BELL PEPPER PHYTOPHTHORA RESISTANCE VARIETY TRIAL RESULTS IN NEW JERSEY – 2021

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Introduction:

Phytophthora blight caused by the pathogen *Phytophthora capsici* is one of the most economically important diseases of pepper in New Jersey. It was first identified in the early 1980's and is found in vegetable production fields throughout the state. Studies evaluating new phytophthora-resistant bell pepper breeding lines and cultivars have been done annually at the Rutgers Agricultural Research and Extension Center (RAREC) since at least 1995 in naturally infected field plots.

Materials and Methods:

One hundred twenty-eight cell trays were seeded on March 17th and entries transplanted June 10th in a randomized complete block design with four replications (18 plants/plot). The trial was established at the Rutgers Agricultural Research and Extension Center in Upper Deerfield, New Jersey on black plastic mulch with one drip line between double rows, 18 inches between plants, and 80 inches between beds center to center.

All cultural practices such as staking/tying, fertilization and pest management were carried out using standard recommendations except no fungicides were applied to control Phytophthora blight.

The entries were harvested 4 times starting 76 days after transplanting from August 25th to October 13th. Peppers were graded based on weight (extra-large >0.49 lbs., large 0.33 – 0.49 lbs., medium 0.25 – 0.32 lbs., commercials, and culls <0.25 lbs.). See Appendix 1 for images of all varieties.

Entries, seed company and reported disease resistance are listed in Table 1. Table 2 summarizes the monthly minimum, maximum and average temperatures, and rainfall for the season.

Table 1. Seed sources and disease resistance as report by the company.

Variety	Company	Disease Resistance[a]
Captain (HMC 1996)	Harris Moran	HR: Xcv: 1-10
Revolution	Harris Moran	HR: Xcv: 1,2,3,5; IR: Pc; IR: CMV
Mercer	Sakata	HR: TMV:0; Xcv 0-3, 7-8; IR: Pc
Nitro S10	Sakata	HR: TMV:0, IR: Xcv 0-10
Sailfish	Seedway	IR: Xcv 1-10; HR: Tm:0; IR: Pc
1819	Seminis	HR: Xcv: 0-5; IR: Pc
Aristotle X3R	Seminis	HR: PVY: 0, Tm: 0; Xcv: 0-3, 7, 8
Camelot X3R	Seminis	Xcv 1-3
Playmaker	Seminis	HR: Xcv: 0-10; HR: Tm:0
Tarpon	Seminis	HR:Tm:0, Xcv: 0-10; Pc
Turnpike	Seminis	HR: Tm; Xcv: 0-5, 7-9; IR: Pc
RPP 52214	Syngenta	Not known
RPP 52243	Syngenta	Not known
RPP 52254	Syngenta	Not known
Intruder	Syngenta	HR: Xcv: 1-3; IR: Pc
Paladin	Syngenta	HR: Pc

[a]PVY = Potato virus Y; TMV = Tobacco Mosaic Virus; TSWV = Tomato Spotted Wilt Virus; Tm = Tobamovirus; Xcv = Bacterial leaf spot race resistance; CMV = Cucumber mosaic virus; Pc = *Phytophthora capsici*, with HR = Highly resistant; IR = Intermediate resistance

Table 2. Summary of average, minimum and maximum temperatures (ºF), and total rainfall, Upper Deerfield, New Jersey May-October 2021.

Month	Average	Minimum	Maximum	Rainfall (inches)
May	68.1	38.8	91.8	3.22
June	77.3	51.3	95.2	2.91
July	80.1	58.5	93.0	8.50
August	80.6	57.9	94.6	4.07
September	75.4	48.9	87.7	4.31
October	75.7	43.2	83.5	3.77

Discussion:

‘Turnpike’ had the highest total marketable yield at the first harvest, but it was not statistically different from ‘1819’, Aristotle’ or ‘Mercer’. ‘Turnpike’ also had significantly more extra-large fruit than all other varieties. The phytothphora-suceptible control ‘Camelot’ and the resistant control ‘Paladin’ did not differ statistically for extra-large, large, medium, or total marketable yield. As a group, all entries had more large fruit compared to extra-large fruit. The variety ‘Sailfish’ was the only variety that had more medium fruit than large fruit (Table 3).

Table 3. Extra-Large, Large, and Medium Sized Fruit (in 28 Lb. Boxes per Acre); Percent Marketable Yield, and Total Marketable (Boxes per Acre) at First Harvest on 8/25/2021, Upper Deerfield, NJ.

Variety/Line	XL[1]		L		M		% Marketable		Total Marketable	
Trunpike	187.30	a[2]	325.47	ab	28.42	bc	95.29	ab	541.19	a
1819	120.31	b	343.55	a	64.72	abc	94.04	ab	528.59	ab
Aristotle X3R	70.79	bcd	339.53	a	51.18	abc	98.00	a	461.50	abc
Mercer	64.37	bcd	272.87	abc	44.08	abc	94.37	ab	381.31	a-d
Revolution	104.36	bcd	225.06	b-e	32.12	bc	92.58	ab	361.54	bcd
Captain	57.37	cde	271.70	abc	25.93	c	89.32	b	354.99	cde
Paladin	46.93	def	237.60	a-d	47.45	abc	96.06	ab	331.98	c-f
Playmaker	28.49	def	203.31	c-f	89.68	ab	96.40	a	321.48	c-f
Intruder	26.93	def	200.65	c-f	49.36	abc	92.42	ab	276.95	d-g
RPP52243	4.89	ef	156.64	def	104.14	a	94.26	ab	265.67	d-g
Camelot X3R	25.28	def	133.60	d-g	29.98	bc	92.69	ab	188.86	efg
Nitro	3.47	ef	130.94	d-g	54.13	abc	97.73	a	188.53	efg
Tarpon	1.75	ef	127.63	efg	51.44	abc	98.79	a	180.82	fg
RPP52214	4.67	ef	122.77	fg	45.31	abc	97.44	a	172.75	fg
RPP52254	3.37	f	108.32	g	56.72	abc	93.99	ab	168.41	fg
Sailfish	0.00	f	26.80	g	98.27	a	96.10	ab	125.07	g
LSD	**56.75**		**108.09**		**63.13**		**6.84**		**167.37**	

[1]XL = Extra-Large; L = Large; M = Medium

[2]Within columns, means followed by different letters are significantly different

At the second harvest, ‘Mercer’ had the the highest yield, but was not statistically different from all other entries except ‘1819’ and Sailfish’ in which both had the lowest yields. ‘Sailfish’ continued to have more medium size fruit compared to the other varieites. ‘1819’ had the highest yield of extra-large fruit but was not significantly different compared to ‘Paladin’, ‘Turnpike’, ‘Aristotle’, ‘Intruder’, ‘Revolution’ or ‘Mercer’.

Table 4. Extra-Large, Large, and Medium Sized Fruit (in 28 Lb. Boxes per Acre); Percent Marketable Yield, and Total Marketable (Boxes per Acre) at Second Harvest on 09/07/2021, Upper Deerfield, NJ.

Variety/Line	XL[1]		L		M		% Marketable		Total Marketable	
Mercer	16.89	abc[2]	203.34	a	81.67	a-d	89.42	bc	301.87	a
Revolution	28.16	ab	182.44	ab	72.54	a-d	91.63	abc	283.14	ab
RPP52214	11.99	bc	162.60	ab	94.44	ab	94.10	ab	269.04	ab
Intruder	27.74	ab	155.54	ab	79.28	a-d	88.59	bc	262.24	ab
Camelot X3R	9.95	bc	163.03	ab	78.82	a-d	91.59	abc	251.80	ab
RPP52243	0.00	c	134.08	abc	99.21	a	92.93	ab	233.29	ab
RPP52254	3.60	c	165.39	ab	58.27	a-d	96.32	ab	227.26	ab
Nitro	1.75	c	139.56	abc	85.18	abc	96.31	ab	226.52	ab
Aristotle X3R	17.76	abc	129.29	abc	61.00	a-d	95.06	ab	208.04	ab
Playmaker	3.40	c	122.97	abc	76.68	a-d	92.92	cd	203.05	ab
Turnpike	16.56	abc	145.43	abc	31.86	cd	96.67	ab	193.85	ab
Tarpon	1.69	c	115.58	abc	73.83	a-d	96.86	ab	191.09	ab
Paladin	20.81	abc	124.23	abc	40.22	bcd	89.64	bc	185.26	ab
Captain	5.61	bc	121.96	abc	42.46	bcd	73.96	d	170.03	ab
1819	36.56	a	99.92	bc	29.07	d	93.50	ab	165.55	b
Sailfish	1.72	c	48.52	c	106.05	a	98.96	a	156.28	b
LSD	**23.50**		**97.58**		**54.85**		**9.07**		**135.02**	

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'Camelot', the phytophthora-susceptible control, had the highest total yield at the third harvest, but was not statistically different from 'Mercer', 'Intruder' or 'RPP52243'. There continued to be more large fruit than extra-large or medium as was the case for the previous harvests. 'Sailfish' continued to have the highest yield of medium fruit and was statistically different from all other entries except 'Camelot' and 'Intruder'.

Table 5. Extra-Large, Large, and Medium Sized Fruit (in 28 Lb. Boxes per Acre); Percent Marketable Yield, and Total Marketable (Boxes per Acre) at Third Harvest on 09/21/2021, Upper Deerfield, NJ.

Variety/Line	XL[1]		L		M		% Marketable		Total Marketable	
Camelot X3R	5.41	abc[2]	88.42	a	45.57	a	84.94	b-f	139.40	a
Mercer	3.37	bc	78.47	ab	22.43	bcd	85.91	b-f	104.27	ab
Intruder	9.53	abc	54.90	abc	29.33	abc	79.51	ef	93.76	abc
RPP52243	13.87	abc	63.14	abc	11.73	cd	94.36	a-d	88.74	abc
Turnpike	15.04	ab	62.23	abc	6.68	d	96.67	ab	83.94	bc
RPP52214	3.24	bc	65.73	abc	14.65	cd	94.53	abc	83.62	bc
1819	18.73	a	38.83	bc	10.01	cd	93.32	c-f	67.58	bc
Tarpon	1.75	bc	52.64	abc	12.48	cd	93.07	a-d	66.86	bc
Playmaker	10.53	abc	49.85	abc	6.42	d	93.36	a-d	66.80	bc
Paladin	6.71	abc	54.77	abc	4.08	d	91.33	def	65.57	bc
Sailfish	0.00	c	24.66	c	37.05	ab	93.29	a-d	61.71	bc
Aristotle X3R	2.11	bc	49.17	abc	7.81	d	96.61	ab	59.08	bc
Nitro	8.46	abc	39.54	bc	10.21	cd	87.70	a-e	58.21	bc
Revolution	13.39	abc	31.63	c	9.27	cd	87.43	a-f	54.29	bc
RPP52254	5.80	abc	37.95	bc	7.07	d	100.00	a	50.82	bc
Captain	3.37	bc	29.88	c	6.94	d	74.40	f	40.19	c
LSD	**14.32**		**45.12**		**21.25**		**13.11**		**54.28**	

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For the Fourth harvest, ‘Playmaker’ had a statistically higher yield than all other entries. It also had the highest extra-large fruit, but it was not statistically different from ‘1819’, and ‘Turnpike’.

Table 6. Extra-Large, Large, and Medium Sized Fruit (in 28 Lb. Boxes per Acre); Percent Marketable Yield, and Total Marketable (Boxes per Acre) at Fourth Harvest on 10/13/2021, Upper Deerfield, NJ.

Variety/Line	XL[1]		L		M		% Marketable		Total Marketable	
Playmaker	48.55	a[2]	130.62	a	41.13	a	98.63	a	220.30	a
Aristotle X3R	15.82	cde	106.37	ab	34.65	abc	100.00	a	156.84	b
Revolution	23.27	bcd	77.04	bc	19.80	bcd	94.21	ab	120.11	bc
1819	30.95	abc	70.10	c	18.54	bcd	94.96	ab	119.60	bc
Turnpike	39.90	ab	61.22	c	16.43	cd	96.51	ab	117.55	bc
Tarpon	6.74	de	82.42	bc	23.24	a-d	97.51	a	112.40	bc
Mercer	12.71	cde	76.39	bc	20.94	bcd	90.32	b	110.03	bc
RPP52254	19.09	cd	55.71	cd	24.67	a-d	98.35	a	99.47	c
Sailfish	0.00	e	60.58	c	36.79	ab	100.00	a	97.36	c
Intruder	9.04	de	53.45	cde	31.15	abc	93.32	ab	93.63	cd
Paladin	19.61	cd	54.90	cd	19.09	bcd	94.91	ab	93.60	cd
RPP52243	17.02	cde	53.06	cde	18.67	bcd	96.30	ab	88.74	cd
RPP52214	9.72	de	54.09	cde	18.60	bcd	98.32	a	82.42	cde
Camelot X3R	8.52	de	21.07	de	18.571	bcd	76.72	c	48.16	de
Nitro	8.20	de	23.01	de	9.205	d	95.36	ab	40.42	e
Captain	10.17	de	19.35	e	8.848	d	100.00	a	38.37	e
LSD	**18.85**		**37.78**		**19.43**		**7.09**		**48.21**	

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'Turnpike' had the highest total marketable yield, but it was not statically different from 'Mercer', 'Aristotle', '1819' 'Revolution' or 'Playmaker'. It also had the highest extra-large fruit yield and was significantly higher than all other entries except '1819'. 'Sailfish' had the lowest yield, but did not differ from 'Nitro', 'RPP52254' or 'Tarpon'. 'Sailfish' continued to produce more medium size fruit as compared to extra-large or large fruit. This variety would probably only fit into a market for smaller size fruit.

Table 7. Extra-Large, Large, and Medium Sized Fruit (in 28 Lb. Boxes per Acre); Percent Marketable Yield, and Total Marketable (Boxes per Acre) for all Harvests in 2021, Upper Deerfield, NJ.

Variety/Line	XL[1]		L		M		% Marketable		Total Marketable	
Turnpike	258.80	a[2]	594.35	ab	83.39	g	96.16	abc	936.54	a
Mercer	97.33	cde	631.07	a	169.09	cde	91.50	cd	897.49	a
Aristotle X3R	106.47	cd	624.36	a	154.63	cde	97.43	ab	885.46	ab
1819	206.55	ab	552.41	abc	122.35	efg	92.49	bcd	881.31	ab
Revolution	169.18	bc	516.17	a-d	133.73	d-g	91.18	cd	819.08	abc
Playmaker	90.98	c-f	506.74	a-d	213.91	bc	94.69	abc	811.63	abc
Intruder	72.92	d-g	464.54	cde	189.12	bcd	89.28	d	726.58	bcd
RPP52243	35.78	d-g	406.92	def	233.75	ab	93.08	bcd	676.44	cde
Paladin	94.06	c-f	471.51	b-e	110.84	efg	93.01	bcd	676.41	cde
Camelot X3R	49.17	d-g	406.11	def	172.94	b-e	89.44	d	628.22	def
RPP52214	29.62	d-g	405.20	def	173.01	b-e	95.53	abc	607.83	def
Captain	76.52	d-g	442.89	c-f	84.17	gf	83.87	e	603.58	ef
Tarpon	11.93	fg	378.27	ef	160.98	cde	97.15	ab	551.18	efg
RPP52254	31.86	d-g	367.38	ef	146.72	def	96.02	abc	545.96	efg
Nitro	21.88	e-g	333.08	f	158.72	cde	95.52	abc	513.68	fg
Sailfish	1.72	g	160.56	g	278.15	a	98.75	a	440.43	g
LSD	**82.56**		**126.92**		**63.23**		**5.08**		**158.89**	

[1]XL = Extra-Large; L = Large; M = Medium

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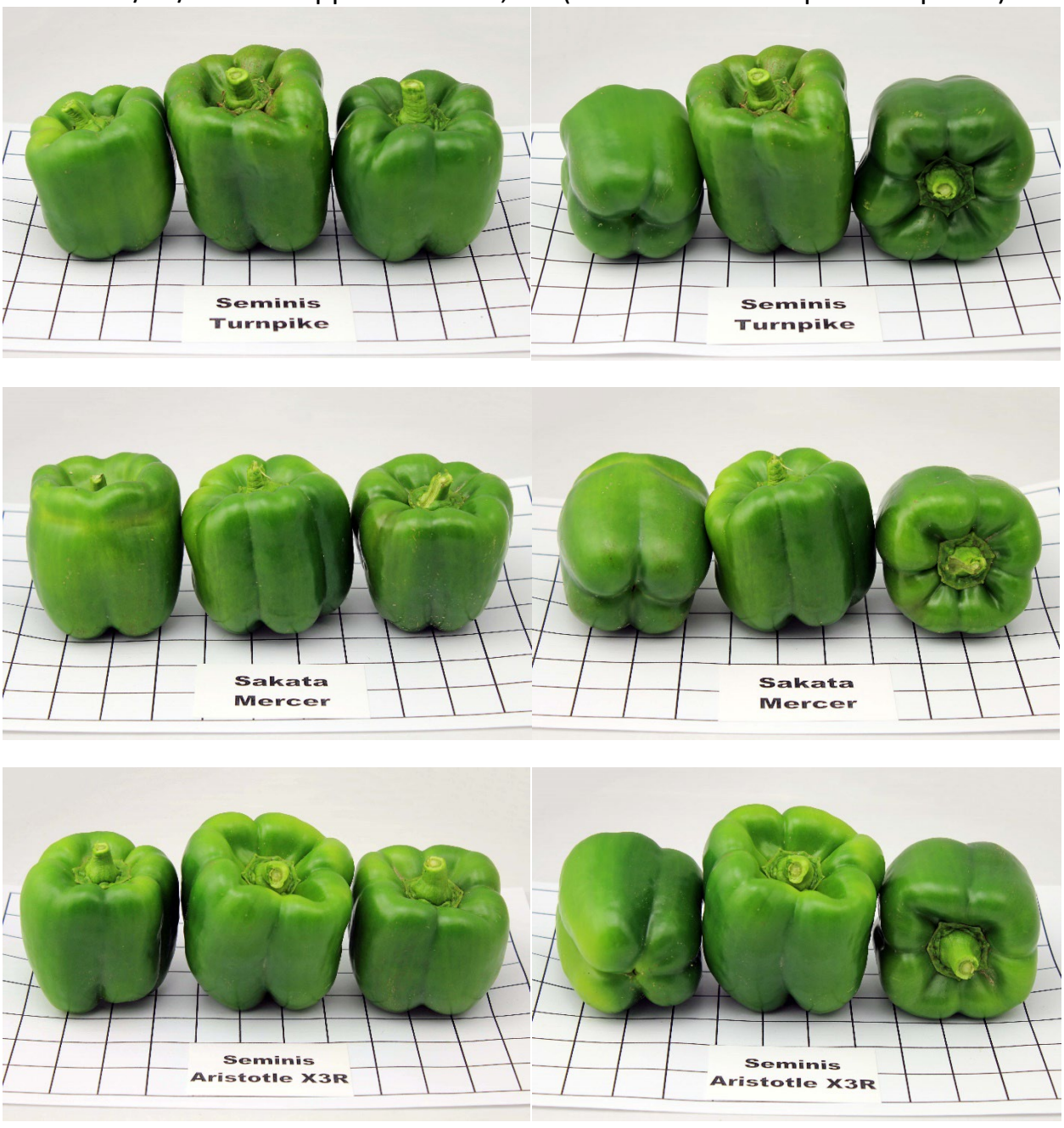
Phytophthora blight pressure was considered very low during the season. Plots were visually rated every 7 to 10 days for phytophthora-killed plants and the average number of healthy or plants killed by the end of the production season were calculated (Table 8).

Table 8. Variety, Bacterial Leaf Spot (BLS) resistance, phytophthora blight (Phyto-R) resistance, and the average number of healthy and phytophthora-killed plants at RAREC in 2021.

			Means	
Variety	BLS	Phyto-R	% Healthy plants	% Phyto-killed plants
Sailfish	X10R	IR	100	0
Revolution	1,2,3,5	IR	100	0
Tarpon	X10R	IR	100	0
Playmaker	X10R	R	100	0
Paladin	none	R	100	0
Aristotle X3R	0-3, 7, 8	R	99	1
Turnpike	0-5,7-9	R	99	1
Intruder	1,2,3	IR	99	1
RPP52214	no info	no info	97	3
Captain	X10R	R	94	6
1819	1,2,3,4,5	IR	91	9
Mercer	0-3, 7, 8	IR	90	10
RPP52243	no info	no info	89	11
RPP52254	no info	no info	88	13
Nitro	X10R	IR	85	15
Camelot X3R	1,2,3	none	81	19

Appendix 1. Images of cultivars and breeding lines taken at harvest two of the BLS trial on 08/30/2021 at Upper Deerfield, NJ. (Note: One-inch squares in photo)



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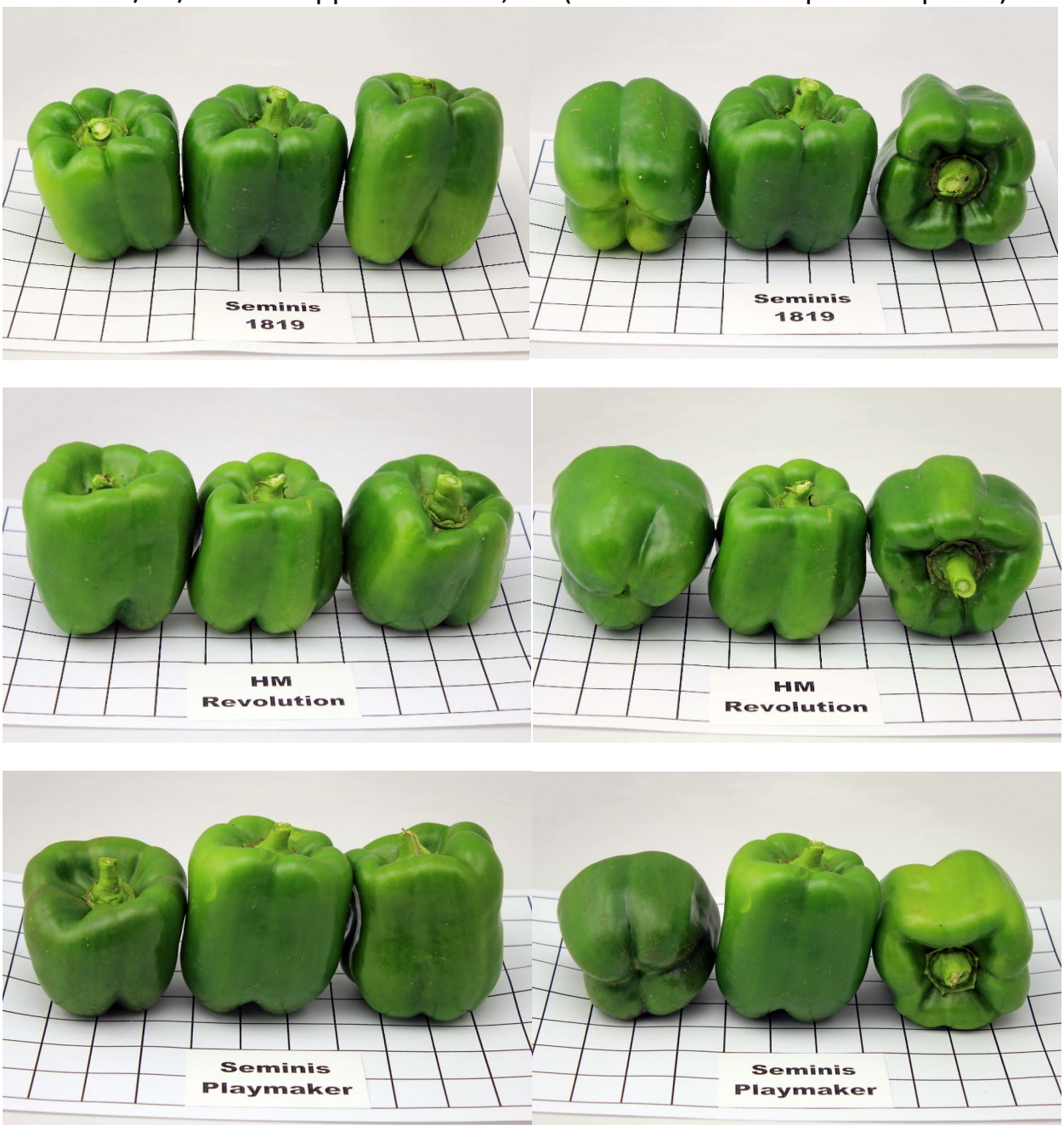

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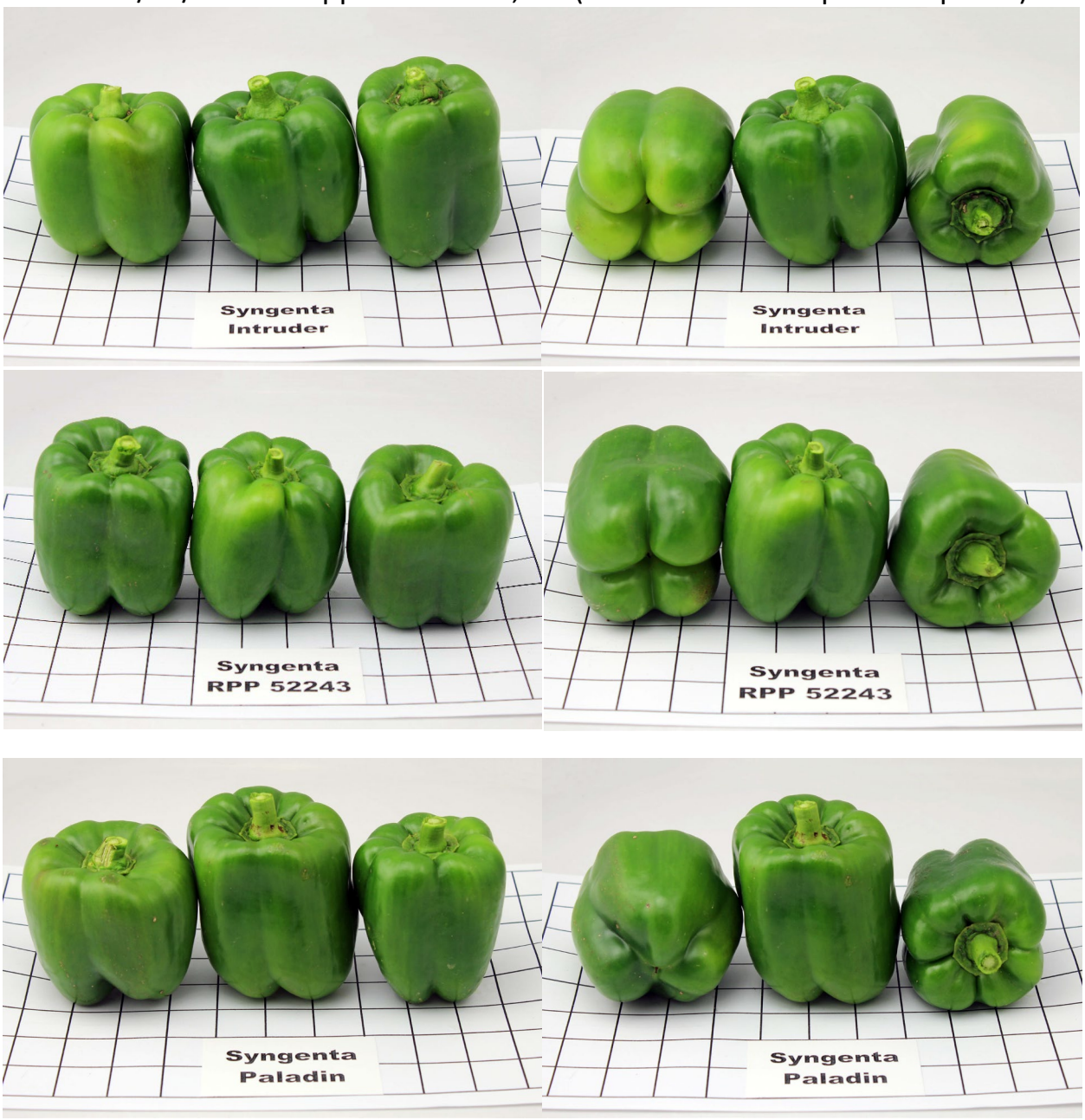

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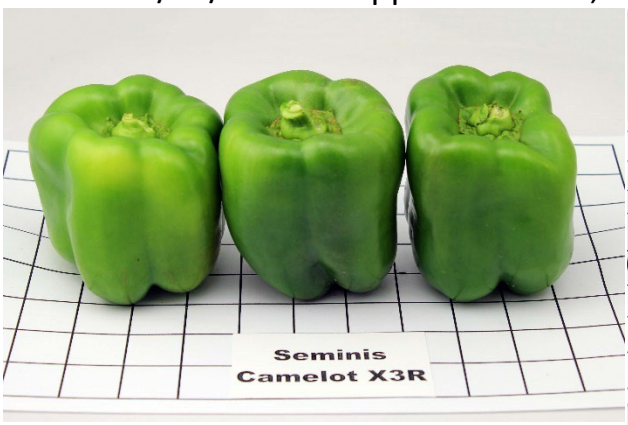

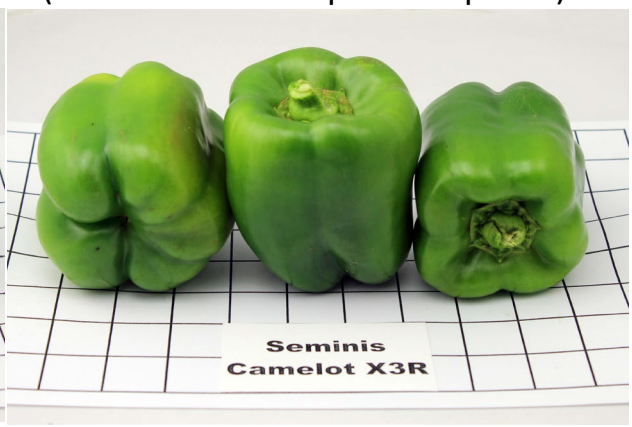

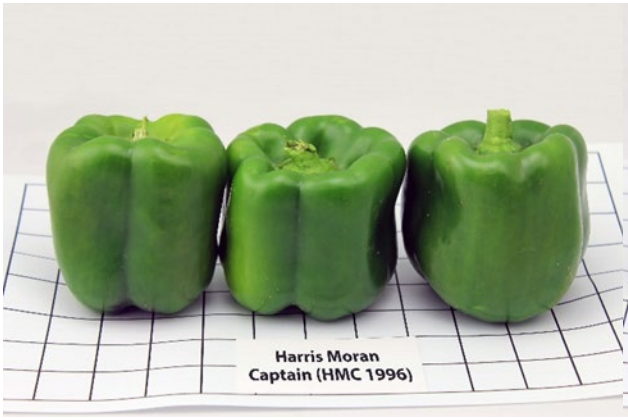

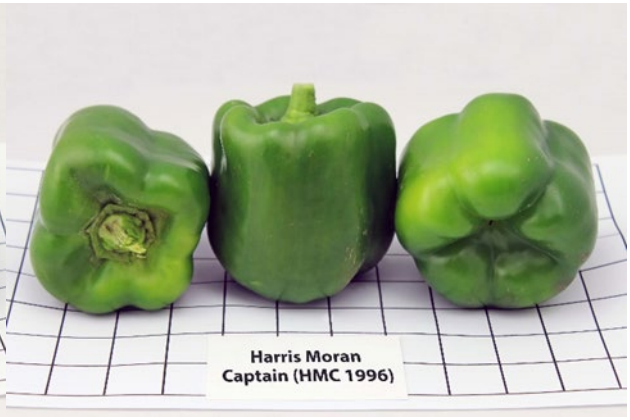

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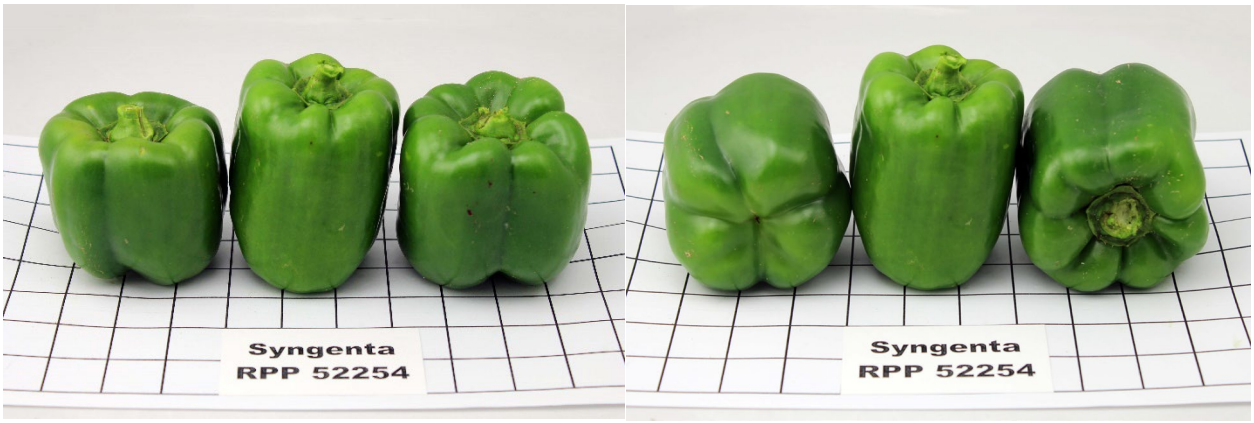

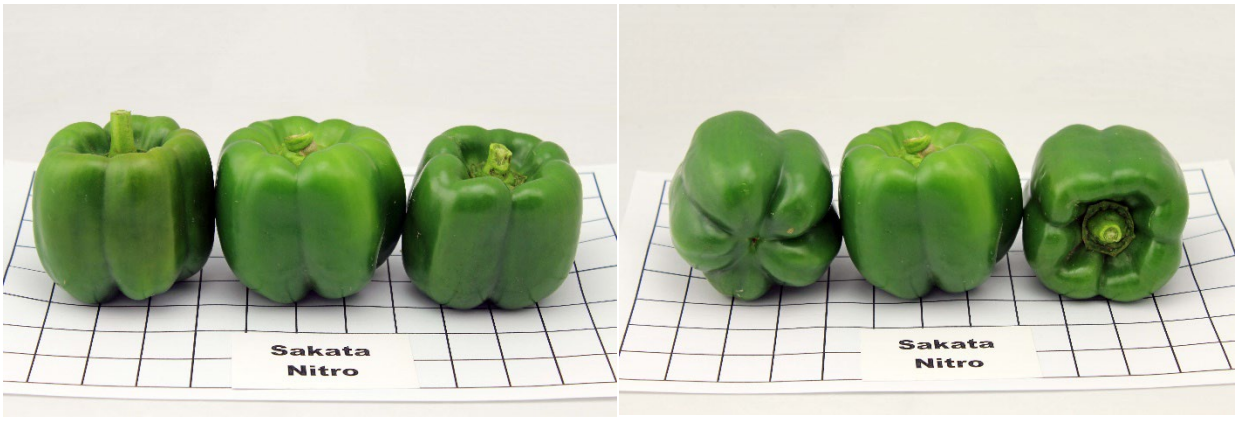

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