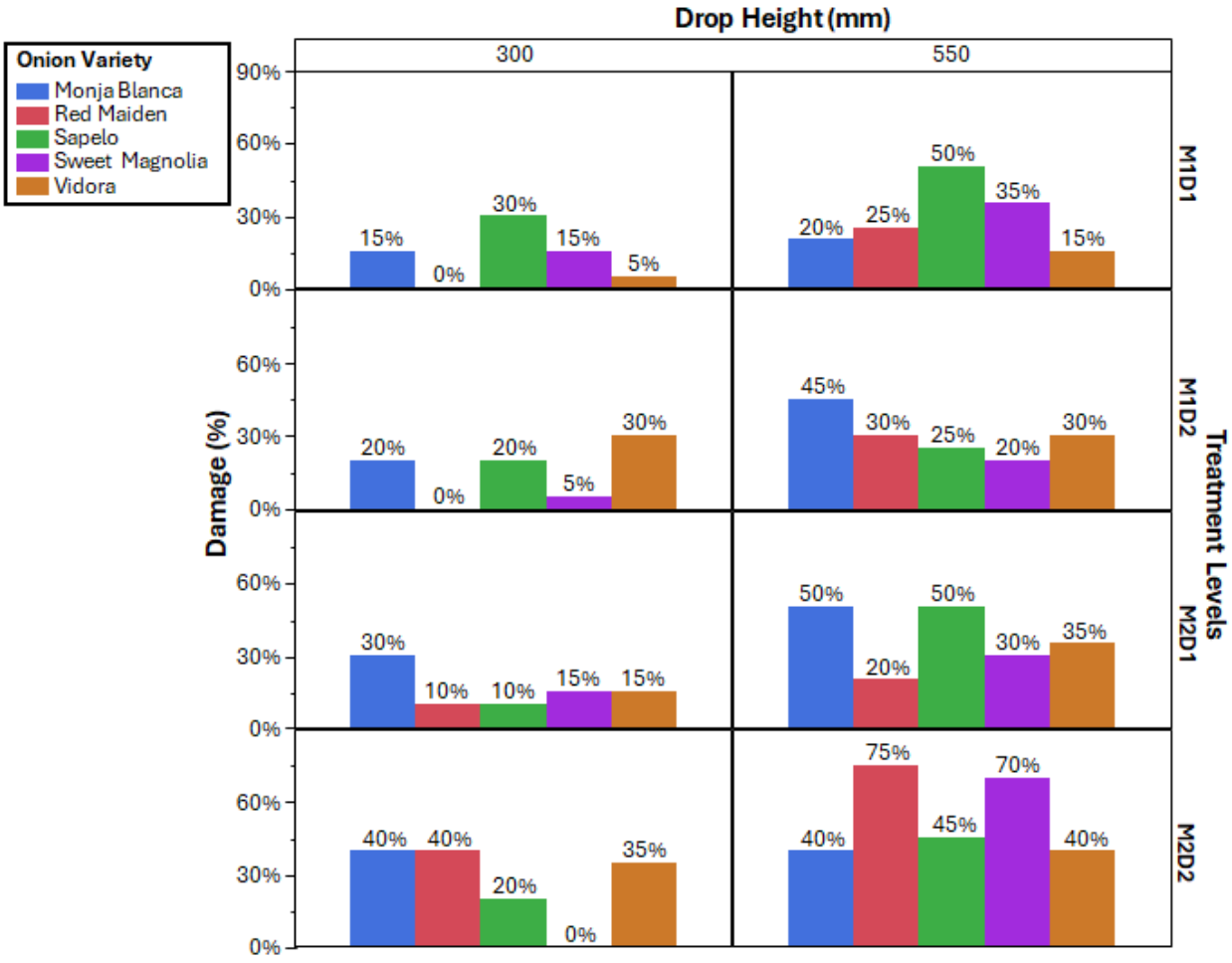


Figure 4. Damage percentage profiles for five varieties (Monja Blanca, Red Maiden, Sapelo, Sweet Magnolia, and Vidora) at four different treatment levels (M1D1, M1D2, M2D1, M2D2; M1: 80% tops down, M2: one week after 80% tops down, D1: no drying, D2: 7 days drying) and two drop heights (100 mm and 300 mm) when impacted on a padded surface.

Impact measurements collected during mechanical harvesting showed that the final conveyor transfer into the field bin was the most critical source of mechanical damage. This section recorded the highest average impact force (47.4 G) and the highest individual impacts, reaching nearly 119 G. In comparison, the collection and elevating belts averaged 36.1 G, while the grading and clipper section averaged 33.4 G. The final conveyor-to-bin transfer also exhibited the greatest variability in impact levels. This variability was likely caused by changes in bin fill level and differences in landing location as onions dropped into the container. The results indicate that reducing drop height, improving cushioning, or modifying the final transfer point could substantially reduce mechanical damage during harvest. **Figure 4** visualizes the relationship between maximum G and velocity change at different machine sections during mechanical harvesting.

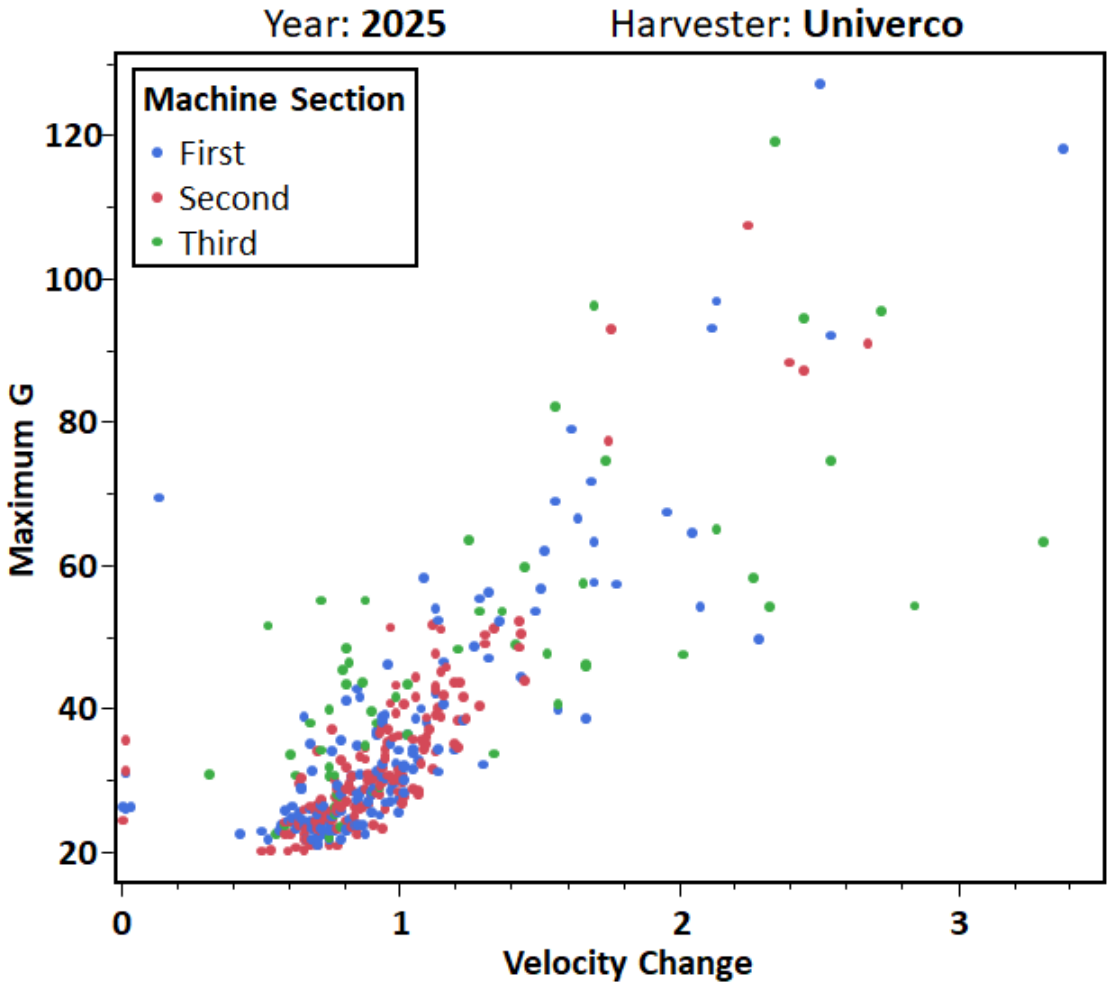


Figure 5. The graph visualizing the relationship between Maximum G and velocity change at three sections of a mechanical harvester recorded using an IRD sensor inserted during mechanical harvesting of Macon variety of onions.

Conclusions

Bruise damage in Vidalia onions increased with impact severity and was strongly influenced by impact surface and onion variety. Padded surfaces consistently reduced bruising compared with steel surfaces. Among the varieties tested, Vidora and Sweet Magnolia showed the greatest resistance to mechanical damage, while Monja Blanca was the most susceptible. Impact measurements from a commercial harvester identified the final conveyor-to-bin transfer as the primary source of damaging impacts. Reducing drop heights, adding cushioning materials, and improving bin-filling practices at this location could help minimize bruising and improve postharvest quality during mechanical harvesting.

UAV-AI Assessment of Bulb Count and Bulb Size Estimation

Luan Pereira de Oliveira, Lucas Sales, and Chris Tyson

Introduction

Vidalia onion production in Georgia faces several field-management challenges, including pre-harvest evaluation of bulb count and bulb size. Fast and reliable field information is important for supporting timely management decisions. Traditional field scouting and manual counting require time and labor, especially across large onion fields. Drone imagery combined with artificial intelligence, or AI, may provide a faster way to estimate bulb counts and bulb size in the field.

This project evaluated one main objective:

Vidalia onion bulb sizing and count estimates using drones and artificial intelligence

Materials and Methods

This study tested whether drones and AI could estimate onion bulb count and bulb size near harvest. Drone images were collected after leaf and undercutting, when onion bulbs were visible from above.

The Solvi.ag platform was used to count and measure onion bulbs from the drone images. To check the accuracy of the AI results, 200 onion bulbs were measured manually using digital calipers. These field measurements were compared with the AI-based estimates as illustrated in **Figure 1**. A summary of UAV image collection and AI-based assessment methods used for Vidalia onion stand count, bulb count, and bulb size estimation is provided in **Table 1**.



Figure 1. Drone image processing for onion bulb count and size estimation near harvest: (**A**) original drone image and (**B**) AI-detected bulbs using Solvi.ag.

Table 1. Summary of UAV image collection and AI-based assessment methods used for Vidalia onion stand count, bulb count, and bulb size estimation.

S.N.	Item	Bulb Count/Size
1	Stage	Leaf drop
2	Drone	DJI Mavic 3M
3	Flight Height	32 ft
4	Platform	Solvi.ag
5	Ground check	200 bulbs
6	Output	Count, size

Results

Drone images collected after leaf drop clearly showed exposed onion bulbs, which made AI detection easier. For onion bulb counting, the drone and AI method achieved approximately 99% accuracy. This result shows strong potential for estimating bulb numbers before harvest. For bulb size estimation, the AI method achieved approximately 78% accuracy. The size estimation error was less than 0.25 inches compared with manual caliper measurements. This result is useful because onion market classes are based on bulb size as illustrated in **Figure 2**.

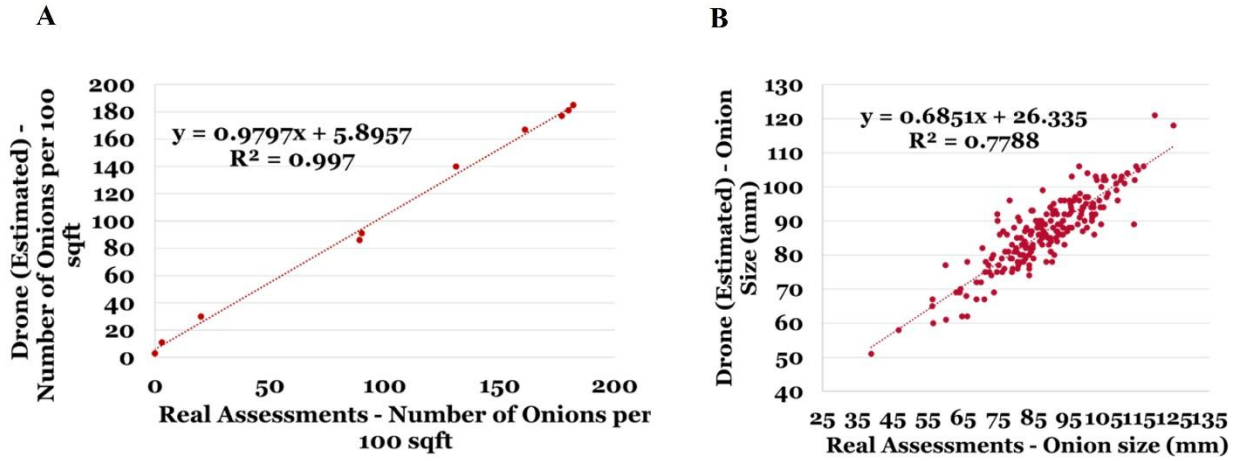


Figure 2. Results of Relationship between ground-truth measurements and UAV-AI estimates for Vidalia onion assessment: (**A**) onion count per 100 sq ft and (**B**) onion bulb size.

These results suggest that drone-based AI bulb counting is the strongest current application. Bulb size estimation also has good potential for supporting pre-harvest market class decisions

Conclusions

Bulb count and bulb size estimation showed strong results. Drone-based AI counting achieved approximately 99% accuracy for bulb counts, while bulb size estimation achieved approximately 78% accuracy with an error of less than 0.25 inches. Overall, the most promising current use is pre-harvest bulb counting and bulb size estimation. Early stand count estimation still needs improvement through better image collection, more training data, and higher-resolution drone cameras.

If you have any questions about the methods and/or results from these trials, please contact Dr. Luan Oliveira at luan@uga.edu or +1 229 386 3377.

Vidalia Onion Yield Prediction Using UAV Imagery and Artificial Intelligence

Luan Pereira de Oliveira, Marcelo Barbosa, and Chris Tyson

Introduction

Vidalia onion production in Georgia requires timely information on expected yield and bulb market class before harvest. Traditionally, yield and bulb size are measured after harvest through manual sampling, grading, and weighing. This process is labor-intensive, destructive, and does not provide early information for harvest planning. Drone imagery combined with artificial intelligence, or AI, may provide a faster and non-destructive way to estimate field productivity before harvest. By collecting multispectral drone images and using machine learning models, it may be possible to forecast yield and market class before the crop is harvested.

This project evaluated one main objective:

Vidalia onion yield and market class prediction using UAV multispectral imagery and AI-based models.

The goal was to determine whether drone image data could be used to predict Vidalia onion yield and market classes before harvest, supporting earlier harvest planning and field-level decision-making

Materials and Methods

The study was conducted in two commercial Vidalia onion fields in Georgia. Field 1 was located near Glennville, and Field 2 was located near Cobbtown. Both fields were planted with the Macon variety. Drone images were collected using a DJI Mavic 3 Multispectral drone. Images were collected on six dates before harvest:

- 90 days before harvest
- 75 days before harvest
- 60 days before harvest
- 45 days before harvest
- 30 days before harvest
- 15 days before harvest

The drone collected multispectral images using Green, Red, RedEdge, and Near-Infrared bands. These images were processed into high-resolution field maps. The image data were then used to extract canopy coverage, spectral information, and image texture information.

At harvest, 50 sample plots were evaluated in each field. Onion bulbs from each sample area were harvested, counted, weighed, and measured. These field measurements were used as ground-truth data for yield and market class prediction. Market classes were grouped as:

- Medium
- Jumbo
- Colossal

The image data and harvest measurements were then used to train and test machine learning models. Several models were evaluated, and the Random Forest model was selected because it produced the best overall forecasting results.

Results

The preliminary results showed that drone imagery and AI models can predict Vidalia onion yield before harvest. The strongest yield prediction result was obtained **30 days before harvest**. At this timing, the Random Forest model predicted yield with an **R^2 value of 0.73**, which means the model explained approximately 73% of the yield variation. However, the prediction error was still large. The model had a mean absolute error of approximately **4.8 tons/ha**, equivalent to about **10,000 lb/acre**. This means that while the model showed strong promise, the error level still needs to be reduced before the tool can be used for precise yield decisions at the farm scale as illustrated in **Figure 1**.

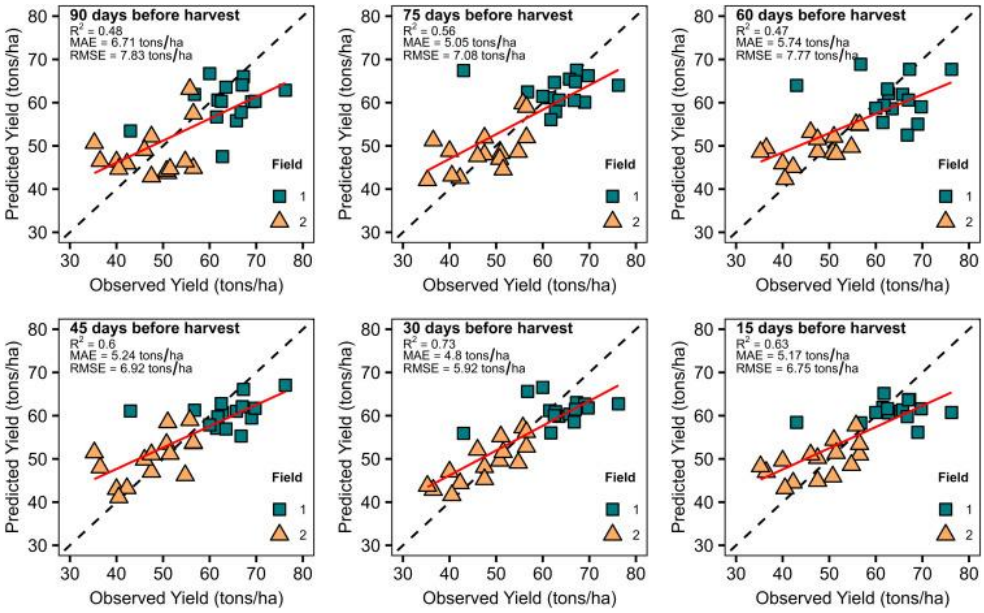


Figure 1. Random Forest machine learning model applied to Vidalia onion yield prediction.

The results also showed that timing was important. Early-season predictions were weaker because onion plants were still developing and had not yet shown clear yield-related canopy patterns. Prediction improved closer to harvest, especially at 45 and 30 days before harvest.

However, prediction performance decreased again at 15 days before harvest, likely because plant senescence and leaf decline reduced the usefulness of canopy image information.

The model was also evaluated for market class prediction. Market class prediction was strongest at **45 days before harvest**, especially for the **medium** onion class. The jumbo and colossal classes were more difficult to predict accurately. Market class prediction models for Vidalia onion using UAV imagery and AI are shown in **Figure 2**.

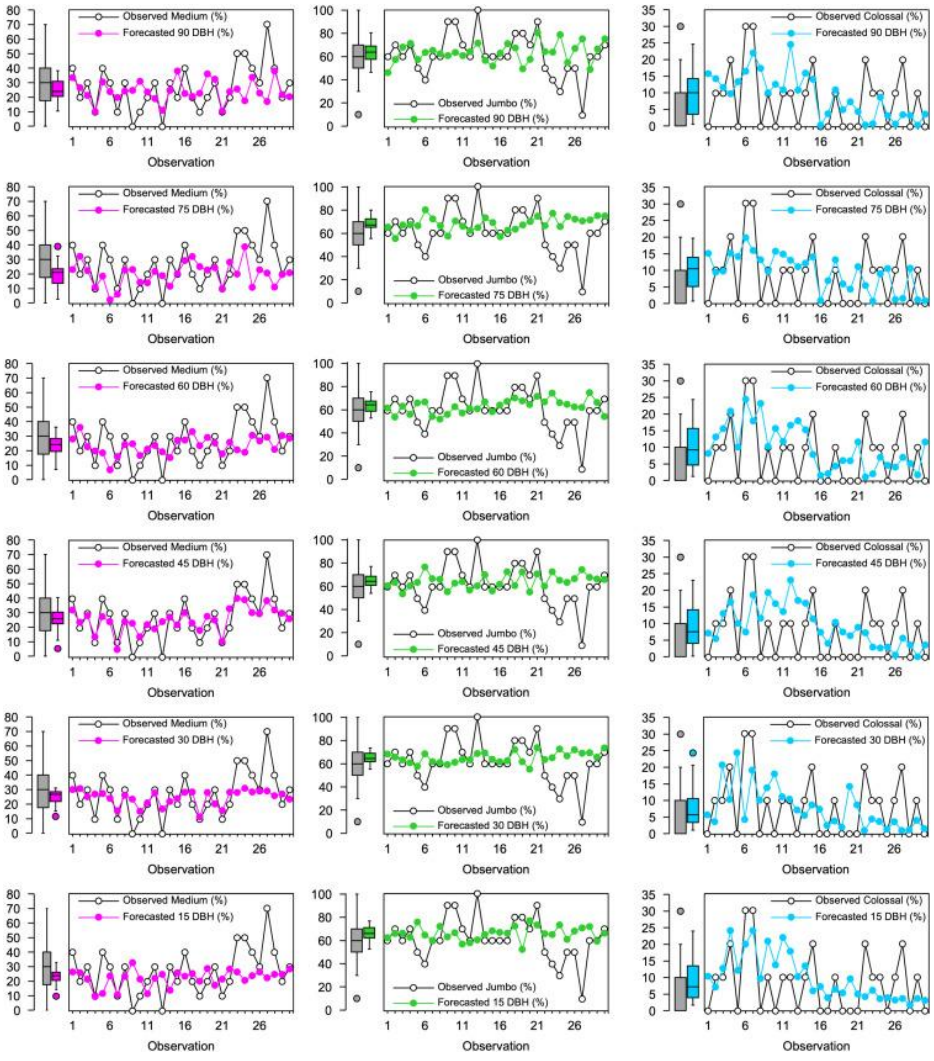


Figure 2. Market class prediction models for Vidalia onion using UAV image data and AI.

A feature importance analysis showed that image texture data were important for prediction. For yield prediction, Near-Infrared and NIR-based texture information were among the most

important inputs. For market class prediction, RedEdge texture information was especially useful. This suggests that both spectral data and texture data from drone images are important for estimating yield and bulb size before harvest. UAV-AI prediction performance for Vidalia onion yield, error, and market class estimation before harvest is given in **Table 1**.

Table 1. Summary of UAV-AI prediction performance for Vidalia onion yield, prediction error, and market class estimation before harvest.

Test	Best timing	Result
Yield prediction	30 DBH	$R^2 = 0.73$
Yield error	30 DBH	~10,000 lbs/acre
Market class	45 DBH	Medium class best
Key image data	30–45 DBH	NIR, RedEdge texture
Current use	Before harvest	Planning support

The study has already been developed into a research article that can be accessed by growers and stakeholders. The Vidalia Onion Committee was included in the funding section of the published article.

Although the results were promising, the model still needs improvement before it can be used as a reliable commercial decision tool. The main limitation was the prediction error. A yield error of approximately 10,000 lbs/acre is still too high for precise field-level yield estimates.

Another important question is whether a model developed using one variety or one season can be used for another variety or another season. To test this, the trial was repeated during the 2025–2026 growing season with Daniel Jackson. The new dataset will be used to test whether the AI model can be replicated and applied to different onion varieties and field conditions.

Future work should focus on:

- Testing the model with additional seasons and varieties
- Reducing yield prediction error
- Improving prediction of jumbo and colossal market classes
- Testing whether the model can be used across different field
- Evaluating whether satellite or other image platforms can improve scalability

Conclusions

Drone imagery and AI-based modeling showed strong potential for Vidalia onion yield prediction. The Random Forest model was able to predict yield 30 days before harvest with approximately 73% accuracy, based only on drone image data. The model also showed potential for market class prediction, especially for the medium class at 45 days before harvest. Image texture data, especially from NIR and RedEdge bands, were important for improving prediction performance.

However, the yield prediction error was still high, at approximately 10,000 lb/acre. Therefore, the method is promising but still needs improvement before being used as a dependable yield prediction tool. Overall, UAV-based AI yield prediction could become a useful tool for pre-harvest planning, harvest timing, and market supply decisions. Additional testing across more varieties, fields, and seasons will be necessary to confirm the reliability and practical value of this approach for Vidalia onion production.

If you have any questions about the methods and/or results from these trials, please contact Dr. Luan Oliveira at luan@uga.edu or +1 229 386 3377.

Optimizing Packing Shed Operations to Reduce Postharvest Losses in Short-Day Onions Using Impact Sensing Technologies

Aleena Rayamajhi, Md Sultan Mahmud, and Chris Tyson

Introduction

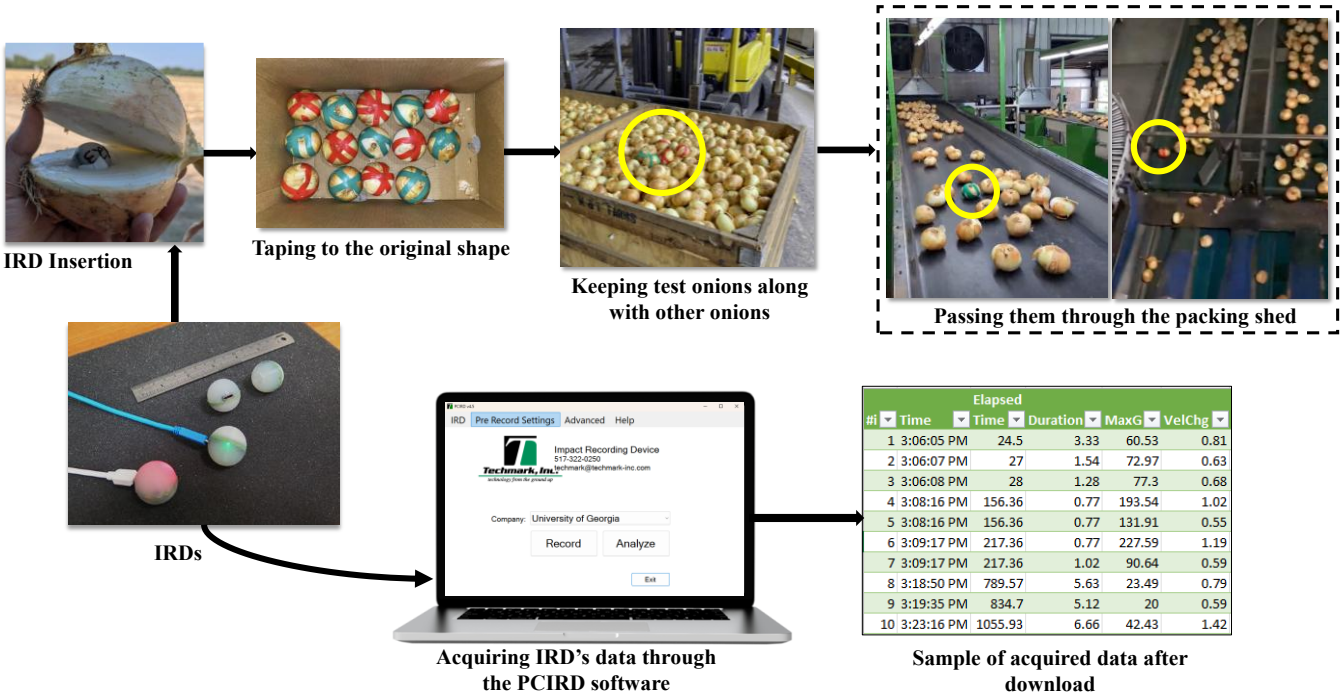
Postharvest handling operations can expose onions to repeated impacts that contribute to bruising and quality losses. Although bulbs may appear undamaged externally, impacts occurring during dumping, conveying, cleaning, and sizing can cause internal tissue injury that becomes visible later during storage or marketing. Sweet onions are particularly susceptible because their fleshy scales are arranged in concentric layers that can shift when subjected to mechanical forces. Damage to these internal layers can lead to moisture accumulation, increased susceptibility to decay, and reduced marketability. Modern packing facilities are designed to improve handling efficiency; however, transfer points, drop zones, and contact with hard surfaces may still generate impacts capable of causing hidden damage. In this study, impact-sensing technology was used to quantify the magnitude and location of impacts experienced by onions as they moved through a commercial packing shed. Identifying sections associated with elevated impact levels can help growers and packing shed operators improve handling practices, reduce bruising, and maintain bulb quality during postharvest processing.

Materials and Methods

Fourteen Vidalia onions were instrumented to measure impacts experienced during movement through a commercial packing line. Each onion was carefully cut into two halves, and a cavity was created at the center to accommodate an Impact Recording Device (IRD; Techmark, Inc., Lansing, MI). The IRD is a 25-mm spherical sensor that records impact magnitude (Max G) and impact duration during collisions. Because the device closely mimics the size and movement characteristics of an onion, it can be used to quantify the mechanical stresses encountered throughout the packing process. After the sensor was inserted, the onion halves were reassembled and secured with tape to restore their original shape and weight. The instrumented onions were then placed within bins of commercial onions and allowed to move through the packing line under normal operating conditions (**Figure 1**). This approach enabled identification of high-impact locations and evaluation of their potential contribution to bruise development.

During data collection, the instrumented onions traveled through the packing shed under normal operating conditions, following the same route as commercial onions from bin dumping through final collection. The handling process included movement through the hopper, soup line, chain sizer, brush table, grading line, cup sizer, exit belt, and collection bin, requiring approximately 10 minutes and 25 seconds to complete. For analysis purposes, the packing line was divided into four major handling sections representing distinct stages of onion movement and transfer. Impact

data recorded by the IRDs were grouped according to these sections to determine where onions experienced the greatest mechanical stress. The sensors continuously monitored impacts throughout the packing process and transmitted data wirelessly to a laptop running PCIRD software (Techmark, Inc., Lansing, MI). Real-time measurements of impact magnitude, impact duration, and event timing were recorded. These timestamps were subsequently used to assign individual impacts to specific sections of the packing line and identify locations associated with elevated impact levels and increased bruise risk.



#i	Time	Elapsed Time	Duration	MaxG	VelChg
1	3:06:05 PM	24.5	3.33	60.53	0.81
2	3:06:07 PM	27	1.54	72.97	0.63
3	3:06:08 PM	28	1.28	77.3	0.68
4	3:08:16 PM	156.36	0.77	193.54	1.02
5	3:08:16 PM	156.36	0.77	131.91	0.55
6	3:09:17 PM	217.36	0.77	227.59	1.19
7	3:09:17 PM	217.36	1.02	90.64	0.59
8	3:18:50 PM	789.57	5.63	23.49	0.79
9	3:19:35 PM	834.7	5.12	20	0.59
10	3:23:16 PM	1055.93	6.66	42.43	1.42

Figure 6. Workflow from preparing test onions with IRD up to data acquisition after passing through packing shed sections.

Results

A total of 136 impacts were recorded as instrumented onions moved through the packing shed (**Figure 2**). Average impact levels were relatively similar across the four packing-line sections, ranging from 31.8 to 36.5 G (**Table 1**). The highest average impact was observed in Section 1 (36.5 G), which included the initial transfer of onions from bins onto the conveyor system, while the lowest average impact occurred in Section 3 (31.8 G). Individual impacts ranged from approximately 20 G to 88 G across the entire packing process.

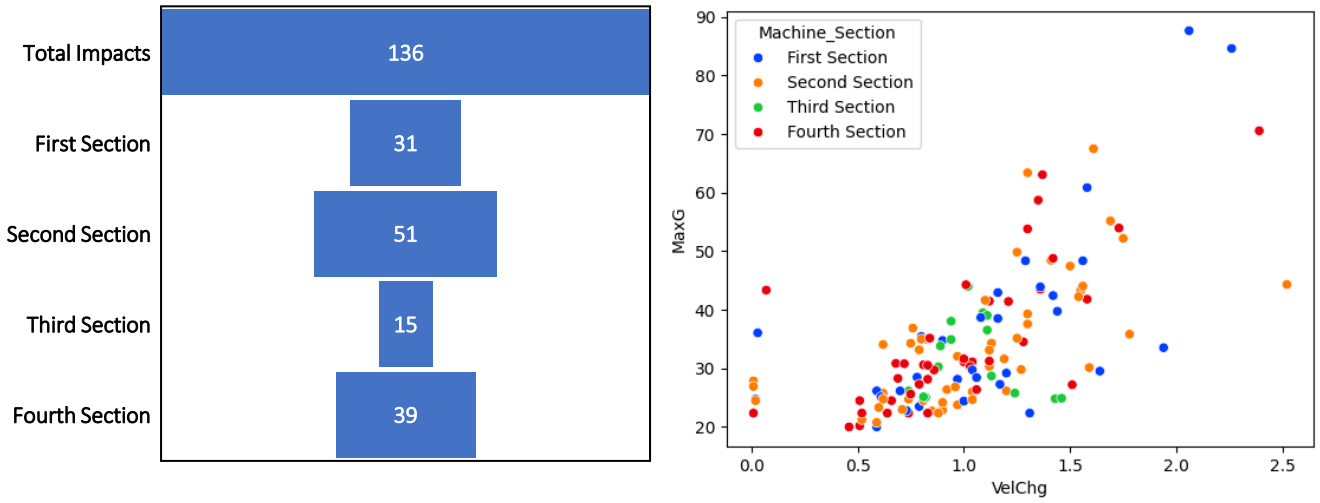


Figure 7. The chart on the left shows the number of impacts recorded in each section of the packing line, and the scatter plot on the right displays the relationship between impact strength (Max G) and change in velocity (VelChg) for all four sections.

Table 1. Average impact, impact range and handling consistency among four sections of packing shed according to IRD sensor's data.

Section	Average Impact (G)	Impact Range	Handling Consistency
Section 1	36.51	20 - 88	Variable
Section 2	33.63	21 - 68	Moderate
Section 3	31.78	25 - 44	Most Consistent

Although impact levels were generally consistent throughout the packing line, Section 1 exhibited the greatest variability and produced the highest recorded impact. This is likely due to differences in drop height and landing position as onions are transferred from bins onto conveyors. In contrast, the grading and inspection sections generated lower and more uniform impacts, indicating gentler handling conditions.

Overall, the results suggest that the packaging shed provided relatively gentle handling of onions, with the hopper and dumper area representing the primary opportunity for further improvement. Reducing drop heights, adding cushioning materials, or modifying transfer points in this section could help minimize bruising and maintain bulb quality during postharvest handling. Improvements at these locations may contribute to higher pack-out rates, longer storage life, and reduced postharvest losses for Vidalia onion growers.

Conclusions

This study utilized impact-sensing technology to quantify impacts experienced by onions as they moved through a commercial packing shed. Results showed that impact levels were generally low and relatively consistent throughout the packing process. However, the initial transfer stage from the hopper and dumper to the conveyor system generated the highest impact levels and the greatest variability, indicating a higher potential for bruise development. The remaining sections of the packing line exhibited more uniform handling conditions and lower impact forces. These findings suggest that improvements such as reducing transfer heights, incorporating cushioning materials, and optimizing dumping operations could further minimize mechanical damage. Continued use of impact-sensing tools can assist packing shed operators in identifying problem areas, improving equipment performance, and maintaining the high quality expected of Vidalia onions during postharvest handling.

Raising the Economic Bottom Line for Onion Growers: A Forward-Thinking Strategy to Recover Value from Onion 2nds and Discards

Joseph G. Usack, James P. Gratzek, and Ashfaq Sial

Introduction

The Georgia Vidalia onion industry contributes substantially to the state's agricultural economy; however, a significant fraction of harvested onions does not reach premium fresh-market venues. Growers estimate that No. 2 onions account for approximately 20–30% of production, while an additional portion is discarded due to quality standards, storage losses, or market limitations. These byproducts typically generate minimal economic return and represent an underutilized opportunity for value recovery. This study investigates a novel upcycling strategy in which onion byproducts are fermented into fatty acids (FAs), a group of higher-value bio-based chemicals used across food, feed, and other industries. Our overarching aim in establishing this new onion-upcycling fermentation platform is to provide growers with a reliable pathway to sell below-grade produce at consistently higher prices than they currently receive. The specific objective is to evaluate the technical feasibility and economic profitability of producing FAs from onion culls and to quantify the potential revenue for onion growers.

Materials and Methods

Approximately 50 kg of Vidalia onion culls were collected from a commercial onion operation and processed into a slurry at the University of Georgia Food Product Innovation & Commercialization Center (FoodPIC) in Griffin, Georgia. The slurry was then transported to the Food Systems Engineering Laboratory (FSE) in Athens, Georgia, for fermentation trials.

The FSE lab evaluated an advanced microbial fermentation process to convert onion culls into higher-value compounds, namely medium-chain fatty acids (MCFAs). Prior to fermentation, the onion culls were characterized for key properties including acidity (pH), total and volatile solids, chemical oxygen demand, total Kjeldahl nitrogen, sugars, and other compounds relevant to microbial conversion (**Table 1**). These measurements were used to identify appropriate operating condition setpoints for the fermentation process (*e.g.*, pH, temperature, redox level, H_2 partial pressure, inoculation rate) and viable operating ranges.

Table 1. Physical and chemical properties of pulverized onion culls

Property	Units	Value
pH	-	4.54 ± 0.12
Total Solids, TS	g L^{-1}	95.8 ± 2.9
Volatile Solids	g L^{-1}	91.7 ± 1.1
Fixed Solids	g L^{-1}	4.1 ± 0.1
Chemical Oxygen Demand, Total	g L^{-1}	125 ± 21
Total Kjeldahl Nitrogen	g kg TS^{-1}	14.0 ± 1.5
Sucrose	g kg TS^{-1}	10.1 ± 0.8
Fructose	g kg TS^{-1}	19.8 ± 1.5
Glucose	g kg TS^{-1}	21.5 ± 1.6
Total Volatile Fatty Acids, VFAs	g L^{-1}	2,199 ± 286
VFAs, as Acetic Acid	%	73.8 ± 9.6

Fermentation experiments were conducted under controlled conditions in 250-mL batch reactors (**Figure 1**), with product formation and process stability monitored over time. Multiple operating conditions were systematically evaluated to determine their effects on product yield and specificity. Experimental performance data, along with energy, material, and chemical inputs, were collected and used to conduct a techno-economic analysis (TEA) to estimate commercial feasibility and the economic



Figure 1: Fermentation experiments evaluating the effect of operating conditions (pH, temperature, redox, pH_2, etc.) on fatty acid product yields.

Results

With support from the Vidalia Onion Commission, we generated the preliminary results needed to validate the fermentation technology using onion waste. Specifically, we successfully demonstrated that we could profitably convert the liquid fraction of Vidalia onion culls into high-value fermentation products (*i.e.*, MCFAs) that can be sold into existing animal feed markets as microencapsulated feed powders (**Figure 2**), supporting our original proposition that onion residues are amenable to



Figure 2. Photograph of the shelf-stable microencapsulated MCFA feed powder using maltodextrin and gum arabic as carriers.

The results from this study were used to prepare a grant proposal to the non-profit organization ReFED in April, 2026, which was awarded $183,281 in funding, representing a ~9.5x return on investment (https://grantfund.refed.org/). The project will involve scaling up our fermentation process from lab- to pilot-scale, and conducting animal feed-in trials with beef/dairy cattle to determine the methane-reducing potential of the MCFA feed powder derived from onion waste and other fruits & vegetables.

We encountered several challenges in our initial attempts to bioconvert the onion waste. We found the onion waste inhibited the microbial community (*i.e.*, microbiome) underlying the fermentation process upon initial exposure. However, the microbiome eventually acclimated after approximately 7 days and began producing FAs and MCFAs at low levels (**Figure 3**). To determine the cause of inhibition, we ran a series of analytical assays to characterize the chemical composition of the onion waste. We deduced that various organosulphur compounds (*e.g.*, thiosulphanate) – a group of bactericidal compounds naturally present in the onions – were responsible for the microbial inhibition.

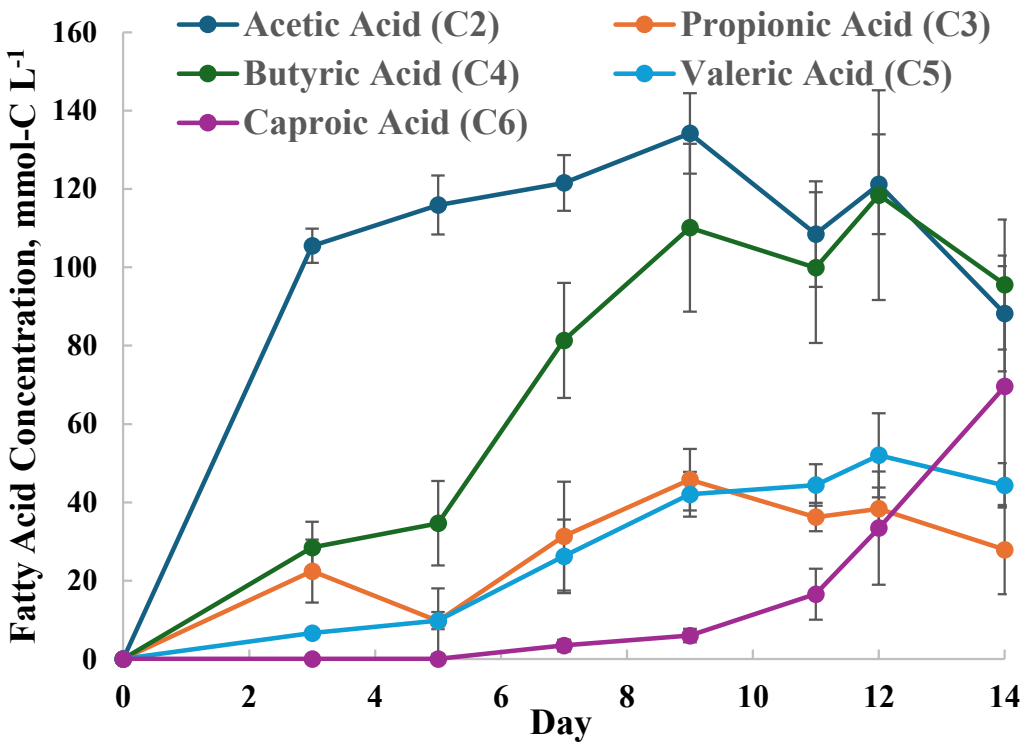


Figure 3. Production of short-chain (C2-C5) and medium-chain (C6) fatty acids during onion fermentation without pre-treatment.

To improve product yields, we tested a variety of low-cost thermochemical pretreatments on onion waste to mitigate the bactericidal effects of the organosulphur compounds. We determined that thermal pretreatment at 98°C, combined with alkali pretreatment (pH ≥ 9), effectively degrades thiosulfinate compounds and significantly improves MCFA product yields.

The addition of the specific methanogenic inhibitor, 2-bromoethanesulfonate (BES), at 1 g L^{-1}, also increased MCFA product yields by reducing carbon loss via methane. We then conducted a series of fermentation assays testing various operating parameters at multiple levels. We observed the highest yields at pH = 6, temperature = 37°C, oxidation-reduction potential (ORP) = < -450 mV, pH_2 = 1% *v/v*, and a substrate: inoculum ratio of 4:1 (VS-basis). The corresponding FA product distribution (*i.e.*, specificity) was: 27% acetic acid, 9% propionic acid, 29% *n*-butyric acid, 14% *n*-valeric acid, and 21% *n*-caproic acid (**Figure 4**).

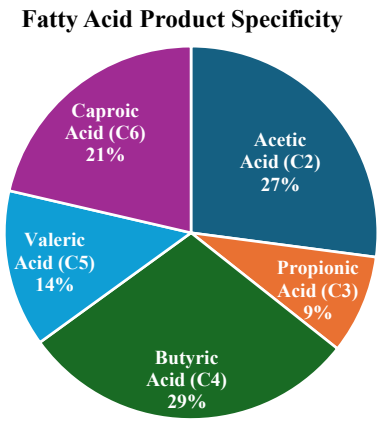


Figure 4. Distribution of fatty acids products from onion waste fermentation.

Process optimization and intensification work is still ongoing. The extent of process optimization will determine MCFA production margins, which, in turn, will determine the amount the fermentation plant operator would pay growers for their onion culls. Using the highest yields observed so far, we ran a preliminary techno-economic analysis (TEA) of an onion waste-to-MCFA fermentation plant (**Figure 5**).

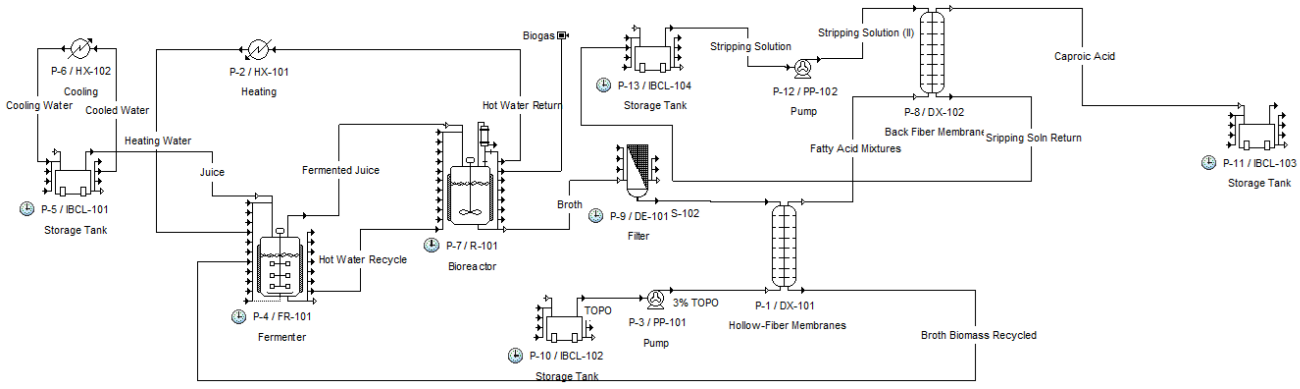


Figure 5. Process flow diagram of the onion waste-to-MCFA fermentation plant for use in the TEA.

The analysis is still in progress; however, we estimate growers could be paid approximately $0.015/lbs for culls. While the price point seems low, the result is highly encouraging given the early stage of R&D and the amount of room for further process optimization.

We also determined that the solid fraction of the onion waste was the primary technical bottleneck during fermentation, reducing yields and slowing processing throughput. Therefore, we separated the solid fraction and used only the liquid fraction (onion juice) for these preliminary trials. However, given that the low-moisture separated solid fraction represents >25% (w/w) of the original onion biomass, there is a tremendous opportunity to increase yields (and profit margins) using solid-state fermentation (SSF), while using the same liquid fermentation process to convert the juice. The advantage of SSF over liquid fermentation is that it can directly enrich biomass with FAs, thereby circumventing the cost of product extraction and purification (the major cost drivers). It also means we can create a fermentation-enriched 'feed-ready' product for livestock. MCFA-enriched feeds are of particular interest to the beef and dairy industries because they can increase feed efficiency while reducing enteric methane emissions.

Conclusions

This study demonstrated the technical feasibility of biologically upcycling Vidalia onion culls into higher-value fatty acid products through microbial fermentation, supporting the original objective of creating new value streams from below-grade onions. Although initial fermentation performance was limited by naturally occurring antimicrobial compounds in the onions and by challenges associated with processing the solid fraction, targeted pretreatment strategies and process optimization substantially improved product yields and enabled successful FA production.

These results suggest that onion culls may represent an underutilized economic resource rather than a disposal burden. Preliminary techno-economic analysis results indicate that growers could potentially receive additional revenue for culls under a future commercial-scale implementation, with opportunities for further value creation through continued process optimization and integration of solid-state fermentation approaches. Importantly, this work generated the preliminary data necessary to secure follow-on funding for pilot-scale development and bio-based product validation using onion culls as feedstock, positioning the Vidalia onion industry to participate in and benefit from emerging bio-based agricultural product markets.

Vidalia Growers' Labor Hiring Decisions and Business Viability Issues under Recent Adverse Effect Wage Rate Hikes

Cesar L. Escalante and Saurabh Sharma

Introduction

Given the dependence of Vidalia Onion growers on H-2A (Temporary Agricultural Worker Program) labor, a Master of Agribusiness (MAB) technical paper research partially funded by a VOC grant evaluated the business viability effects of recent changes made in the determination of **adverse effect wage rates** (AEWR), which is the H-2A guiding hiring wage. In October last year, the U.S. Department of Labor introduced a new Interim Final Rule (IFR) that restructured the AEWR system by introducing a skill-based wage classification. H-2A positions are now classified under two job skill categories. Skill Level 1 includes tasks that require no formal education or training and are performed under close supervision. Skill Level 2 includes tasks that require prior experience, training, or specialized skills and can be performed with limited supervision. The findings contribute to policy discussions and provide insights for growers, policy makers, and agricultural economists regarding labor policy and specialty crop profitability.

Materials and Methods

This study employs an enterprise budget framework to evaluate how changes in the AEWR determination methodology affect the profitability of Vidalia onion production. The enterprise budget used in this analysis allocates production costs into three major components: pre-harvest variable costs, harvest and marketing costs, and fixed costs, while revenue is calculated based on expected yield and market price. This framework allows labor wage rates to vary across scenarios while holding all other production costs constant. As a result, any changes in profitability can be attributed specifically to differences in AEWR wage policies rather than changes in yield, input prices, or production practices.

This study evaluates two wage policy systems: the old flat-rate AEWR system used prior to October 2, 2025, and the new skill-based AEWR system introduced by the U.S. Department of Labor under the Interim Final Rule (IFR) effective October 2, 2025. To capture the range of hiring decisions available to Vidalia onion producers, we developed seven different labor composition scenarios based on the share of H-2A workers employed. These scenarios include 0 percentage H-2A (all domestic labor), 50–50, 60–40, 70–30, 80–20, 90–10, and 100 percentage H-2A labor. Each of these seven scenarios is evaluated under both the old AEWR system and the new skill-based AEWR system, resulting in fourteen total cost and profitability scenarios. The

ten percentage increments between scenarios allow for a clear analysis of how production costs and profitability change as reliance on H-2A labor increases.

Three financial performance indicators are calculated for each scenario. The first indicator is total budgeted cost per acre, which represents the sum of all pre-harvest variable costs, harvest and marketing costs, and fixed costs. Fixed costs include depreciation on machinery, irrigation system expenses, and overhead and management costs, which amount to approximately 15 percentage of pre-harvest costs. Total budgeted cost per acre serves as the primary measure of the financial burden faced by growers under each scenario.

The second indicator is net return per acre, calculated as gross revenue minus total budgeted cost. Gross revenue is held constant at $13,110 per acre, calculated as the product of 570 boxes per acre and the expected market price of $23 per box. Net return per acre provides a direct measure of farm profitability and represents the most important financial indicator for grower decision-making and lender assessments of farm viability.

The third indicator is the break-even price per box, calculated by dividing total budgeted cost by expected yield of 570 Boxes/acre. This measure represents the minimum price that growers must receive to cover all production costs. A lower break-even price indicates greater financial resilience and the ability to withstand lower market prices without incurring losses.

Results

A direct comparison between the two wage systems reveals several important findings (**Table 1**). Across all hiring scenarios, the new skill-based AEWR system reduces total production costs by $852.55 per acre relative to the previous flat-rate system (**Figure 1**). Consequently, net returns increase by the same amount under every labor hiring scenario (**Figure 2**).

Table 1. Old and New AEWR system- cost and return comparison per acre

Scenario	H-2A%	Old Cost	New Cost	Cost Savings	Old Return	New Return	Return Gain	Old BE	New BE
All Domestic	0	8985.23	8132.68	-852.55	4124.77	4977.32	852.55	15.76	14.27
50-50	0.5	9336.63	8484.08	-852.55	3773.37	4625.92	852.55	16.38	14.88
60-40	0.6	9406.91	8554.36	-852.55	3703.09	4555.64	852.55	16.5	15.01
70-30	0.7	9477.19	8624.64	-852.55	3632.81	4485.36	852.55	16.63	15.13
80-20	0.8	9547.46	8694.91	-852.55	3562.54	4415.09	852.55	16.75	15.25
90-10	0.9	9617.74	8765.19	-852.55	3492.26	4344.81	852.55	16.87	15.38

All H-2A	1	9688.02	8835.47	-852.55	3421.98	4274.53	852.55	17	15.5

Note: All costs and returns are in U.S. dollars per acre. H-2A% refers to the proportion of total seasonal labor hours supplied by H-2A temporary agricultural workers, ranging from 0% (all domestic) to 100% (all H-2A). Cost Savings and Return Gain reflect the difference between the old flat-rate AEWR system and the new skill-based AEWR system. Old BE and New BE denote break-even price per box ($/box) calculated as total budgeted cost divided by expected yield of 570 boxes/acre. Gross revenue is held constant at $13,110/acre (570 boxes/acre × $23.00/box). The uniform $852.55/acre cost savings reflects wage reductions for Skill Level 1 tasks (plant setting, harvesting, and grading) under the October 2025 Interim Final Rule (IFR).

This cost reduction occurs primarily because the new wage system distinguishes between Skill Level 1 and Skill Level 2 tasks. Many of the labor activities involved in Vidalia onion production-such as plant setting, harvesting, and grading-fall into the Skill Level 1 category. Under the new policy, these tasks receive a lower wage rate than under the previous flat-rate system, which reduces overall labor costs.

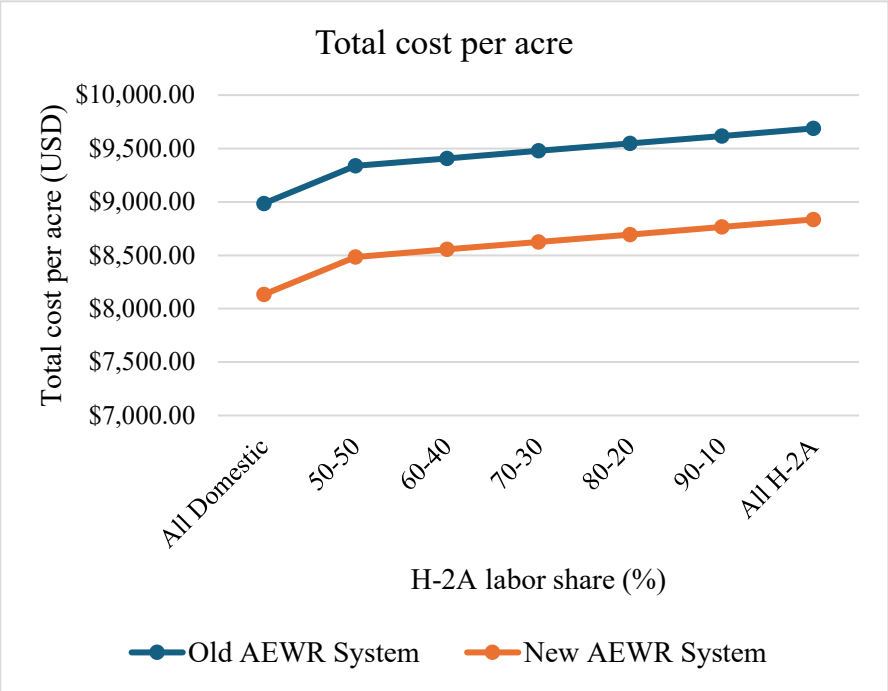


Figure 1. Total cost per acre comparison between the Old AEWR and New AEWR systems

Despite the reduction in base wage rates, the cost difference between domestic and H-2A workers remains unchanged. In both the old and new systems, the cost penalty associated with hiring H-2A workers remains $702.79 per acre when comparing all-domestic and all-H-2A

scenarios. This occurs because the additional $2.55 per hour fringe cost required for H-2A workers remains unchanged under the new policy.

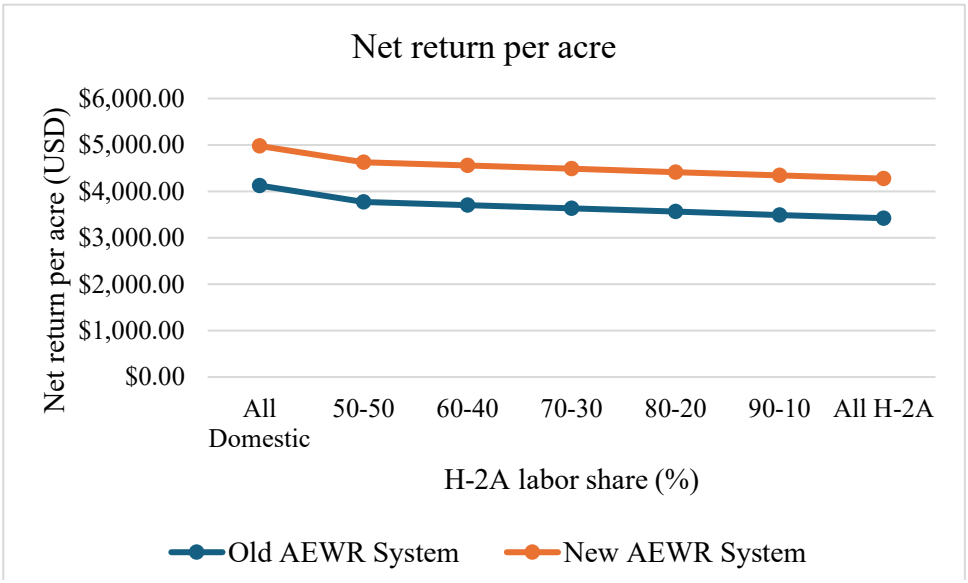


Figure 2. Net return per acre comparison between the Old and New AEWR systems

The break-even price comparison further illustrates these results (**Figure 3**). Under the old AEWR system, break-even prices range from $15.76 to $17.00 per box depending on the labor hiring scenario. Under the new skill-based system, break-even prices decline significantly, ranging from $14.27 to $15.50 per box. This reduction improves the financial resilience of Vidalia onion producers by lowering the minimum price required to cover production costs.

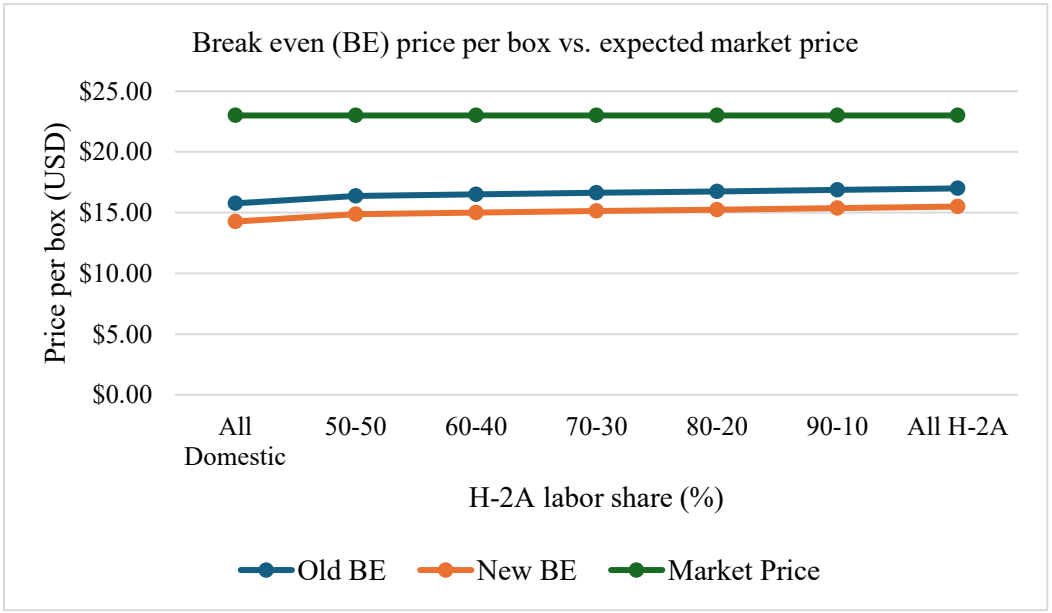


Figure 3. Comparison of break-even prices under the Old and New AEWR scenarios relative to the expected market price across all hiring scenarios.

Conclusions

The results of the analysis indicate that, across all labor hiring scenarios considered in this study, grower profitability improves under the new AEWR system. This improvement occurs because several key farm tasks fall under Skill Level 1, which carries a lower wage rate under the new methodology. As a result, the revised wage structure provides modest financial relief for growers who depend heavily on hired labor.

Despite these improvements, the new IFR does not eliminate the wage gap between domestic workers and H-2A workers. Because the H-2A program requires employers to provide additional benefits such as housing, transportation, and other support services, the effective cost of hiring H-2A workers remains higher than that of domestic labor. In labor-intensive sectors such as fruit and vegetable production, where H-2A workers perform the majority of field operations, these additional costs continue to place financial pressure on farm operations.

Furthermore, U.S. specialty crop producers face increasing competition from neighboring countries such as Mexico, where labor costs are substantially lower. This cost differential makes it difficult for U.S. growers to remain competitive in domestic and international markets. While the new AEWR methodology provides some relief to growers by reducing wage rates for certain tasks, broader policy considerations are still necessary.

Overall, the findings suggest that the new AEWR policy represents a positive step toward reducing labor cost pressures for agricultural producers. However, policymakers should continue to explore strategies that address the structural wage gap between domestic and H-2A labor while ensuring that the agricultural sector remains economically viable and globally competitive.

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