Muck Vegetable Cultivar Trial & Research Report 2021

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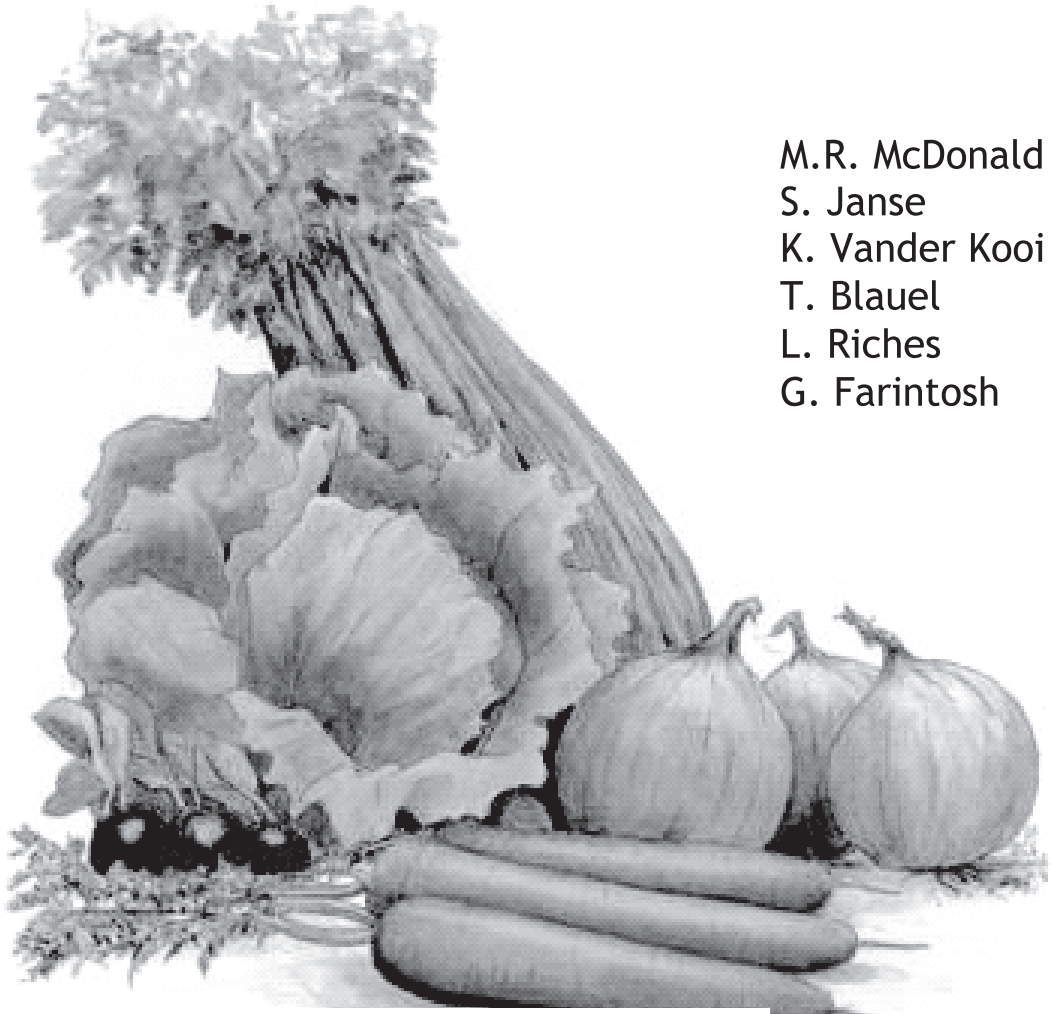
S. Janse
K. Vander Kooi
T. Blauel
L. Riches
G. Farintosh



UNIVERSITY of GUELPH

Office of Research &
Dept. of Plant Agriculture
Report No. 71

Ontario Crops
Research Centre
Bradford, Ontario

Research and Cultivar Trial Report for 2021

University of Guelph
Ontario Crops Research Centre - Bradford
Office of Research &
Department of Plant Agriculture
Muck Crops Research Station

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STAFF - 2021

UNIVERSITY OF GUELPH
Ontario Crops Research Centre - Bradford
Office of Research and
Department of Plant Agriculture

MUCK CROPS RESEARCH STATION

Staff:

Shawn Janse	Research Station Manager
Mary Ruth McDonald, Ph.D., P.Ag.	Research Scientist
Kevin Vander Kooi	Agricultural Technician
Geoff Farintosh	Agricultural Technician
Laura Riches	Agricultural Technician
Miško Mitrović	Agricultural Assistant
Tyler Blauel	IPM Supervisor / Research Associate
Afsaneh Sedaghatkish	Post Doctoral Fellow

IPM Scouts:

Tori Baxter	Andrew Knoop

Seasonal Contracts:

Luke Burleigh	Summer Assistant
Thomas Jarko	Summer Assistant
Mickaela Junck	Summer Assistant
Madalena Liougas	Summer Assistant
Julia Scicluna	Summer Assistant

Graduate Students:

Emily McFaul	Department of Plant Agriculture
Umbrin Ilyas	Department of Plant Agriculture
Shauna Chesney	Department of Plant Agriculture
Michael Kooy	Department of Plant Agriculture

CO-OPERATING COMPANIES 2021

Special thanks for supplying seed used in many of the research projects at the Muck Crops Research Station.

Stokes Seed Ltd	Bridget Visser
Bejo Seeds Inc.	Jan Van Der Heide
Seminis Seeds	Ron Garton

CO-OPERATING RESEARCH STAFF - EDUCATION/RESEARCH/GOVERNMENT

Clarence Swanton	Dept. of Plant Agriculture, University of Guelph, ON, Canada
Peter Smith	Dept. of Plant Agriculture, University of Guelph, ON, Canada
Alan Taylor	Dept. Horticultural Science, Cornell University, NY, USA
Phil Simon	USDA/ARS, Madison, WI, USA
Dennis Van Dyk	Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph, ON, Canada

CO-OPERATING RESEARCH STAFF - INDUSTRY/PRIVATE SECTOR

Matt Sheppard	Bradford Cooperative Storage Ltd, Bradford, ON, Canada
Alan Butterfield	California Fresh Carrot Advisory Board, Dinuba, CA, USA
Dan Brotslaw	California Garlic & Onion Research Advisory Board, Clovis, CA, USA
Laura Smith	Corteva Agriscience, Winnipeg, MB, Canada
Tom Miedema	Fresh Vegetable Growers of Ontario, Ridgetown, ON, Canada
Inna Teshler	Suncor AgroScience, Suncor Energy Inc., Mississauga, ON
Colin Smith	Sylvar Technologies Inc, Fredericton, NB, Canada
Tessa de Boer	Syngenta Canada Inc., Plattsville, ON, Canada

SEED SOURCES - 2021 - CULTIVAR TRIALS

Bejo **Bejo Seeds Inc.**, 1088 Healey Road, Geneva, New York, 14456, U.S.A.
Tel: (308) 789-4155

CF **Clifton Seed Company**, P.O. Box 206, Faison, North Carolina, 28341, U.S.A.
Tel: (800) 231-9359

Cro **Crookham Company**, P.O. Box 520, Caldwell, Idaho, 83606, U.S.A.
Tel: (208) 459-7451

EZ **Enza Zaden**, 360 St Patrice, Sherrington, Quebec, J0L 2N0, Canada
Tel: (518) 390-2837

Haz **Hazera Seeds**, 3155 SW 10th Street, Suite 6L, Deerfield Beach, Florida, 33442, U.S.A.
Tel: (954) 429-9445

ILL **Illinois Foundation Seeds Inc**, 1083 County Road 900N, Tolono, IL, 61880, U.S.A.
Tel: (217) 485-6260

Pure **Pure Line Seeds Inc**, 222 S Wisconsin Dr, Jefferson, WI, 53549, U.S.A.
Tel: (509) 349-2374

Nor **Norseco**, 2914 Boul. Cure-Labelle, Laval, Quebec, H7P 5R9, Canada
Tel: (514) 332-2275

Sem **Seminis Vegetable Seeds,** 2700 Camino Del Sol, Oxnard, California, 93030, U.S.A.
Tel: (866) 334-1056

SN **Seminova,** 20 rue de l'Industrie, C.P. 3640, St-Remi, Quebec, J0L 2N0, Canada
Tel: (450) 454-5155

Sto **Stokes Seed Ltd.**, 296 Collier Rd, Box 10, Thorold, Ontario, L2V 5E9, Canada
Tel: (800) 396-9238

Tak **American Takii Inc.**, 301 Natividad Rd., Salinas, California, 93906, U.S.A.
Tel: (408) 443-4901

Vil **Vilmorin Inc.**, 2551 N Dragoon Street # 131, Tucson, Arizona, 85745, U.S.A.
Tel: (520) 884-0011

We would like to thank our seed suppliers for the various cultivar trial submissions in 2021.

LEGEND OF SEED SOURCES

Bejo Bejo Seeds Inc.

BCSVS Bayer Crop Science Vegetable Seeds

CF Clifton Seed Company

Cro Crookham Company

EZ Enza Zaden

Haz Hazera Seeds Inc

HM Harris Moran Seeds

ILL Illinois Foundation Seeds

Pure Pure Line Seeds

Nor Norseco Inc.

Rog Rogers Seed

RZ Rijk Zwaan Export B.V.

Sak Sakata Seed America Inc.

Sem Seminis Vegetable Seeds

Sieg Siegers Seed Co.

Sol Solar Seed Co.

Sto Stokes Seeds Ltd.

SN Seminova

Swy Seedway Inc.

Toz Tozer Seeds America

Tak American Takii Inc.

UNF Co-op Uniforce

Vil Vilmorin Inc.

INTRODUCTION AND ACKNOWLEDGMENTS

The Muck Crops Research Station, as part of the Department of Plant Agriculture and the Office of Research, University of Guelph, is responsible for conducting and coordinating research projects to solve problems in the production of vegetables grown in organic soils.

In 2021, Muck Crops Research Station staff conducted, and/or co-operated on research projects with researchers from the Department of Plant Agriculture and School of Environmental Sciences at the University of Guelph; researchers from OMAFRA, Agriculture and Agri-Food Canada, and Cornell University; research departments of the Crop Production Chemical Industry, numerous seed companies, growers' organizations and growers.

This report consists of two sections: the first contains highlights of research projects which were conducted in 2021 under the supervision of Professor Mary Ruth McDonald and other researchers at the University of Guelph. The second section contains highlights of various muck crops cultivar evaluations in 2021 in-field and storage trials, under the supervision of the Research Station Manager, Shawn Janse. The results published in this report should be treated as a progress report. Some of the chemicals used in the trials are not registered for use on the crops they were applied to. Additional trials may be necessary before firm conclusions and recommendations can be made.

The Muck Crops Research Station is an active participant in the training of new researchers on muck vegetables through the Graduate Student Program of the University of Guelph. Presently the Muck Crops Research Station has two M.Sc. and one Ph.D. graduate students working on muck vegetables.

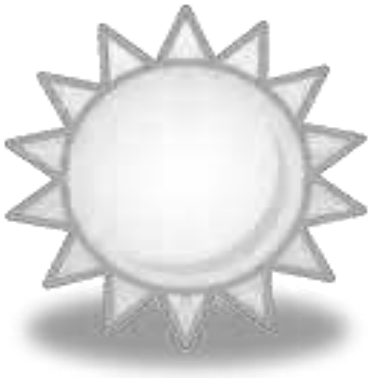
The Muck Crops Research Station continues to conduct research to assist in the future registration of chemicals for muck vegetables. Recently, research programs have aided in the registration of Chateau herbicide for onions (Dr. Clarence Swanton) and the registration of Delegate and Movento for thrips on onions and Evergol Prime (penflufen) for onion smut (Dr. Mary Ruth McDonald).

We would like to take this opportunity to express our sincere appreciation to the staff for their efforts in conducting these research projects, cultivar evaluation trials and producing this report. Many thanks also to all the co-operating researchers, technicians, industry personnel, and growers for their continued support and interest in muck crops.

Mary Ruth McDonald, Ph.D., P.Ag.
Professor
Department of Plant Agriculture

Shawn Janse
Research Station Manager
Office of Research

Weather Data 2021



PRECIPITATION

Month	2011		2012		2013		2014		2015		2016	
	Rain mm	Snow cm	Rain mm	Snow cm	Rain mm	Snow cm	Rain mm	Snow cm	Rain mm	Snow cm	Rain mm	Snow cm
January	15	38	39	13	36	16	28	19	0	15	23	2
February	17	40	15	19	17	58	19	45	0	32	29	12
March	56	21	30	2	12	6	9	16	10	5	80	30
April	75	0	51	0	82	4	82	2	48	0	22	18
May	92	0	49	0	112	0	58	0	40	0	45	0
June	68	0	55	0	94	0	88	0	171	0	39	0
July	56	0	140	0	104	0	92	0	36	0	51	0
August	113	0	69	0	87	0	63	0	79	0	58	0
September	67	0	94	0	83	0	113	0	27	0	25	0
October	83	0	123	0	92	0	67	0	54	0	41	0
November	85	1	32	0	24	15	24	5	40	0	40	5
December	49	4	35	14	29	40	11	22	39	3	20	65
Annual	**776**	**104**	**732**	**48**	**772**	**139**	**654**	**109**	**544**	**55**	**473**	**132**
Total Precip.	**880**		**780**		**911**		**763**		**599**		**605**	

LTA = Long Term Average for U of Guelph, Dept. of Plant Agriculture - Kettleby
1125 Woodchoppers Lane, King, ON, L7B 0E9 47 Years (1975-2021)

PRECIPITATION

Month	2017		2018		2019		2020		2021		LTA	
	Rain mm	Snow cm	Rain mm	Snow cm	Rain mm	Snow cm	Rain mm	Snow cm	Rain mm	Snow cm	Rain mm	Snow cm
January	61	14	34	25	14	52	84	24	4	22	21	27
February	28	23	28	32	14	43	0	44	5	44	19	27
March	54	8	21	14	39	17	42	5	34	3	31	14
April	87	12	117	12	89	0	30	0	44	4	57	4
May	120	0	82	0	77	0	38	3	22	0	72	0
June	209	0	59	0	100	0	77	0	56	0	80	0
July	74	0	104	0	93	0	58	0	105	0	84	0
August	53	0	109	0	80	0	140	0	41	0	80	0
September	38	0	20	0	61	0	65	0	173	0	80	0
October	99	0	69	0	74	0	61	0	77	0	69	1
November	22	11	63	31	27	31	27	22	24	13	51	10
December	2	32	44	10	44	40	29	39	36	21	26	28
Annual	**847**	**100**	**750**	**124**	**712**	**183**	**651**	**138**	**621**	**107**	**670**	**111**
Total Precip.	**947**		**874**		**895**		**789**		**728**		**782**	

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MEAN TEMPERATURE (°C)

Month	2011		2012		2013		2014		2015		2016	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	-3.0	-14.2	1.3	-6.9	2.1	-6.3	-3.9	-14.7	-3.2	-13.1	0.4	-7.8
February	-0.8	-11.3	2.7	-5.6	-1.0	-10.3	-2.2	-17.3	-8.2	-19.8	1.9	-8.3
March	3.7	-5.6	12.7	-0.1	3.7	-4.3	1.9	-12.2	2.7	-7.4	6.6	-2.8
April	12.7	1.2	12.5	0.0	11.4	0.7	11.9	0.3	13.0	0.8	10.3	-1.7
May	19.8	8.4	23.4	8.4	21.8	7.6	20.9	6.6	23.5	8.3	21.2	6.3
June	24.8	12.0	26.9	13.2	24.2	12.8	27.1	11.6	23.8	11.8	26.2	11.1
July	30.1	15.5	29.7	14.7	27.5	15.1	25.9	12.5	28.1	13.3	28.8	15.3
August	26.9	13.4	27.0	13.1	26.7	12.4	25.8	12.5	25.7	13.2	29.6	15.5
September	22.6	10.6	21.7	8.0	22.4	8.1	22.8	8.5	25.9	12.1	24.8	10.0
October	15.4	4.7	14.6	4.8	16.3	4.6	15.3	5.5	14.6	3.9	15.9	5.9
November	11.1	1.1	7.3	-1.4	6.6	-3.2	5.2	-1.0	10.8	0.6	11.5	0.9
December	3.7	-3.9	3.8	-3.4	-1.0	-9.4	2.0	-2.9	6.9	-0.1	1.3	-5.8
Mean	**13.9**	**2.7**	**15.3**	**3.7**	**13.4**	**2.3**	**12.7**	**0.8**	**13.6**	**2.0**	**14.9**	**3.2**

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MEAN TEMPERATURE (°C)

Month	2017		2018		2019		2020		2021		LTA	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	0.8	-5.2	3.3	-3.2	-3.7	-12.3	0.9	-6.5	-0.5	-6.9	**-2.2**	**-10.7**
February	3.7	-5.0	1.7	-7.7	-0.4	-9.9	-0.1	-8.3	-1.6	-11.6	**-1.2**	**-10.5**
March	3.4	-5.0	2.9	-4.5	2.8	-6.0	6.6	-1.6	8.7	-3.7	**3.5**	**-5.4**
April	14.4	3.4	7.0	-1.9	5.8	1.3	10.0	0.0	12.6	2.3	**11.3**	**1.1**
May	17.3	7.2	23.4	9.0	16.5	6.3	17.4	5.7	19.9	5.2	**19.2**	**6.8**
June	24.1	12.8	25.1	12.2	23.5	11.6	26.4	12.0	27.0	15.2	**24.2**	**11.7**
July	26.4	14.9	28.4	15.0	29.3	15.4	29.6	16.9	25.2	14.2	**26.8**	**14.2**
August	25.2	12.6	27.8	16.9	26.3	12.4	26.8	14.3	28.9	15.5	**25.7**	**13.1**
September	25.0	9.6	23.7	11.3	21.6	9.6	21.3	8.7	22.1	9.5	**21.3**	**9.1**
October	17.2	5.8	12.2	3.8	14.8	4.3	12.6	3.6	16.8	8.7	**13.9**	**3.9**
November	7.3	-1.8	3.3	-3.2	4.0	-3.9	10.7	1.5	7.5	-1.6	**6.8**	**-0.9**
December	-2.0	-11.6	1.7	-4.3	2.2	-6.7	1.7	-4.0	3.8	-3.0	**0.6**	**-6.5**
Mean	**13.6**	**3.1**	**13.4**	**3.6**	**11.9**	**1.8**	**13.7**	**3.5**	14.2	3.7	**12.5**	**2.2**

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EXTREME TEMPERATURE (°C)

Month	2011 H	2011 L	2012 H	2012 L	2013 H	2013 L	2014 H	2014 L	2015 H	2015 L	2016 H	2016 L
January	11.7	-28.7	7.9	-20.3	14.0	-22.4	8.3	-30.4	5.3	-21.4	10.3	-19
February	9.7	-24.8	9.2	-17.3	6.5	-23.8	7.6	-30.2	-1.8	-30.8	15.4	-28.8
March	14.8	-14.8	26.4	-15.6	12.3	-10.3	12.9	-27.8	12.9	-26.3	18.5	-14.7
April	23.5	-3.0	25.7	-5.9	24.7	-7.4	23.4	-7.3	22.7	-5.1	26.2	-15.3
May	28.3	-0.2	34.9	1.1	31.3	0.0	31.9	-0.1	30.8	-1.2	33.2	-1.6
June	33.4	5.2	35.5	7.6	33.4	6.1	32.7	2.8	29.1	4.1	34.2	3.1
July	36.3	6.8	35.3	9.7	35.3	7.6	31.4	6.5	34.2	7.2	35.1	8.4
August	31.5	8.5	32.6	6.4	31.7	7.3	32.6	5.7	32.8	6.9	34.8	9.8
September	30.8	5.4	29.9	1.7	35.3	-0.5	32.1	0.1	34.1	4.3	34.2	1.2
October	29.2	-3.6	23.5	-4.7	24.7	-5.7	24.4	-1.5	23.9	-3.1	25.8	-3.5
November	19.2	-6.6	18.5	-5.8	16.0	-19.0	16.6	-10.3	22.1	-6.8	19.1	-6.5
December	14.3	-19.6	15.1	-12.7	15.9	-25.3	10.5	-11.1	15.4	-8.1	9.1	-15.9
Annual High & Low	**36.3**	**-28.7**	**35.5**	**-20.3**	**35.3**	**-25.3**	**32.6**	**-30.4**	**34.2**	**-30.8**	**35.1**	**-28.8**

Extreme Temperatures for U of Guelph, Dept. of Plant Agriculture - Kettleby
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EXTREME TEMPERATURE (°C)

Month	2017 H	2017 L	2018 H	2018 L	2019 H	2019 L	2020 H	2020 L	2021 H	2021 L	EXTREME TEMPERATURES H	Year	L	Year
January	7.2	-16.8	11.4	-28.6	6.6	-23.5	10.5	-24.1	7.3	-22.3	15.8	2005	-36.0	1977
February	16.7	-14.8	14.7	-21.7	11.2	-23.4	8.9	-25.4	6.4	-24.9	16.7	2017	-33.0	1979
March	14.8	-17.3	10.3	-11.7	11.6	-18.7	17.4	-18.7	21.0	-15.8	26.4	2012	-29.0	1984
April	26.6	-1.6	18.8	-8.3	14.4	-6.4	17.2	-5.6	23.0	-5.5	30.0	1990	-15.3	2016
May	31.5	1.1	30.6	-1.0	24.2	-0.3	33.3	-5.4	32.2	-0.8	34.6	2006	-5.4	2020
June	32.6	4.5	33.2	5.9	31.4	2.8	33.6	3.6	34.0	4.6	35.5	1988	-2.0	1977
July	30.8	10.5	35.3	8.6	34	9.3	35.1	11.5	31.3	7.9	36.3	2011	2.5	1984
August	30.4	5.3	33.1	10.9	30.8	6.8	32.3	8.0	33.1	7.9	36.3	2001	0.5	1982
September	34.6	1.1	33.4	1.9	29.9	1.0	28.0	-1.3	26.7	4.6	35.3	2013	-6.5	1991
October	26.0	-1.6	28.7	-3.3	27.2	-2.4	24.4	-6.1	27.0	-0.6	30.0	89 & 07	-9.0	1975
November	22.6	-14.4	14.5	-25.3	11.5	-19.1	24.0	-7.4	19.2	-13.2	24.0	1990	-25.3	2018
December	12.1	-29.0	11.0	-12.4	8.9	-21.6	8.6	-13.1	16.9	-14.9	20.0	1982	-31.5	1980
Annual High & Low	**34.6**	**-29.0**	**35.3**	**-28.6**	**31.4**	**-23.5**	**35.1**	**-25.4**	**33.1**	**-24.9**	**36.3**		**-36.0**	

Extreme Temperatures for U of Guelph, Dept. of Plant Agriculture - Kettleby
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GROWING DEGREE DAYS (5°C Base)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	LTA
January	1	0	9	0	0	1	0	2	0	1	0	**1**
February	0	0	0	0	0	8	8	7	2	0	0	**1**
March	5	123	8	0	1	31	12	0	2	17	41	**15**
April	74	54	78	63	79	56	123	25	19	42	102	**76**
May	282	338	304	271	337	273	220	348	200	220	234	**242**
June	403	450	405	431	390	409	404	410	375	426	483	**388**
July	552	533	507	443	480	528	486	518	535	567	455	**478**
August	472	467	450	438	456	543	431	531	446	483	533	**444**
September	348	295	306	320	419	372	368	375	323	300	324	**305**
October	163	145	177	171	141	188	203	108	142	109	240	**133**
November	69	15	28	30	72	67	20	11	2	80	20	**32**
December	6	11	4	4	22	2	1	2	2	0	10	**4**
Annual	**2375**	**2431**	**2276**	**2171**	**2397**	**2478**	**2276**	**2338**	**2048**	**2245**	**2442**	**2119**

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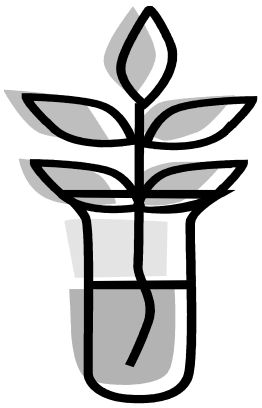

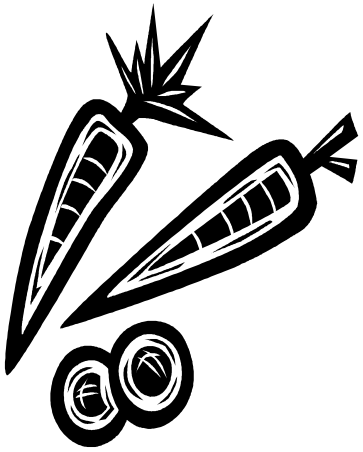

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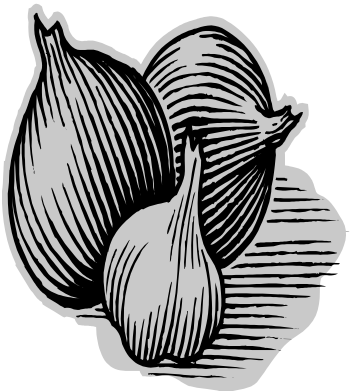

CROP: Carrot (*Daucus carota* subsp. *sativus* (Hoffm.) Arcang.), cv. Cellobunch
PEST: Root-knot nematode (*Meloidogyne hapla*) Chitwood, 1949

AUTHORS: BLAUEL T, VANDER KOOI K and MCDONALD M R
U of Guelph, Dept. of Plant Agriculture, Ontario Crops Research Centre - Bradford

TITLE: FIELD EVALUATIONS OF NEMATICIDES FOR ROOT-KNOT NEMATODE CONTROL IN CARROTS, 2021

MATERIALS: NIMITZ (fluensulfone 480 g/L), REKLEMEL (fluazaindolizine 500 g/L), VYDATE (oxamyl 240 g/L)

METHODS: The trial was conducted in a commercial field naturally infested with northern root-knot nematode (RKN; *Meloidogyne hapla*) in the Holland/Bradford Marsh, Ontario. A randomized complete block design with five replicates per treatment was used. The treatments were: NIMITZ at 4.0 L/ha, REKLEMEL at 1.12, 2.24 and 4.48 L/ha, VYDATE at 2.3 and 9.3 L/ha, and two combinations of REKLEMEL and VYDATE which were REKLEMEL at 2.24 L/ha + VYDATE at 2.3 L/ha and REKLEMEL at 1.12 L/ha + VYDATE at 9.3 L/ha. All treatments were applied to the soil surface using a CO_2 backpack sprayer fitted with TeeJet 8003 flat fan nozzles at the rate of 200 L/ha and were incorporated into carrot hills at seeding. An untreated check was also included. Carrots, cv. Cellobunch, were direct seeded at 65 seeds/m on raised beds on 2 June. Each experimental unit consisted of three rows, 66 cm apart and 8 m in length. Twelve 15 cm soil cores were taken from each plot to create one soil sample before application, 4 weeks after application (4 WAA) and at harvest for nematode analysis. Nematodes were extracted at the University of Guelph Ontario Crops Research Centre - Bradford using the Baermann pan method. Carrot emergence was recorded on 22 and 29 June, phytotoxicity was recorded on 22 and 29 June and 15 July, and vigor was recorded on 29 June and 15 and 29 July.
Carrots were hand harvested from two 1.5 m sections of row on 27 October and placed in cold storage until assessment on 3 November. Carrot samples were assessed for nematode damage (stunting and forking) and sorted using the Becker root galling scale (0-10), where: 0 = no nematode damage; 1 = few small galls, difficult to find; 2 = small galls only but clearly visible, main roots clean; 3 = some larger galls visible, minimal forking on main root; 4 = larger galls predominate, minor forking; 5 = many galls, minor forking and stunting; 6 = galls easily present, carrots forked or stunted; 7 = carrots forked and/or stunted, some galled roots; 8 = major forking and/or stunting, galled roots, few clean roots visible; 9 = significant forking and/or stunting, heavily galled roots, plant usually dying; 10 = all roots severely damaged, no root. Marketable yield was also determined from the harvest samples. Carrots in classes 0 to 3 were considered marketable and carrots in classes 4 to 10 were considered unmarketable. The damage severity index (DSI) was determined using the following equation:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of carrots in each class})]}{(\text{total no. of carrots per sample})\ (\text{no. of classes} - 1)} \times 100$$

Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C), August (22.2°C) and October (12.8°C), average for September (15.8C), and below average for July (19.7°C). The 10-year average temperatures were: June 18.6°C, July 21.7°C, August 20.2°C, September 16.4°C and October 9.8°C.
Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm), average for October (77 mm) and below average for June (56 mm) and August (41 mm). The 10-year rainfall averages were: June 94 mm, July 75 mm, August 83 mm, September 59 mm and October 78 mm.

Data were analyzed using the General Analysis of Variance function of the Linear Analysis section of Statistix V.10. Means separation was obtained using Tukey's HSD test with $P = 0.05$ level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSIONS: Root-knot nematode counts four weeks after nematicide treatment were significantly lower for all REKLEMEL and VYDATE treatments compared to the check and NIMITZ treatment. The REKLEMEL and VYDATE treatments were also the only treatments with negative reproduction ratios when comparing the pre-plant and 4 WAA nematode counts. No other significant differences were observed for nematode counts or reproduction ratios among the treatments at the other sampling periods (Table 1). No phytotoxicity or differences in vigor were observed in the trial. There were no significant differences among the treatments at harvest (Table 2). Overall, root-knot nematode populations were low which contributed to low damage in the trial. It is important to note that the treatment threshold for RKN on carrot is 1/kg soil.

Table 1. Root-knot nematode (RKN) soil counts and reproduction ratios from carrot soil at prior to planting, four weeks after nematicide application (4 WAA) and at harvest in the Holland Marsh, Ontario, 2021.

Treatment	Rate (L/ha)	Root-Knot Nematode Counts (RKN/kg soil)			Reproduction Ratio [1] (Pre-4 WAA)	Reproduction Ratio (Pre-Harvest)	Reproduction Ratio (4 WAA-Harvest)
		Pre-plant	4 WAA	Harvest			
Check	-	36 ns[2]	36 a[3]	36 ns	0.37 ns	-0.03 ns	0.00 ns
REKLEMEL	4.48	36	4 bc	4	-0.75	-0.75	0.00
REKLEMEL + VYDATE	2.24 + 2.3	32	4 bc	12	-0.60	-0.36	0.20
REKLEMEL + VYDATE	1.12 + 9.3	28	8 bc	0	-0.70	-1.00	-0.40
REKLEMEL	1.12	24	4 bc	184	-0.40	1.70	-0.20
VYDATE	9.3	20	0 c	0	-0.60	-0.60	0.00
VYDATE	2.3	16	4 bc	0	-0.40	-0.60	-0.20
REKLEMEL	2.24	12	8 bc	60	-0.20	-0.10	-0.40
NIMITZ	4.0	8	28 ab	16	0.00	-0.20	-0.30

[1] Reproduction ratio = (final population – initial population)/initial population

[2] ns indicates no significant differences were found among the treatments at $P = 0.05$, Tukey's HSD test

[3] Numbers in a column followed by the same letter are not significantly different at $P = 0.05$, Tukey's HSD test

Table 2. Percent marketable, marketable yield, percent nematode damage and damage severity index (DSI) for carrots, cv. Cellobunch, grown in root-knot nematode infested soil treated with nematicides in the Holland Marsh, Ontario, 2021.

Treatment	Rate (L/ha)	% Marketable Carrots	Marketable Yield (t/ha)	% Nematode Damage	DSI[1]
REKLEMEL	4.48	85.2 ns[2]	49.9 ns	14.8 ns	12.7 ns
REKLEMEL + VYDATE	2.24 + 2.3	84.5	50.8	15.5	13.4
Check	-	84.2	51.6	15.8	14.6
VYDATE	9.3	84.0	47.6	16.0	14.0
NIMITZ	4.0	82.4	47.7	17.6	16.1
VYDATE	2.3	82.0	44.1	18.0	14.8
REKLEMEL + VYDATE	1.12 + 93	81.0	47.1	19.0	15.1
REKLEMEL	2.24	79.7	48.2	20.3	16.1
REKLEMEL	1.12	72.9	44.0	27.1	23.3

[1] DSI was calculated using the following equation:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of carrots in each class})]}{(\text{total no. of carrots per sample})\ (\text{no. of classes} - 1)} \times 100$$

[2] ns indicates no significant differences were found among the treatments at $P = 0.05$, Tukey's HSD test.

Funding for this project was provided by Corteva Agriscience.

CROP: Carrot (*Daucus carota* subsp. *sativus* (Hoffm.) Arcang.), cv. Envy
PESTS: Cavity spot, stunting, forking (*Pythium intermedium* de Bary, *Pythium irregulare* Buisman, *Pythium sulcatum* Pratt & Mitchell, *Pythium sylvaticum* W.A. Campbell & J.W. Hendrix, *Pythium ultimum* Trow and *Pythium violae* Chesters & C.J. Hickman)

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TITLE: EVALUATION OF FUNGICIDES AS SEED TREATMENTS AND DRENCHES TO CONTROL PYTHIUM DISEASES IN CARROTS, 2021

MATERIALS: RIDOMIL 1G (metalaxyl-M & S-isomer 1%), PRESIDIO (fluopicolide 39.5%), PICARBUTRAZOX 10 SC (picarbutrazox 100 g/L), VAYANTIS (picarbutrazox 400 g/L), TORRENT 400 SC (cyazofamid 34.5%)

RATIONALE: The Pythium species found in the Holland Marsh may be resistant to Ridomil. New products currently used in soybean and potato production may reduce damage from *Pythium* spp. plant pathogens in carrot production. Picarbutrazox is available as a foliar formulation and as a new seed treatment called Vayantis.

METHODS: The trial was conducted at the Ontario Crops Research Centre – Bradford, Ontario in muck soil (organic matter ≈ 71.7%, pH ≈ 5.8) known to be infested with *Pythium* spp. A randomized complete block design with four replicates per treatment was used. Each experimental unit consisted of two rows, 86 cm apart and 6 m in length. Seed treatments were: VAYANTIS at 2.5 g a.i./100 kg seed (cv. Envy), applied using a tabletop laboratory seed treater, six drops of methyl cellulose and 1 mL of various rates of stock solutions of VAYANTIS. Drench treatments were: PICARBUTRAZOX 10 SC at 3.0 L/ha, TORRENT 400 SC at 0.44 L/ha, PRESIDIO at 0.29 L/ha and RIDOMIL 1G at 25 kg/ha (13 g/6 m row) and RHIZOVITAL 42 at 0.5 L/ha. An untreated check was also included. All carrot seeds, (treated and untreated) were direct seeded at 70 seeds/m into raised beds using a push cone seeder on 7 June. Drench treatments were applied on 2 June in a 13-15 cm band over the row after seeding using a CO_2 backpack sprayer fitted with a single TeeJet XR8004 nozzle in a water volume of 300 L/ha, followed by 7 mm of irrigation water. Two 1.16 m long sections of row were randomly chosen and staked out to be used as harvest plots. The number of emerged plants in the staked-out sections were recorded. For a mid-season assessment, 25 carrots were harvested and assessed on 1 September. Carrots were hand-washed, visually examined for cavity spot lesions, and sorted into classes based on the size of the largest lesion (measured as horizontal length). The six classes were: 0 = no disease, 1 = very light (< 1 mm), 2 = light (1-2 mm), 3 = medium (3-5 mm), 4 = heavy (6-10 mm), and 5 = very heavy (> 10 mm).
On 1 October, carrots from the two 1.16 m staked-out sections of row were harvested by hand and placed in cold storage. On 26 November carrots were removed from storage, graded for size into the following categories: jumbo (>4.4 cm), medium (1.9-4.4 cm), and culls (<1.9 cm). Fifty carrots from the medium or jumbo categories were set aside after grading to be used for the cavity spot assessment. On 26 November, carrots were visually examined and sorted into classes as described for the mid-season assessment. The disease severity index (DSI) was determined using the above classes and the following equation:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of carrots in each class})]}{(\text{total no. of carrots per sample})\ (\text{no. of classes} - 1)} \times 100$$

Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C

and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm. Data were analyzed using the General Analysis of Variance function of Statistix V.10. Means separation was obtained by using Fisher's Protected LSD test at P = 0.05 level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSION: Cavity spot pressure and percent forking was relatively low in this trial. No significant differences in the percentage of forking or cavity spot incidence or severity were found among the treatments at either the midseason or late assessment dates (Table 1).
No significant differences in total or marketable yield or in the percentage of marketable carrots were found among the treatments (Table 2).

Table 1. Cavity spot incidence, severity and percent forked for carrots, cv. Envy, treated with various seed treatments and drench applications and grown in muck soil infested with *Pythium* spp. at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment	Midseason (1 Sept)			Harvest (20 Oct)		
	Incidence (%)	DSI[1]	% Forked	Incidence (%)	DSI	% Forked
PICARBUTRAZOX High	50.4 ns[2]	21.9 ns	4.9 ab	23.4 ns	8.5 ns	7.6 ns
VAYANTIS 2.5 (seed trt)	51.0	20.8	6.0 ab	24.5	7.5	11.1
TORRENT	51.0	21.2	3.0 a	27.3	9.8	8.7
PRESIDIO	48.0	22.4	12.0 c	15.9	5.9	10.4
RIDOMIL	38.0	14.0	9.0 bc	25.3	7.5	10.5
Untreated	43.0	18.8	7.0 abc	34.1	12.0	11.5

[1] DSI was calculated using the following equation:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of carrots in each class})]}{(\text{total no. of carrots per sample})\ (\text{no. of classes} - 1)} \times 100$$

[2] ns indicates no significant differences were found among the treatments.
[3] Numbers in a column followed by the same letter at not significantly different at P = 0.05, Fisher's Protected LSD test

Table 2. Yield and percent marketable for carrots, cv. Envy, treated with VAYANTIS seed treatments or drench applications of various fungicides grown at the Ontario Crops Research Centre – Bradford, Ontario, 2021.

Treatment	Marketable Yield (t/ha)	% Marketable
PICARBUTRAZOX High	54.5 ns[1]	92.3ns
VAYANTIS 2.5 (seed trt)	45.8	86.7
TORRENT	52.5	90.2
PRESIDIO	49.9	77.5
RIDOMIL	51.7	90.2
Untreated	50.5	87.6

[1] ns indicates no significant differences were found among the treatments.

Funding for this project was provided by the Ontario Agri-Food Innovation Alliance, the Bradford Cooperative and Storage, Ltd. and the Fresh Vegetable Growers of Ontario.

CROP: Carrot (*Daucus carota* subsp. *sativus* (Hoffm.) Arcang.), cv. Envy
PESTS: Cavity spot, stunting, forking (*Pythium intermedium* de Bary, *Pythium irregulare* Buisman, *Pythium sulcatum* Pratt & Mitchell, *Pythium sylvaticum* W.A. Campbell & J.W. Hendrix, *Pythium ultimum* Trow and *Pythium violae* Chesters & C.J. Hickman)

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TITLE: EVALUATION OF FUNGICIDES APPLIED IN-FURROW TO CONTROL PYTHIUM DISEASES IN CARROTS, 2021

MATERIALS: ROOT SHIELD (*Trichoderma harzianum* strain T-22), RIDOMIL GOLD 480 SL (metalaxyl-M & S-isomer 480g/L), PICARBUTRAZOX 10 SC (picarbutrazox 100 g/L) HICAL Grade F LIMESTONE (calcium oxide 54.5 %)

METHODS: The trial was conducted at the Ontario Crops Research Centre – Bradford, Ontario in muck soil (organic matter ≈ 71.7%, pH ≈ 5.8) known to be infested with *Pythium* spp. A randomized complete block design with four replicates per treatment was used. Each experimental unit consisted of three rows, 66 cm apart and 8 m in length. Treatments were: RIDOMIL GOLD at 0.65 L/ha and PICARBURAZOX at 3 L/ha, ROOT SHEILD 2.25 kg/ha and HICAL LIMESTONE at 5 t/ha. Carrots (cv. Envy) were direct seeded at 70 seeds/m into raised beds using a Stanhay Precision seeder on 7 June. HICAL LIMESTONE was broadcast over the treatment plots prior to seeding and incorporated into the soil prior to seeding. RIDOMIL GOLD, PICARBUTRAZOX and ROOT SHIELD treatments were applied directly over the seed using StreamJet nozzles SJ3-030VP on the seeder using a water volume of 254 L/ha. Two assessment plots 1.5 m in length were set up in the middle of the three rows of each replicate. Stand counts were done in each assessment plot once the carrots were established. On 2 September, a mid-season assessment of 25 consecutive carrots were harvested, hand washed and visually examined for cavity spot lesions, and sorted into classes based on the size of the largest lesion (measured as horizontal length). The six classes were: 0 = no disease, 1 = very light (< 1 mm), 2 = light (1-2 mm), 3 = medium (3-5 mm), 4 = heavy (6-10 mm), and 5 = very heavy (> 10 mm). On 8 November, carrots from the two staked out 1.5 m sections of row were harvested by hand and placed into storage. On 7 December, carrots were removed from storage, washed in a small drum washer and graded for size into the following categories: jumbo (>4.4 cm), medium (1.9-4.4 cm), and culls (<1.9 cm). Fifty healthy carrots were set aside for the cavity spot assessment and sorted into classes as described for the mid-season assessment.
The disease severity index (DSI) was determined using the above classes and the following equation:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of carrots in each class})]}{(\text{total no. of carrots per sample})\ (\text{no. of classes} - 1)} \times 100$$

Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C), August (22.2°C) and October (12.8°C), average for September (15.8C) and below average for July (19.7°C). The 10-year average temperatures were: June 18.6°C, July 21.7°C, August 20.2°C, September 16.4°C and October 9.8°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm), average for October (77 mm) and below average for June (56 mm) and August (41 mm). The 10-year rainfall averages were: June 94 mm, July 75 mm, August 83 mm, September 59 mm and October 78 mm.
Data were analyzed using the General Analysis of Variance function of Statistix V.10. Means separation was obtained by using Fisher's Protected LSD test at P = 0.05 level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSION: Cavity spot incidence and severity, and percent forking was low in this trial. No significant differences in cavity spot incidence and severity were found among the treatments at the midseason assessments (Table 1). At harvest, all treatments expect ROOT SHIELD had lower cavity spot incidence and DSI compared to the untreated check. (Table 1). There were no significant differences in marketable yield found among the treatments (Table 2).

Table 1. Cavity spot incidence, severity (DSI) and percent forked for carrots, cv. Envy, grown in muck soil infested with *Pythium* spp. at the Ontario Crops Research Centre – Bradford, Ontario, 2021.

Treatment	Midseason[1]			Harvest[2]		
	Incidence (%)	DSI[3]	% Stunted or Forked	Incidence (%)	DSI	% Stunted or Forked
HICAL LIMESTONE	30 ns[4]	9.8 ns	7.0 ns	19.0 a[5]	5.5 a	8.6 ns
ROOT SHEILD	36	13.2	4.0	28.0 ab	7.9 ab	4.8
RIDOMIL	37	12.3	2.0	25.5 a	7.0 a	7.1
PICCARBUTRAZOX	46	14.7	0.0	23.5 a	6.1 a	5.6
Untreated	52	18.7	9.0	36.0 b	10.1 b	5.2

[1] Mid-season assessment was conducted on a 25-carrot sample on 2 September.
[2] Harvest assessments were conducted carrots on 50 carrots on 7 December.
[3] DSI was calculated using the following equation:

$$DSI = \frac{\sum [(\text{class no.})\ (\text{no. of carrots in each class})]}{(\text{total no. of carrots per sample})\ (\text{no. of classes} - 1)} \times 100$$

[4] ns indicates no significant differences were found among the treatments.
[3] Numbers in a column followed by the same letter at not significantly different at P = 0.05, Fisher's Protected LSD test

Table 2. Marketable yield size distribution for carrots, cv. Envy, treated with fungicides applied in-furrow and grown at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment	MKB Yield (t/ha)	% Medium (1.9 – 4.4 cm)	% Jumbo (> 4.4 cm)
HICAL LIMESTONE	56.4 ns[1]	82.7 ns	6.4 ns
ROOT SHEILD	59.7	86.5	5.2
RIDOMIL	56.5	87.8	3.1
Untreated	68.3	90.1	2.5
PICARBUTRAZOX	64.2	85.7	7.5

[1] ns indicates no significant differences were found among the treatments.

Funding for this project was provided by the Ontario Agri-Food Innovation Alliance, the Bradford Cooperative and Storage, Ltd. and the Fresh Vegetable Growers of Ontario.

CROP: Carrots (*Daucus carota subsp. Sativus* (Hoffm.) Arcang)
PEST: *Pythium* species

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TITLE: EVALUATION OF COMMERCIAL CARROT CULTIVARS FOR SUSCEPTIBILITY TO CAVITY SPOT, 2021

MATERIALS: Commercial cultivars Deep Purple, Atomic Red, RedSun (Johnny's Select Seeds), Cellobunch and Envy (Seminis Vegetable Seeds), Nairobi (Bejo Seeds Inc), Upper Cut and Honey Snax (Nunhems USA)

METHODS: The trial was conducted on organic soils (pH ≈ 6.4, organic matter ≈ 68.3%) naturally infested with *Pythium* species at the Ontario Crops Research Centre - Bradford, Ontario. Carrot cultivars were direct seeded (≈ 65 seeds/m) on raised beds with spacing of 66 cm on 21 May. The trial was a randomized complete block with four replicates of each treatment. One experimental unit was three rows with the row length of 6 m. The eight carrot cultivars had varying susceptibility to cavity spot. These carrot cultivars were divided into three categories: relatively resistant: Deep Purple, moderately susceptible: Cellobunch, Uppercut, Nairobi, Honey Snax and very susceptible: Atomic Red, Envy, and Red Sun, based on the results from previous cavity spot trials (McDonald et al. 2015 – 2019). The incidence and severity of cavity spot on carrots was assessed at mid-season and harvest. Thirty carrots were pulled from each experimental unit (10 consecutive carrots per row) to assess cavity spot at mid-season on 24 August. Treatment 1 (Atomic Red), had poor stand count and the carrots were not harvested from this treatment for mid-season assessment. On 6 October, 100 carrots were pulled from two rows of each experimental unit (50 consecutive carrots from each row) to assess cavity spot. The two rows with the highest stand count were chosen for harvest. The carrots were placed in cold storage until assessment. Carrots were washed with water in a small rotating drum washer. Carrots were examined for the characteristic symptoms, sunken lesions horizontally arranged on the carrot root. Incidence of cavity spot was the percent of carrots in the sample with one or more cavity spot lesions. Disease severity was determined based on the horizontal length of the largest lesion on the carrot. Disease severity was divided into six classes: 0 = no lesions, 1= lesions up to 0.09 cm, 2= lesions of 0.1 to 0.2 cm, 3= lesions of 0.2 to 0.5 cm, 4= lesions of 0.5 to 1 cm and 5= lesions >1 cm (Saude et al. 2014). The disease severity values were transformed to an index of 0 – 100 using the equation of Kobriger and Hagedorn (1983) to determine disease severity index (DSI).

$$DSI = \frac{\sum [(\text{class no.})\ (\text{no. of carrots in each class})]}{(\text{total no. of carrots assessed per sample})\ (\text{no. of classes } -1)} \times 100$$

The relative disease response of the carrot cultivars was determined by comparing disease incidence and severity to pre-identified most resistant cultivar, Deep Purple, and the most susceptible cultivar, Atomic Red. The carrot cultivars that had a DSI statistically the same as Purple Elite were considered relatively resistant. Similarly, the carrot cultivars had disease response statistically the same as Atomic Red were considered susceptible. The cultivars shown intermediate disease response were considered moderately susceptible. *Pythium* species were isolated from cavity spot lesions on the carrots. Five lesions from each experimental unit were placed on culture media to isolate *Pythium* species. These cultures were identified microscopically based on morphological characteristics including sporangia, antheridia, oospores and oogonia following the key of van der Plaats-Niterink (1981).

Data were analyzed using the General Analysis of Variance using Statistix V.10. Means separation was obtained using Tukey's test with P = 0.05 level of significance. Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C), August (22.2°C) and October (12.8°C), average for September (15.8C), and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C, September 16.4°C and October 9.8°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm), average for October (77 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm, September 59 mm and October 78 mm.

RESULTS: The incidence of cavity spot at the mid season assessment was lower in Deep Purple compared to other cultivars, however, there was no difference in disease severity (Table 1). At harvest, the incidence and severity of cavity spot was again lowest in Deep Purple, and moderate in UpperCut and Cellobunch (Table 1). Both the incidence and severity were highest in Envy (Table 1).

CONCLUSION: The cultivar Deep Purple was relatively resistant as expected, Cellobunch, HoneySnax and UpperCut were moderately susceptible, Atomic Red and Envy was susceptible to cavity spot. Overall, the disease incidence was high both at midseason (34 – 58 %) and at harvest (37 – 77 %). The disease severity was relatively high compared to last year due to more rain fall this year. Overall, the disease severity was moderately high (14 – 44 %) in the trial.

Table 1. Incidence and severity cavity spot on carrots cultivars, grown on muck soils at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Cultivars	Color	Cavity spot assessment			
		24 August		06 October	
		Incidence (%)	DSI[1]	Incidence (%)	DSI
Atomic Red	Red	NA [2]	NA	77.0 a	44.1 a
Envy	Orange	54.2 a[3]	19.7 a	70.7 ab	27.4 b
Nairobi	Orange	40.8 a	12.8 ab	56.0 abc	24.2 bc
Red Sun	Red	58.3 a	24.2 a	52.2 bc	27.3 b
Upper Cut	Orange	57.5 a	25.7 a	45.5 c	18.8 bc
HoneySnax	Orange	45.8 a	19.8 a	44.5 c	19.6 bc
Cellobunch	Orange	34.2 a	14.2 a	37.2 c	14.4 c b
Deep Purple	Purple	0.8 b	0.3 b	0.0 d	0.0 d

[1] DSI indicates disease severity index calculated as

$$DSI = \frac{\sum [(\text{class no.})\ (\text{no. of carrots in each class})]}{(\text{total no. of carrots assessed per sample})\ (\text{no. of classes } -1)} \times 100$$

[2] Not assessed at mid season

[3] Numbers in column followed by same letter are not significantly different at *P* =0.05, Tukey`s Test.

Funding was provided by the California Fresh Carrot Marketing Board, the Plant Production Systems of the Ontario Agri-Food Innovation Alliance and the Fresh Vegetable Growers of Ontario.

CROP: Carrot (*Daucus carota* subsp. *sativus* (Hoffm.) Arcang.)
PEST: Cavity spot (*Pythium intermedium* de Bary, *Pythium irregulare* Buisman, *Pythium sulcatum* Pratt & Mitchell, *Pythium sylvaticum* W.A. Campbell & J.W. Hendrix, *Pythium ultimum* Trow and *Pythium violae* Chesters & C.J. Hickman)

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TITLE: EVALUATION OF CARROT BREEDING LINES FOR SUSCEPTIBILITY TO CAVITY SPOT, 2021

MATERIALS: USDA experimental carrot breeding lines, commercial cultivars Cellobunch, Envy, Pro Peel (Seminis Vegetable Seeds), Atomic Red (OSC Seeds), Deep Purple, Nairobi (Bejo Seed Inc.), Maverick (Nunhems USA)

METHODS: The trial was conducted on organic soil (pH ≈ 5.7, organic matter ≈ 70.8%) naturally infested with *Pythium* spp. at the Ontario Crops Research Centre - Bradford, Ontario. Carrots were direct seeded (≈70 seeds/m) onto raised beds using a push cone seeder on 9 May. A randomized complete block design with four replicates per treatment was used. Each experimental unit consisted of one row, 6 m in length, spaced 66 cm apart. On 28 July stand was rated on a 0-5 scale were 0 = ≤ 9 carrots, 1 = very poor, 2 = poor, 3 = good, 4 = very good, 5 = excellent. On 8 October, plots were visually assessed for: leaf blight, (0-5 scale where 0= no blight to 5= leaf/ petiole necrosis), and bolting, (0-3 scale where 3 = more than 50% flowering, 2 = 5 to 49%, 1 = <5% and 0 = no flowering). On 29 and 30 October, 50 carrots from each replicate were harvested, placed into cold storage, and assessed for cavity spot on 9-10 December. Carrots were washed in a small drum washer, visually examined for cavity spot lesions, and sorted into classes based on the size of the largest lesion (measured as horizontal width). The six classes were: 0 = no disease, 1 = very light (< 1 mm), 2 = light (1-2 mm), 3 = medium (3-5 mm), 4 = heavy (6-10 mm), and 5 = very heavy (> 10 mm). The disease severity index (DSI) was determined using the above classes and the following equation:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of carrots in each class})]}{(\text{total no. carrots per sample})\ (\text{no. classes } -1)} \times 100$$

Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C), August (22.2°C) and October (12.8°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C, September 16.4°C and October 9.8°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm), average for October (77 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm, September 59 mm and October 78 mm. Data were analyzed using the General Analysis of Variance function of Statistics V.10. Means separation was obtained using Tukey's HSD test with P = 0.05 level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSIONS: In 2021, rainfall in August was below average (41 mm), irrigation was applied in early August to assist in disease development. Above average rainfall in September (173 mm) created moist soil conditions for cavity spot development until harvest. The incidence of cavity spot in cv. Cellobunch was 33% in 2021 compared to 42% in 2020. Significant differences in cavity spot incidence were observed among the lines tested, ranging from 0-91%. Disease severity ranged from 0 -69%. The orange line crosses 18'B112-1, 18'B112-7, 17'766-4, 18'B111-7 and 18'B112-8 -1 all had cavity spot incidence less than 25% and these all had parental line F7738B. Significant differences in leaf blight ratings were also observed with 23 of the crosses tested having a leaf blight rating 1.5 or less (Table 2).

Table 1. Cavity spot incidence and severity index (DSI) and percent forked for carrot breeding lines from the University of Wisconsin grown at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Name/Seed source	Pedigree	Incidence (%)	DSI[1]	% Forked
Deep Purple		0.0 a[2]	0.0 a	7.5 a-e
18'B112-1	F7738B	15.0 ab	5.6 ab	2.0 ab
18'B112-7	(2566A×F7738B) × F7738B	20.5 abc	6.8 ab	1.0. a
17'766-4	(1111A×2226B)×F7738B	22.0 abc	7.2 abc	3.5 abc
18'B111-7	(2566A×F7738B) × F7737B	23.0 abc	8.4 a-d	2.5 abc
18'B112-8	(9304A×F7738B) × F7738B	24.0 a-d	6.7 abc	2.5 abc
Triton		25.5 a-e	8.5 a-d	6.5 a-e
17'725-1	F5367B	28.4 b-f	9.5 a-f	3.0 abc
18'B112-3	(2566A×F7738B) × F7738B	28.5 b-f	8.8 a-e	2.5 abc
18'B111-6	(L1408A×Nbh2306B) × F7737B	29.0 b-f	9.7 a-f	3.5 abc
19'B112-1	Nbh2306B	33.5 b-g	10.2 a-f	3.0 abc
Cellobunch		**33.5 b-g**	**10.6 a-f**	**2.5 abc**
17'766-5	(5280A×Nbh2306B)×F7738B	35.0 b-h	11.4 a-g	3.5 abc
18'B111-1	F7737B	36.0 b-h	12.7 a-h	3.0 abc
18'B112-4	(9304A×F7738B) × F7738B	38.0 b-i	10.8 a-g	2.0 ab
18'B112-5	(2566A×F7738B) × F7738B	38.0 b-i	14.0 a-i	3.5 abc
Propeel (1)		38.5 b-i	15.4 a-j	4.0 a-d
N17005-1	Nbh2306B	41.0 c-j	14.0 a-i	2.0 ab
18'B112-6	(9304A×F7738B) × F7738B	41.5 c-k	15.8 a-k	4.5 a-d
19'B113-4	(2566XF7737) × F5367B	42.0 c-l	15.0 a-j	4.0 a-d
19'B112-3	(1138XL3303) × Nbh2306B	43.0 c-m	16.5 b-k	4.5 a-d
Imperial Cuts	Imperial Cuts	43.0 c-m	16.0 a-k	3.5 abc
Nairobi		44.0 c-m	14.2 a-i	3.0 abc
19'B113-3	(6274XF7737) × F5367B	44.5 c-n	15.4 a-j	4.0 a-d
17'789-1	Nbh2306B	47.4 d-o	17.2 b-l	7.8 a-e
17'730-3	(1111A × L3303B)×6116B	49.0 e-p	18.3 b-l	6.5 a-e
Maverick (2)		49.5 e-p	16.6 b-k	3.5 abc
Istanbul	Istanbul	50.0 f-p	17.2 b-l	3.5 abc
17'730-4	(Nb8483A × Nbh2306B)×6116B	50.4 f-p	19.8 b-m	6.4 a-e
19'B112-2	Nbh2306A	51.9 f-q	18.8 b-m	6.0 a-e
19'959-2	B2144A × F5367B	54.0 g-r	21.1 b-o	4.0 a-d
17'725-2	(1138A × L3303B)×5367B	56.5 g-r	21.2 b-o	5.5 a-d
20'B110-1	T-4 Top Size-2 Pool #3	56.8 g-r	24.8 e-p	14.8 e
17'791-5	(L1406A×L0567B)×Nbh2306B	57.0 g-r	20.7 b-n	6.0 a-e
19'S1433-2	L1408A	57.5 g-r	25.5 f-q	8.0 a-e
Propeel (2)		59.0 h-s	23.5 d-o	2.0 ab
Maverick (1)	Maverick	60.5 i-t	21.6 b-o	2.5 abc
06'H305-21	F3513B	60.7 i-t	27.7 h-q	7.5 a-e
19'B113-1	F5367B	61.0 i-t	22.5 c-o	3.6 abc
17'790-2	L1408A×Nbh2306B	61.6 i-t	25.4 f-q	6.2 a-e
17'791-4	(L9785A×L2576B)×Nbh2306B	63.0 j-u	23.4 d-o	4.0 a-d
17'791-6	(L9793A×L3726B)×Nbh2306B	63.5 j-u	24.8 e-p	3.0 abc
N17005-2	Nbh2306A	65.5 k-v	24.8 e-p	2.0 ab
17'B101-2	(L1406A × L0567B)× L2577B	65.5 k-v	26.9 g-q	8.0 a-e
19'B109-3	(L2574XL1408) × L7553B	65.5 k-v	28.8 h-q	4.0 a-d

17'B121-3	L2574A × L1408B	66.0 l-v	30.0 i-q	5.0 a-d
17'788-5	(5280A×Nbh2306B)×Npbw7261B	66.0 l-v	28.9 i-q	4.0 a-d
20'B111-1	F5367B	66.5 m-w	25.3 f-q	4.0 a-d
17'790-6	(L9793A×L3726B)×Nbh2306B	68.5 n-x	30.9 j-q	4.5 a-d
17'791-2	L1408A×Nbh2306B	68.5 n-x	29.5 i-q	3.5 abc
17'790-4	(L9785A×L2576B)×Nbh2306B	70.5 o-x	31.9 k-q	4.5 a-d
17'750-5	(Nb8483A×Nbh2306B)×F7142B	70.5 o-x	27.8 h-q	1.5 ab
18'B111-5	(L9793A × L3726B) × F7737B	73.0 p-x	30.9 j-q	5.5 a-d
17'B102-1	F3513	74.8 q-x	40.1 p-t	3.5 abc
19'B109-1	L7553B	75.0 q-x	32.8 l-r	2.5 abc
20'B107-1	A-3 ALB ++ Pool #2	75.5 r-x	36.1 n-t	11.0 cde
19'B109-2	L7553A	77.8 r-x	34.8 m-s	1.5 ab
17'B101-1	L2577B	82.5 s-x	36.9 o-t	6.5 a-e
17'789-2	(L1406A×L0567B)×Nbh2306B	83.8 t-x	37.0 o-t	9.8 b-e
Envy		87.0 u-x	41.1 q-t	5.0 a-d
17'B121-1	L1408B	88.0 vwx	49.8 st	7.5 a-e
17'790-5	(L1406A×L0567B)×Nbh2306B	90.5 wx	48.5 rst	
Atomic Red		90.9 x	69.5 u	9.3 a-e
19'S1433-1	L1408B	91.5 x	51.7 t	12.5 de

[1] Disease Severity Index (DSI) was determined using the following equation:

$$DSI = \frac{\sum [(\text{class no.})\ (\text{no. of carrots in each class})]}{(\text{total no. carrots per sample})\ (\text{no. classes } -1)} \times 100$$

[2] Numbers in a column followed by the same letter are not significantly different at P= 0.05, Tukey's HSD test

Table 2. Stand (28 July), bolting and leaf blight ratings (8 October), for carrot breeding lines from University of Wisconsin grown at the Ontario Crops Research Centre - Bradford, 2021.

Field #	Name	Stand Rating[1]	Bolting Rating[2]	Leaf Blight Rating[3,4]
CS042	18'B111-6	5.0	0.0	**2.4**
CS056	Istanbul	5.0	0.1	1.9
CS058	Propeel (2)	5.0	0.0	1.0
CS059	Deep Purple	5.0	0.0	**3.0**
CS061	Envy	5.0	0.0	1.5
CS033	20'B107-1	4.8	0.8	1.0
CS040	18'B111-1	4.8	0.0	**3.9**
CS041	18'B111-5	4.8	0.1	1.8
CS054	Imperial Cuts	4.8	0.0	1.6
CS055	Maverick (1)	4.8	0.0	1.3
CS057	Propeel (1)	4.8	0.0	1.5
CS065	Maverick (2)	4.8	0.0	0.8
CS002	17'B121-3	4.5	0.0	1.3
CS014	17'790-4	4.5	0.0	0.9
CS038	19'B109-2	4.5	0.0	1.1
CS017	17'791-2	4.3	0.1	1.1
CS018	17'791-4	4.3	0.0	0.8
CS021	17'B101-2	4.3	0.0	0.6
CS030	19'B113-4	4.3	0.0	**3.6**
CS034	17'750-5	4.3	0.0	2.0
CS043	18'B111-7	4.3	0.0	**2.8**
CS051	18'B112-4	4.3	0.0	2.3
CS063	Nairobi	4.3	0.0	**2.8**

CS004	19'S1433-2	4.0	0.0	1.3
CS011	19'B112-3	4.0	0.0	1.4
CS022	17'B102-1	4.0	0.0	2.1
CS025	19'B113-1	4.0	0.0	**2.8**
CS029	19'B113-3	4.0	0.0	**3.8**
CS039	19'B109-3	4.0	0.0	1.4
CS053	18'B112-6	4.0	0.0	2.1
CS003	19'S1433-1	4.0	0.1	1.6
CS005	20'B110-1	4.0	0.8	0.6
CS007	N17005-1	4.0	0.0	1.0
CS020	17'791-6	4.0	0.0	1.0
CS026	20'B111-1	4.0	0.0	**2.6**
CS036	17'B101-1	4.0	0.0	1.3
CS046	18'B112-8	4.0	0.0	**2.9**
CS052	18'B112-5	4.0	0.0	1.8
CS062	Cellobunch	4.0	0.0	**2.4**
CS001	17'B121-1	3.8	0.5	0.8
CS009	N17005-2	3.8	0.0	1.6
CS015	17'790-5	3.8	0.0	1.3
CS016	17'790-6	3.8	0.0	1.1
CS027	17'725-2	3.8	0.0	1.8
CS035	17'788-5	3.8	0.0	1.6
CS044	18'B112-1	3.8	0.0	**4.0**
CS048	17'766-5	3.8	0.0	**3.1**
CS050	18'B112-3	3.8	0.0	**4.0**
CS019	17'791-5	3.5	0.0	1.9
CS031	17'730-3	3.5	0.0	1.3
CS008	19'B112-1	3.3	0.0	1.6
CS010	19'B112-2	3.3	0.0	1.1
CS028	19'959-2	3.3	0.0	1.9
CS037	19'B109-1	3.3	0.0	1.9
CS045	18'B112-7	3.3	0.0	**2.8**
CS013	17'790-2	3.0	0.0	0.9
CS047	17'766-4	3.0	0.0	2.1
CS023	06'H305-21	2.8	0.0	1.4
CS032	17'730-4	2.8	0.4	2.0
CS060	Atomic Red	2.8	0.0	**2.4**
CS064	Triton	2.8	0.0	0.5
CS006	17'789-1	2.5	1.4	1.1
CS024	17'725-1	2.5	0.0	**3.6**
CS012	17'789-2	2.3	0.0	0.6
CS049		1.0	---	

[1] Stand (carrot emergence) was rating on 28 July using a 0-5 scale where 0 = <5 carrots, 1 = very poor, 2 = poor, 3 = good, 4 = very good, 5 = excellent.

[2] Bolting was rated on 1 October using a comparative 0-3 scale where 0= no flowering, 1= <5% flowering, 2= 5-49% flowering, 3 = >50% flowering.

[3] Leaf blight was rated on a 0-5 scale where 0 = no light, 1 = 1-10% leaf area blighted, 2 = 11-25% leaf/petiole blighted, 3 = 26-50% leaf/petiole blighted, 4 = >75% leaf/petiole area blighted, 5 = leaf/petiole necrotic.

[4] Leaf blight ratings 2.4 or higher (the rating for Cellobunch) are noted in bold.

Funding was provided by the California Fresh Carrot Advisory Board and the Plant Production Systems of the Ontario Agri-Food Innovation Alliance.

CROP: Carrot (*Dauca carota*, subsp sativus), cv. Cellobunch

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TITLE: TOLERANCE OF CARROT TO PYRIDATE FORMULATIONS

MATERIALS: BCP258H (pyridate 600 g/l), BCP1047H (pyridate 30% granular), BLAZER (aciflurofen 240 g/l), LOROX-L (linuron 480 g/l), ZIDUA (pyroxasulfone 85% granular), GOAL 2XL (oxyfluorfen 120 g/l)

METHODS: Carrots, cv. Cellobunch, were direct seeded (25 seeds per 30 cm of row) on May 27 into muck soil (organic matter ≈ 55.6%, pH ≈ 7.3) at the Ontario Crops Research Centre - Bradford, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of two raised beds spaced 85 cm apart and 6 m in length. Herbicide treatments were applied using a backpack mounted sprayer fitted with AIXR110-02 spray tips calibrated to deliver 200 L/ha at 206.84 kPa. Herbicide treatments are listed in Table 1. Treatments were applied to carrots on 12 June, 16 June, 28 June and 10 July 2021. Pyridate was not applied to the check treatment. All treatments were kept weed-free in order to confirm crop tolerance to pyridate. Carrots were grown using best agronomic practices for nutrients and pest management. Carrots were harvested on October 21 from two 1.16 m sections of row per plot. Yield samples were graded on November 19 for size and weight to determine marketable yield.
Yield data were analyzed using ARM Version 2021.2 Analysis of Variance function. Means separation was obtained by using Tukey's HSD test at P = 0.05 level of significance.

RESULTS: as presented in Table 1

CONCLUSIONS: Tolerance of carrot var. Cellobunch to pyridate formulations BCP258H and BCP1047H applied at rates of 300 to 600 g ai/ha was excellent at all stages of carrot growth. No crop injury was observed when either pyridate formulation was tank mixed with linuron. No significant differences in crop yield were detected among treatments. Research results to date, suggest that pyridate has significant potential as a new herbicide for carrots.

Funding for this project was provided by Plant Production Systems of the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph Partnership, Belchim Crop Protection Canada, and the Bradford Co-operative and Muck Crop Growers.

Table 1. Yield of carrots, cv. Cellobunch, treated with different pyridate formulations and herbicide rates, applied to carrots at three selected growth stages. Stale seedbed treatments were applied prior to carrot seedling emergence. Check means no pyridate applied. Trial conducted at the Ontario Crop Research Centre - Bradford, Ontario, 2021.

	Treatment	Rate (g ai/ha)	Crop growth stage at time of herbicide application	Marketable Yield (T/ha)
1	Check			58.0
2	BCP258H	600	Bunny ear	54.2
	BCP258H	300	2-3 leaf	
	BCP258H	300	5-7 leaf	
3	BCP258H	300	Bunny ear	58.9
	BCP258H	300	2-3 leaf	
	BCP258H	300	5-7 leaf	
4	BCP258H	450	Bunny ear	50.7
	BCP258H	450	2-3 leaf	
	BCP258H	450	5-7 leaf	
5	BCP258H	900	Bunny ear	57.9
	BCP258H	450	2-3 leaf	
	BCP258H	450	5-7 leaf	
6	BCP1047H	450	Bunny ear	55.2
	BCP1047H	450	2-3 leaf	
	BCP1047H	450	5-7 leaf	
7	BCP1047H	600	Bunny ear	55.5
	BCP1047H	450	2-3 leaf	
	BCP1047H	450	5-7 leaf	
8	PYROXASULFONE	89	Bunny ear	48.9
	ACIFLUORFEN	18.75	Bunny ear – 1 leaf	
	LINURON	1000	2-3 leaf	
	ACIFLUORFEN	18.75	2-3 leaf	
	LINURON	1000	5-7 leaf	
	OXYFLUORFEN	60	5-7 leaf	
9	PYROXASULFONE	89	Bunny ear	51.1
	BCP258H	600	Bunny ear – 1 leaf	
	LINURON	1000	2-3 leaf	
	BCP258H	450	2-3 leaf	
	LINURON	1000	5-7 leaf	
	BCP258H	450	5-7 leaf	
10	PYROXASULFONE	89	Bunny ear	49.6
	BCP1047H	600	Bunny ear – 1 leaf	
	LINURON	1000	2-3 leaf	
	BCP1047H	450	2-3 leaf	
	LINURON	1000	5-7 leaf	
	BCP1047H	450	5-7 leaf	
11	BCP258H	600	Stale seed bed	59.4
	BCP258H	300	Bunny ear	
	BCP258H	300	2-3 leaf	
12	BCP1047H	900	Stale seed bed	40.9
	BCP1047H	450	Bunny ear	
	BCP1047H	450	2-3 leaf	

No significant yield differences were detected among treatments.

CROP: Carrot (*Dauca carota* subsp sativus), cv. Navedo

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TITLE: CARROT SEEDLING TOLERANCE TO TWO PYRIDATE FORMULATIONS APPLIED AS A STALE SEEDBED TREATMENT

MATERIALS: BCP258H (pyridate 600 g/l), BCP1047H (pyridate 30% granular)

METHODS: Carrots, cv. Navedo were direct seeded (25 seeds per 30 cm of row) on June 17 into muck soil (organic matter ≈ 55.6%, pH ≈ 7.3) in range 1 at the Jane Street research sight, near the Ontario Crops Research Centre - Bradford, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of two raised beds spaced 85 cm apart, and 6 m in length. Herbicide treatments were applied using a backpack mounted sprayer fitted with AIXR110-02 spray tips calibrated to deliver 200 L/ha at 206.84 kPa. Herbicide treatments are listed in Table 1. Treatments were applied on 20 June 2021, prior to carrot seedling emergence. Pyridate was not applied to the check treatment. All treatments were kept weed-free in order to confirm crop tolerance to pyridate. Plant counts were recorded from two separate 1m sections of row per hill on 28 July and combined for analyses.
Yield data were analyzed using ARM Version 2021.2 Analysis of Variance function. Means separation was obtained by using Tukey's HSD test at P = 0.05 level of significance.

RESULT: as presented in Table 1

CONCLUSIONS: No delay in carrot seedling emergence compared to the check treatment (no pyridate) was observed. In addition, no significant difference in carrot seedling count was detected 38 days after the stale seedbed application of pyridate formulations BCP258H or BCP1047H at the 1X or 2X rate.

Funding for this project was provided by Plant Production Systems of the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph Partnership, Belchim Crop Protection Canada, and the Bradford Co-operative and Muck Crop Growers.

Table 1. Carrot var. Navedo seedling emergence count per metre of row following stale seedbed treatment of two formulations of pyridate applied at a 1X and 2X rate. Check treatment means no pyridatee applied. Trial was conducted at the Jane Street research site near the Ontario Crop Research Centre - Bradford, Ontario, 2021.

	Treatment	Rate (g ai/ha)	Herbicide application timing	Stand Count (per m row)
1	Check			47.0
2	BCP258H	600	PRE emergence	47.0
3	BCP258H	1200	PRE emergence	40.5
4	BCP1047H	900	PRE emergence	41.8
5	BCP1047H	1800	PRE emergence	46.0

No significant differences were detected among treatments

PRE applied as a stale seedbed treatment prior to carrot seedling emergence

Stand count recorded 38 days after application of stale seedbed treatments.

CROP: Yellow cooking onions (Allium cepa L.), cv. Fortress
PESTS: Onion maggot, (*Delia antiqua* (Meigen))
Seed corn maggot, (*Delia platura* (Meigen))

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TITLE: **EVALUATION OF VARIOUS INSECTICIDES FOR CONTROL OF MAGGOTS IN YELLOW COOKING ONIONS, 2021**

MATERIALS: SEPRESTO 75 WS (clothianidin 56.25%, imidacloprid 18.75%), REGARD SC (spinosad 22.5%), CIMEGRA (broflanilide 9.51%), TRIGARD (cryomazine 75%)

METHODS: The trial was conducted on organic soil (pH ≈ 6.1, organic matter ≈ 69.8%) naturally infested with *Delia antiqua* and *D. platura* pupae at the Ontario Crops Research Centre - Bradford, Ontario. A randomized complete block design with four replicates per treatment was used. Each experimental unit consisted of four rows, spaced 40 cm apart, 6 m in length. Onions, cv. Fortress, were seeded (≈ 35 seeds/m) on 16 May using a Stanhay precision seeder. Insecticide seed treatments applied at the manufacturer's recommended rates were: SEPRESTO, REGARD, and TRIGARD. CIMEGARD was applied as a seed coating at 0.04 and 0.08 g ai/seed, and as an in-furrow application at 25 and 50 g/ha. A no-insecticide check was also included. All treatments included EVERGOL PRIME (penflufen 0.0087 g ai/1,000 seeds) for smut control and 42-S THIRAM (thiram 12.5 g ai/kg seed) to prevent damping off. Treatments and pelleting were done by Incotec using standard methods. Three randomly chosen 2 m sections of row for damage plots plus a 2.32 m section for a yield sample were staked out in each replicate. Emergence counts were conducted within the 2 m staked sections on 4 June to determine initial stands. Beginning on 10 June and continuing weekly, onion plants within the 2 m sections were examined for loss due to maggot damage or damage caused by other pests. Damaged onions were removed, and numbers and the cause of damage recorded. The remaining onions within the assigned 2 m sections were removed and visually examined for maggot damage on 5 July 11 Aug and after lodging on 16 September. On 17 September, onions from the 2.32 m yield section of row were pulled, sorted by size and weighed to determine yield. Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.10. Means separation was obtained using Fisher's Protected LSD Test at P = 0.05 level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSIONS: Significant differences in the number of onions lost to maggot damage were found among the treatments (Table 1). Seeds treated with SEPRESTO had significantly greater plants emerge per meter than the other treatments except for CIMEGRA at 50g/ha in-furrow. Over the course of the season significant differences in the percent of onion lost to maggot damage started to appear. SEPRESTO had the fewest losses, significantly less than the in-furrow CIMEGRA treatments or the untreated check. Significant differences in yield and onions per meter at harvest were found among the treatments (Table 2). SEPRESTO and CIMEGRA at 0.04 g ai/seed had significantly higher yield than

either of the CIMEGRA in-furrow treatments. The SEPRESTO treated onions also had more onions per meter than either the in-furrow CIMEGRA or TRIGARD treatment. No significant differences in size distribution were found among the treatments.

Table 1. Emergence and percentage of onions, cv. Fortress, lost due to maggot damage, treated with various insecticides, and grown at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment	Rate & application method	Emergence (plants/m)	% Onions lost due to maggot damage		
			1st Generation	1st and 2nd Generation	Total Season
SEPRESTO	-	30.5 a[1]	3.4 ns[2]	0.0 a	0.4 a
CIMEGRA	0.08 ai/seed	27.9 b	4.4	1.6 ab	0.5 ab
CIMEGRA	0.04 ai/seed	27.8 bc	4.1	1.5 ab	1.5 abcd
TRIGARD	-	25.7 c	4.8	3.5 abc	0.1 ab
REGARD	-	27.5 bc	1.5	3.7 bc	1.1 abc
CIMEGRA	25 g/ha in-furrow	27.4 bc	6.9	6.7 c	4.0 bcd
CIMEGRA	50 g/ha in-furrow	29.4 ab	5.7	4.3 bc	5.9 d
Check seed	-	27.8 bc	5.9	1.9 ab	5.4 cd

[1] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD test.
[2] ns = no significant differences were found among treatments at P = 0.05, Fisher's Protected LSD test.

Table 2. Yield, number and size distribution for onions, cv. Fortress, treated with various insecticide seed treatments, pelleted by Incotec and grown at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment[1]	Rate & application method	Yield (t/ha)	Onions/m	Size Distribution[1] (%)		
				Jumbo (>76mm)	Large (76-64 mm)	Medium (>64-45 mm)
SEPRESTO	-	55.2 a[2]	26.7 a	0.0 ns[3]	20.5 ns	74.2 ns
CIMEGRA	0.08 ai/seed	45.2 ab	23.0 abc	0.0	14.9	79.1
CIMEGRA	0.04 ai/seed	48.2 a	24.8 ab	0.0	20.4	72.1
TRIGARD	-	49.2 ab	21.0 bc	1.4	25.8	69.2
REGARD	-	56.2 a	24.1 ab	1.8	35.0	58.9
CIMEGRA	25 g/ha in-furrow	35.5 b	17.7 c	6.2	25.9	57.4
CIMEGRA	50 g/ha in-furrow	35.4 b	19.4 bc	0.0	32.5	55.1
Check seed	-	47.5 ab	23.1 abc	0.0	25.9	68.5

[1] Size distribution was based on weights.
[2] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD test.
[3] ns = no significant differences at P = 0.05, Fisher's Protected LSD test.

Funding was provided by Incotec for seed pelleting, Bayer Crop Science for the Sepresto insecticide, the Plant Production Systems of the Ontario Agri-Food Innovation Alliance and the California Garlic and Onion Research Advisory Board. Dr. Taylor's effort was supported under the United States Multi-State project, W-3168.

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Traverse
PEST: Onion thrips, (*Thrips tabaci* Lindeman)

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TITLE: EVALUATION OF ISM-555 FOR CONTROL OF THRIPS IN YELLOW COOKING ONIONS, 2021

MATERIALS: ISM-555, MOVENTO (spirotetramat 240g/L)

METHODS: Onions, cv. Traverse, were direct seeded (≈ 35 seed/m) on 8 May using a Stanhay Precisions Seeder into organic soil (organic matter ≈ 58.7%, pH ≈ 7.2) near the Ontario Crops Research Centre - Bradford, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of four rows (40 cm apart), 6 m in length. Treatments were: ISM-555 applied at 600mL/ha, 750mL/ha, and 900mL/ha with Agral 90, at 750mL/ha without Agral 90, and MOVENTO at 365mL/ha. An untreated check was also included. Treatments were applied on 16 and 23 July over using a CO_2 backpack sprayer equipped with four TeeJet 8002 VS fan nozzles spaced 40 cm apart and calibrated to deliver 400 L/ha at 275 kPa. Adult and larval thrips were counted on the inside surface of the five innermost leaves of 10 randomly selected onions per replicate on 13 July (pre-spray), 22, 30 July, 3, 6, 11, 16, 20 August. The average number of thrips on the various count dates were used to calculate the area under the thrips population curve (AUTPC) using the following formula:

$$\text{AUTPC} = \sum_{j=1}^{N_{j-1}} \left(\frac{y_j + y_{j+1}}{2}\right)\left(t_{j+1} - t_j\right)$$

On 14 September, onions in two 2.32 m sections of row per replicate designated for yield were harvested. On 5 November, onions were sorted by size to determine yield. Data were analysed using the General Analyses of Variance function of the Linear Models section of Statistix V.10. Means separation was obtained using Fisher's Protected LSD test with $P = 0.05$ level of significance.

RESULTS & DISCUSSION: The numbers of thrips per plant was sporadic throughout the season. Of the eight counts the two dates which showed significant differences were 13 July, before the first spray application, and on the last assessment, 20 August, when thrips numbers had fallen, with the highest average count per plant only having 4.3 thrips (Table 1). No significant differences in the cumulative total number of thrips or in the area under the thrips population curve (AUTPC) were found among the treatments (Table 1). There were no significant differences in yield among the treatments, although the untreated check had the lowest yield and lowest marketable percentage (Table 4). There were no signs of phytotoxicity caused by the products. There were no differences in insect damage on plants between treatments.

CONCLUSIONS: No significant reduction in the numbers of thrips was achieved by the ISM-555 treatments.

Table 1. Onion thrips per plant and area under the thrips population curve (AUTPC) for onions treated with ISM-555 grown near Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment	Product Rate	Onion Thrips/Plant								Season Total[2]	AUTPC[3]
		13 Jul[1]	22 Jul	30 Jul	3 Aug	6 Aug	11 Aug	16 Aug	20 Aug		
Adult											
ISM-555+ AGRAL 90	900mL/ha 0.25% v/v	1.0bc[4]	4.1ns[5]	2.6ns	1.4ns	0.6ns	0.3ns	0.4ns	0.3ns	10.7ns	66.2ns
ISM-555+ AGRAL 90	750mL/ha 0.25% v/v	1.2b	3.5	2.2	2.8	0.6	0.4	0.6	0.0	11.3	65.2
ISM-555	750mL/ha	0.5c	3.4	1.5	0.8	1.0	0.6	0.8	0.2	9.0	54.6
ISM-555+ AGRAL 90	600mL/ha 0.25% v/v	1.2b	2.4	2.5	1.9	0.4	0.4	0.1	0.1	9.0	52.3
MOVENTO	365mL/ha	0.6c	3.0	2.3	1.2	1.2	0.4	0.6	0.2	9.5	56.0
Check	--	1.8a	2.7	2.6	2.7	0.8	0.4	0.1	0.2	11.4	62.5
Larval											
ISM-555+ AGRAL 90	900mL/ha 0.25% v/v	13.5b	8.2ns	20.5ns	26.5ns	20.2ns	14.4ns	12.8ns	2.2bc	118.3ns	560.5ns
ISM-555+ AGRAL 90	750mL/ha 0.25% v/v	16.2b	9.2	18.6	22.8	26.4	15.2	15.5	4.1ab	124.6	586.5
ISM-555	750mL/ha	15.1b	10.2	31.8	35.8	21.2	19.3	17.4	4.4a	155.0	738.4
ISM-555+ AGRAL 90	600mL/ha 0.25% v/v	31.1a	12.5	7.5	22.2	12.3	13.4	9.4	1.2c	109.5	529.5
MOVENTO	365mL/ha	12.7b	13.0	34.5	30.0	27.4	17.0	15.5	4.1ab	154.3	752.3
Check	--	19.9b	15.2	19.4	31.6	14.8	14.2	7.8	0.9c	123.8	612.9
Combined											
ISM-555+ AGRAL 90	900mL/ha 0.25% v/v	14.5bc	12.3ns	23.0ns	27.9ns	20.8ns	14.7ns	13.2ns	2.6ab	129.0ns	626.7 ns
ISM-555+ AGRAL 90	750mL/ha 0.25% v/v	17.3bc	12.7	20.8	25.6	27.1	15.6	12.8	4.1a	135.9	651.7
ISM-555	750mL/ha	15.7bc	13.6	33.3	36.6	22.2	19.9	18.2	4.6a	164.0	793.0
ISM-555+ AGRAL 90	600mL/ha 0.25% v/v	32.2a	15.0	10.0	24.0	12.7	13.8	9.5	1.2b	118.5	581.8
MOVENTO	365mL/ha	13.3c	16.0	36.8	31.2	28.6	17.2	16.1	4.3a	163.7	808.3
Check	--	21.7b	17.8	22.0	34.3	15.6	14.6	8.0	1.1b	135.2	675.4

[1] The date of the pre-spray thrips count.

[2] This is the sum of the number of thrips found on every count date.

[3] AUTPC (Area under the thrips population curve) was calculated using the following equation:

$$\text{AUTPC} = \sum_{j=1}^{N_{j-1}} \left(\frac{y_j + y_{j+1}}{2}\right)(t_{j+1} - t_j)$$

[4] Numbers in a column followed by the same letter are not significantly different at $P = 0.05$, Fisher's Protected LSD test.

[5] ns indicates no significant differences were found at $P = 0.05$, Fisher's Protected LSD Test.

Table 2. Yield and size distribution for onions, cv. Traverse, treated with ISM-555 grown near the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment	Product Rate	% Mkb	Yield (t/ha)	Size Distribution (%)[1]			
				Jumbo (>76 mm)	Large (64-75 mm)	Medium (45-63 mm)	Cull (<45 mm)
ISM-555+ AGRAL 90	900mL/ha 0.25% v/v	85.4 ns[2]	35.2 ns	2.6 ns	18.9 ns	63.9 ns	14.6 ns
ISM-555+ AGRAL 90	750mL/ha 0.25% v/v	85.4	30.7	0.0	10.2	72.1	17.7
ISM-555	750mL/ha	85.2	38.6	0.0	15.3	69.9	14.8
ISM-555+ AGRAL 90	600mL/ha 0.25% v/v	87.5	33.6	0.0	9.5	78.0	12.5
MOVENTO	365mL/ha	86.4	37.6	0.8	13.7	71.9	13.6
Check	--	81.0	27.9	0.0	6.2	74.8	19.0

[1] Percentage values were determined using weight.
[2]ns= no significant differences were found at *P*= 0.05, Fisher's Protected LSD test.

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CROP: Yellow cooking onions (*Allium cepa* L.), cv. Catskill
PEST: Stemphylium leaf blight (*Stemphylium vesicarium* (Wallr.))

AUTHORS: MCDONALD MR & VANDER KOOI K
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TITLE: EVALUATION OF VARIOUS FUNGICIDES FOR CONTROL OF STEMPHYLIUM LEAF BLIGHT ON ONIONS, 2021

MATERIALS: SERCADIS (fluxapyroxad 300 g/L), MIRAVIS DUO (pydiflumetofen 75 g/L, difenoconazole 125 g/L), MERIVON (pyraclostrobin 250 g/L, fluxapyroxad 250 g//L), T 77 (*Trichoderma atroviride* strain 77B < 2.5 x 109 spores/g), PREV-AM (sodium tetraborohydrate decahydrate 0.99%)

METHODS: Onions, cv. Catskill, were direct seeded (≈ 35 seeds/m) on 6 May into organic soil (organic matter ≈ 68.1%, pH ≈ 6.2) at the Ontario Crops Research Centre - Bradford, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of eight rows spaced 40 cm apart, and 6 m in length. Fungicide sprays were applied on 30 June, 12, 21 and 28 July using a tractor-mounted sprayer fitted with hollow cone D-3 spray nozzles at 620 kPa to deliver 500 L solution/ha. Fungicide treatments were: SERCADIS at 666 mL/ha, MIRAVIS DUO at 1.0 L/ha, MERIVON at 600 mL/ha, T-77 at 250 g/ha, PREV-AM at (2.0 L/ha), SERCADIS at 666 mL/ha (12 and 28 July) alternated with T-77 at 250 g/ha (30 June and 21 July), MIRAVIS DUO at 1.0 L/ha (12 and 28 July) alternated with T-77 at 250 g/ha (30 June and 21 July). An untreated check was also included. On 14, 22, 30 July the three oldest leaves on 20 randomly chosen onions per replicate were visually examined for stemphylium leaf blight (SLB) symptoms and rated on a 0-6 scale where 0 = no SLB symptoms, 1 = 1-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75% and 6 = >75% of leaf area infected with symptoms of *Stemphylium* infection. These classes were used to determine the disease severity index (DSI) using the following formula:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of leaves in each class})]}{(\text{total no. leaves assessed})\ (\text{no. classes } -1)} \times 100$$

and the area under the disease progress curve (AUDPC) using the following formula:

$$\text{AUDPC} = \sum_{j=1}^{Nj-1} \left(\frac{y_j + y_{j+1}}{2}\right)\left(t_{j+1} - t_j\right)$$

Where j is the order index for the times and n_j is the total number of assessments, y_j is the average OT count at day t_j, y_{j+1} is the average OT count at day t_{j+1} and (t_{j+1} - t_j) is the number of days between two assessments. On 10 August, 20 onions randomly chosen from the inner rows of every replicate were pulled. Leaves were removed and green leaves sorted into seven classes based on the percentage of the leaf area infected with *Stemphylium*. The seven classes were: 0= no disease, 1 = 1-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75%, 6 > 75% with symptoms of SLB. On 10 September, the onions in two 2.32 m sections of row were pulled from the inner rows for a yield sample. Onions were weighed and graded for size on 25 October to determine yield**.** Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm. Data were analyzed using the General Analysis of Variance function of Statistix V.10. Means separation was obtained by using Fisher's Protected LSD test at P = 0.05 level of significance.

RESULTS: as presented in Tables 1-3

CONCLUSIONS: Stemphylium incidence was moderate in 2021 and increased through July. No significant differences in SLB severity were found among the fungicide treatments for the in-field ratings (Table 1). Significant differences in disease severity were observed among fungicide treatments when plants were destructively sampled and assessed on Aug. 10 (Table 2). Onions sprayed with MIRAVIS DUO, SERCADIS and MERIVON had significantly lower disease severity than onion treated with PREV-AM or the untreated check. Only onions treated with MIRAVIS Duo alone had lower incidence than the untreated check. There were no differences in the number of green leaves per plant, but onions sprayed with MIRAVIS DUO, SERCADIS or MERIVON alone had the most leaves in the 0 and 1 categories (no symptoms or less than 4% of the leaf affected). Significant differences in yield and size distribution were observed among the treatments (Table 3). Onions treated with MIRAVIS DUO or SERCADIS had significantly higher yield (t/ha) and a higher percentage of large onions (except SERCADIS alone) compared to the PREV AM, T-77 treatments and the check.

Table 1. Area under the disease progress curve (AUDPC) and disease severity index (DSI) for onions, cv. Catskill, sprayed with various fungicides at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment	AUDPC[1]	DSI[2]		
		14 July	22 July	30 July
T-77 alt/w SERCADIS	713.3 ns[3]	17.3 ns	49.7 ns	61.7 ns
MIRAVIS DUO	717.9	18.6	50.2	60.4
MERIVON	742.1	16.0	49.8	69.9
T-77	744.2	19.0	55.7	55.6
T-77 alt/w MIRAVIS DUO	750.8	18.9	50.8	67.2
SERCADIS	751.3	18.2	54.4	60.8
PREV AM	757.1	18.4	56.6	57.7
check	787.1	17.8	58.6	61.7

[1] Area under the disease progress curve (AUDPC) was based on the disease severity index for, 14, 22 & 30 July and was determined using the following equation:

$$\text{AUDPC} = \sum_{j=1}^{N_{j-1}} \left(\frac{y_j + y_{j+1}}{2}\right)(t_{j+1} - t_j)$$

[2] Disease severity (DSI) was calculated using the following formula:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of leaves in each class})]}{(\text{total no. leaves assessed})\ (\text{no. classes } -1)} \times 100$$

[3] ns = no significant differences were found among treatments at P = 0.05, Fisher's Protected LSD test.

Table 2. Stemphylium leaf blight (SLB) incidence and severity for onions, cv. Catskill, sprayed with various fungicides and destructively sampled on Aug. 10, at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment	% Leaves rated 0 or 1[1]	SLB incidence	DSI	Green leaves/plant
MIRAVIS DUO	46.4 a[2]	75.0 a	32.5 a	7.4 ns[3]
SERCADIS	40.2 ab	80.5 ab	37.2 ab	6.9
MERIVON	40.0 ab	82.0 ab	38.3 abc	6.9
T-77 alt/w MIRAVIS DUO	35.4 bc	83.0 b	39.2 a-d	7.4
T-77	31.5 bc	81.3 ab	43.6 b-e	6.9
T-77 alt/w SERCADIS	29.8 bc	86.9 b	46.2 cde	6.9
PREV AM	28.1 c	85.7 b	46.8 de	6.8
check	27.3 c	88.2 b	49.5 e	6.6

[1] On 10 August the leaves of 20 plants were sorted into classes: 0= no disease, 1 = 1-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75%, 6 > 75% based on the percentage of leaf area infected with Stemphylium.
[2] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD test.
[3] ns = no significant differences at P = 0.05, Fisher's Protected LSD test.

Table 3. Yield data for onions, cv. Catskill, sprayed with various fungicides at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment	Yield (t/ha)	% Mkb	Size distribution (%)		
			Jumbo (>76mm)	Large (76-64 mm)	Medium (>64-45 mm)
MIRAVIS DUO	66.2 a[1]	98.1 ns[2]	8.6 ns	43.2 a	46.3 cd
T-77 alt/w MIRAVIS DUO	65.8 a	98.2	3.9	34.3 ab	60.1 b
SERCADIS	64.1 ab	97.3	7.6	31.7 abc	57.9 bc
T-77 alt/w SERCADIS	64.0 ab	98.3	9.8	42.9 a	45.6 d
MERIVON	60.8 abc	97.5	3.6	30.1 bc	63.8 ab
Check	58.8 bc	97.3	3.4	33.9 abc	60.1 b
PREV AM	55.7 c	97.1	3.1	33.7 abc	60.3 b
T-77	54.5 c	97.1	1.8	21.9 c	73.3 a

[1] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD test
[2] ns = no significant differences at P = 0.05, Fisher's Protected LSD test.

Funding for this project was provided by Plant Production Systems of the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph partnership, the California Onion and Garlic Research Advisory Board and the Bradford Co-operative and Storage.

CROP: Yellow cooking onions (*Allium cepa* L.)
PEST: Stemphylium leaf blight (*Stemphylium vesicarium*)

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TITLE: EVALUATION OF STEMPHYLIUM VESICARIUM INSENSITIVITY TO FUNGICIDES USED TO CONTROL STEMPHYLIUM LEAF BLIGHT ON ONIONS, 2021

MATERIALS: fluopyram (10 µg a.i./mL), azoxystrobin (5 µg a.i./mL, 100 µg a.i./mL)

METHODS: *Stemphylium vesicarium* colonies were isolated from onion leaf tissue exhibiting SLB symptoms, collected from the Holland Marsh in 2020. Leaf tissue was surface sterilized and plated on V8 agar. Thirty isolates were obtained. These were grown under a 12-hour UV light cycle to stimulate conidiation and stored in a refrigerator until further use. Mycelial growth and conidial germination assays were used to evaluate pathogen insensitivity to azoxystrobin and fluopyram fungicides currently used in the Holland Marsh. Active ingredient concentrations were prepared by diluting technical grade azoxystrobin (Sigma-Aldrich, St. Louis, MS) or fluopyram (Sigma-Aldrich, St. Louis, MS) with 100% acetone. Active ingredients were added to autoclaved PDA for treated media and 100% acetone was added to PDA as the unamended control.

In the conidial germination assay, 1 mL of sterile water was added to *S. vesicarium* colonies and mycelial edge aggravated with a sterile scalpel. Conidial suspension solution was pipetted onto 15 mm x 15 mm amended media squares arranged on a glass slide. Each isolate had three replications assessed for each fungicide concentration. Media sections were protected with plastic cover slips and incubated at 24°C in darkness. After 24 hours, lactophenol cotton blue was added to media sections, and 100 conidia assessed for germination under a light microscope. Germination results on fungicide media were compared to germination of corresponding isolate conidia on the control. A conidium was counted as germinated when the length of the germination tube exceeding the length of the conidium.

The mycelial germination assay used amended media cut into eight uniform laneways, with four of the eight strips removed, leaving five separated media laneways. Each PDA strip was a single replication of a single isolate at that specific concentration. This was a randomized complete block design with three replicates, with each petri plate acting as a replicate. A 5 mm mycelial plug from the edge of a *S. vesicarium* isolate colony was placed face down in the center of the prepared media laneway. Petri plates were incubated at 24°C, in the dark. At 24, 48 and 144 hours, the isolate mycelial diameter was recorded, and growth compared to the corresponding isolate controls. Only mycelium in contact with media was evaluated.

Fungicide inhibition of mycelial growth for each concentration of active ingredient was calculated using the following equation:

$$Fungicide\ inhibition = \frac{mycelial\ growth\ of\ control}{mycelial\ growth\ of\ treatment} x\ 100$$

Isolate data from both assessments were sorted into two categories depending on their reaction to fungicide amended media. A sensitive response had more than 50% inhibition of growth or germination at 5 µg a.i./mL or 10 µg a.i./mL and an insensitive response had less than 50% inhibition of growth or germination at 5 µg a.i./mL or 10 µg a.i./mL. Isolates with <50% germination and growth at 100 µg a.i./mL azoxystrobin were considered highly insensitive. Data was analyzed using IBM SPSS Statistics 26 mixed model factorial

analysis of variance function. Additionally, a two-way ANOVA test and multiple comparisons Dunnett's test was used in GraphPad Prism to determine statistical significance of treatment values for percent germination and mycelial growth in comparison to the control. Differences were statistically significant at $P \leq 0.05$.

RESULTS: as presented in Table 1

CONCLUSIONS: Both assays revealed insensitivity of *S. vesicarium* isolates (n=30) collected from Holland Marsh in 2020. Results from the conidial germination assay showed that 97% (n=29) of the isolates were insensitive to 5 µg a.i./mL azoxystrobin and 70% (n=21) had high insensitivity to 100 µg a.i./mL azoxystrobin. All (100%, n=30) isolates were insensitive to 10 µg a.i./mL fluopyram (Table 1). Overall, 89% of isolates tested were insensitive to both azoxystrobin and fluopyram. Insensitivity of *S. vesicarium* to azoxystrobin and fluopyram increased when compared to results from 2017 (Table 1).

Table 1. *In vitro* response to azoxystrobin and fluopyram of *S. vesicarium* isolates collected in the Holland Marsh, ON in 2020 compared to those collected in 2018 and 2019.

	Percent (number) of *S. vesicarium* isolates and reaction to two fungicide active ingredients				
	Azoxystrobin			Fluopyram (10 µg a.i./mL)	
		2020			
Reaction	2018/2019	5 µg a.i./mL	100 µg a.i./mL	2018/2019	2020
Sensitive	6% (3)	0	10% (3)	61% (57)	0
Insensitive	90% (47*)	87% (26)	33% (10)	18% (17)	20% (6)
Mycelium insensitive but conidia sensitive	2% (1)	3% (1)	20% (6)	0	0
Conidia insensitive but mycelium sensitive	2% (1)	10% (3)	37% (11)	20% (19)	80% (24)
Total exhibiting insensitivity	94% (49)	100% (30)	90% (27)	38% (36)	100% (30)

*****20 isolates were identified as highly insensitive to 100 ppm

Funding for this project was provided by Ontario Agri-Food Innovation Alliance.

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Traverse
PEST: Stemphylium leaf blight (*Stemphylium vesicarium* (Wallr.))

AUTHORS: KOOY M & MCDONALD MR
U of Guelph, Dept. of Plant Agriculture, Ontario Crops Research Centre - Bradford

TITLE: EVALUATION OF FORECASTING MODELS FOR THE CONTROL OF STEMPHYLIUM LEAF BLIGH IN YELLOW COOKING ONIONS, 2021

MATERIALS: DITHANE RAINSHIELD WG (mancozeb 75.0%), MIRAVIS DUO (pydiflumetofen 7.5%, difenoconazole 12.5%), EVERGOL PRIME (penflufen 22.7%)

METHODS: Onions, cv. Traverse with penflufen as a seed treatment, were direct seeded (≈ 35 seeds/m) on 11 May into organic soil (organic matter ≈ 68.1%, pH ≈ 6.2) using a Stanhay precision seeder at the Ontario Crops Research Centre - Bradford, Ontario. Fungicide sprays were timed based on different disease forecasting models. The trial was arranged in a randomized complete block design with four replicates. Each experimental unit consisted of 2 beds each with four rows (40 cm apart) per bed, 6 m in length. Fungicides DITHANE at 2.5 kg/ha and MIRAVIS DUO at 1 L/ha were alternated, starting with DITHANE. These were applied using a tractor-mounted sprayer fitted with hollow cone D-3 spray nozzles at 620 kPa to deliver 500 L solution/ha. The disease forecasting models were TOMcast with threshold 15, TOMcast with threshold 25, BSPcast, and a calendar based spray program (7-10 day interval starting at the 4 true leaf stage). An untreated check was included as well as an untreated check without penflufen as a seed treatment. On 25 June, 6, 13, 20, 27 July, 3, 10 August, in-field assessments were conducted of the three oldest leaves on 20 randomly chosen onions per replicate. The area of the leaf infected with *S. vesicarium* was rated and divided into classes using a 0-4 scale where class 0 = no symptoms, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, and class 4 = >50%. The rating for the plant is the sum of the score of the three leaves. The number of plants in each class was used to determine the disease severity index (DSI) using the following formula:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of leaves in each class})]}{(\text{total no. of leaves assessed})\ (\text{no. of classes} - 1)} \times 100$$

And area under the disease progress curve (AUDPC) using the following formula:

$$\text{AUDPC} = \sum_{j=1}^{Nj-1} \left(\frac{y_j + y_{j+1}}{2}\right)\left(t_{j+1} - t_j\right)$$

Where j is the order index for the times and n_j is the total number of assessments, y_j is the average OT count at day t_j, y_{j+1} is the average OT count at day t_{j+1} and (t_{j+1} - t_j) is the number of days between two assessments.

On 16 August, the green leaves of 20 onion plants randomly chosen from the inner rows of every replicate were removed and sorted into classes based on the percentage of the leaf area infected with *S. vesicarium.* The classes were: 0 = no disease, 1 = 1-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75%, 6 > 75% infected with *S. vesicarium*. Dead leaves were counted separately. On 15 September, the onions in two 2.32 m sections of row were pulled from the inner rows for a yield sample. The number of leaves in each class were used to determine the disease severity index (DSI) using the above formula. Onions were weighed and graded for size on 8 October to determine yield**.** Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm.

Data were analyzed using a mixed model analysis of variance (PROC GLMIMMIX) in SAS. Means were separated using Tukey's Honest Significant Difference (HSD) at P = 0.05 level of significance.

RESULTS: as presented in Tables 2, 3 and 4

CONCLUSIONS: Disease severity was relatively low in 2021 (43% in the nontreated check). All disease forecasting models reduced disease severity in the final assessment compared to the control without seed treatment. DSI of TOMcast with a threshold of 15 was numerically the lowest (Table 3). This reduction in disease is relatively small and demonstrates that the models triggered more fungicide sprays than needed. Calendar, BSPcast received 6 spray applications, TOMcast with threshold 15 and 25 received 5 and 3 spray applications respectively (Table 1). No significant differences for AUDPC (Table 2) or yield (Table 4) were observed among the treatments. Research is continuing to develop an improved disease forecasting model for SLB on onions.

Table 1. Fungicide timing applications to onions, cv. Traverse, 2021.

Treatment	30 Jun	12 Jul	21 Jul	28 Jul	4 Aug	12 Aug
Calendar	DITHANE	MIRAVIS DUO	DITHANE	MIRAVIS DUO	DITHANE	MIRAVIS DUO
BSPcast	DITHANE	MIRAVIS DUO	DITHANE	MIRAVIS DUO	DITHANE	MIRAVIS DUO
TOMcast 15	DITHANE	MIRAVIS DUO	DITHANE	-	MIRAVIS DUO	-
TOMcast 25	-	DITHANE	-	MIRAVIS DUO	-	DITHANE
Control w/o ST	-	-	-	-	-	-
Control ST	-	-	-	-	-	-

Table 2. Area under the disease progress curve (AUDPC) and disease severity index (DSI) for onions, cv. Traverse, sprayed with alternating fungicides according to forecasting models at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment[1]	AUDPC[2]	DSI[3]				
		13 July	20 July	27 July	3 Aug	10 August
Control w/o ST	1554.8 ns[4]	16.6 ns	39.3 ns	58.3 ns	64.0 ns	75.7 ns
TOMcast 25	1541.7	17.1	37.8	57.6	62.8	72.3
Control ST	1516.7	17.9	34.5	55.1	62.2	73.4
BSPcast	1433.3	16.0	34.1	52.6	62.3	66.5
TOMcast 15	1349.7	14.1	30.4	48.5	61.9	65.5
Calendar	1338.4	11.4	31.9	49.7	60.1	65.4

[1] See Table 1 for fungicide application dates

[2] Area under the disease progress curve (AUDPC) was based on the disease severity index for, 13, 20, 27 July & 3, 10 August and was determined using the following equation:

$$\text{AUDPC} = \sum_{j=1}^{N_{j-1}} \left(\frac{y_j + y_{j+1}}{2}\right)\left(t_{j+1} - t_j\right)$$

[3] Disease severity (DSI) was calculated using the following formula:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of leaves in each class})]}{(\text{total no. leaves assessed})\ (\text{no. classes} - 1)} \times 100$$

[4] ns = no significant differences were found among treatments at P = 0.05, Tukey's HSD test.

Table 3. Stemphylium leaf blight (SLB) incidence and severity for onions, cv. Traverse, sprayed with alternating fungicides when forecasting models triggered sprays and destructively sampled on Aug. 16, at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment[1]	DSI	SLB incidence	% Leaves rated 0 or 1[2]	Green leaves/plant
Control w/o ST	43.5 a[3]	84.9 ns[4]	30.7 ns	7.0 ns
TOMcast 25	38.1 ab	80.9	36.5	7.4
Control ST	36.5 ab	78.2	42.3	7.5
BSPcast	36.1 ab	80.3	38.8	7.4
Calendar	33.5 b	77.0	44.8	7.7
TOMcast 15	33.3 b	75.5	45.8	7.7

[1]See Table 1 for fungicide application dates
[2] On 16 August the leaves of 20 plants were sorted into classes: 0= no disease, 1 = 1-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75%, 6 > 75% based on the percentage of leaf area infected with Stemphylium.
[3] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Tukey's HSD test.
[4] ns = no significant differences at P = 0.05, Tukey's HSD test.

Table 4. Yield of onion cv. Traverse, sprayed based on disease forecasting programs at the Ontario Crops Research Centre – Bradford, Ontario, 2021.

Treatment[1]	Yield (t/ha)	% Mkb	Size distribution (%)			
			Jumbo (>76mm)	Large (76-64 mm)	Medium (>64-45 mm)	Cull
Calendar (7-10 days)	63 ns[2]	98 ns	4 ns	46 ns	48 ns	2 ns
TOMcast 15	60	96	3	42	51	4
BSPcast	59	98	2	40	55	2
Control w/o ST	59	98	7	45	46	2
TOMcast 25	53	95	0	34	61	5
Control ST	53	97	3	37	58	3

[1]See Table 1 for fungicide application dates
[2] ns = no significant differences at P = 0.05, Tukey's HSD test.

Funding for this project was provided by Ontario Agri-Food Innovation Alliance and the California Garlic and Onion Research Advisory Board

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FOODLAND ONTARIO

CROP: Yellow & Red cooking onion (*Allium cepa L.*) & French Red Shallots (*Allium cepa* var. *aggregatum*)

PEST: Stemphylium leaf blight (*Stemphylium vesicarium* (Wallr.))

AUTHORS: KOOY M & MCDONALD MR & VANDER KOOI K
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TITLE: **SUSCEPTIBILITY OF ONION CULTIVARS TO STEMPHYLIUM LEAF BLIGHT CAUSED BY STEMPHYLIUM VESICARIUM, 2021**

MATERIALS: Cultivars used: Yellow Onions (Safrane, Yankee, Powell), Red Onion (Monstrell), French Red Shallots (Innovator and Conservor).

METHODS: Four onion cultivars and two cultivars of shallots (Table 1) were evaluated for incidence and severity of Stemphylium leaf blight. Onions Yankee and Powell are resistant to onion downy mildew (*Peronospora destructor*). Red onion Monstrell was found to be susceptible to Stemphylium leaf blight in earlier trials. Safrane was included as a standard yellow onion cultivar. Shallots Innovator and Conservor were included to compare differences between varieties. Onions were seeded in plug trays on 14 April and transplanted on 6 May into organic soil (organic matter ≈ 68.1%, pH ≈ 6.2) at the Ontario Crops Research Centre - Bradford, Holland Marsh, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of 4 rows spaced 40 cm apart, and 6 m in length. No fungicide sprays were applied during the growing season. On 25 June, 6, 13, 20, 27 July, in-field assessments were conducted of the three oldest leaves on 20 randomly chosen onions per replicate. The area of the leaf infected with *S. vesicarium* was rated using a 0-4 scale where 0 = no symptoms, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, 4 = >50%. The rating for the plant was the sum of the score of the three leaves. The number of plants in each class was used to determine the disease severity index (DSI) using the following formula:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of leaves in each class})]}{(\text{total no. of leaves assessed})\ (\text{no. of classes} - 1)} \times 100$$

And area under the disease progress curve (AUDPC) using the following formula:

$$\text{AUDPC} = \sum_{j=1}^{Nj-1} \left(\frac{y_j + y_{j+1}}{2}\right)(t_{j+1} - t_j)$$

Where j is the order index for the times and n_j is the total number of assessments, y_j is the average OT count at day t_j, y_{j+1} is the average OT count at day t_{j+1} and $(t_{j+1} - t_j)$ is the number of days between two assessments.

On 5 August, the green leaves of 20 onion plants randomly chosen from the inner rows of every replicate were removed and sorted into classes based on the percentage of the leaf area infected with *S. vesicarium.* The classes were: 0 = no disease, 1 = 1-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75%, 6 > 75% infected with S. vesicarium. Dead leaves were counted separately. On 15 September, the onions in two 2.32 m sections of row were pulled from the inner rows for a yield sample. The number of leaves in each class were used to determine the disease severity index (DSI) using the above formula. Onions were weighed and graded for size on 8 October to determine yield. Data were analyzed using a mixed model analysis of variance (PROC GLMIMMIX) in SAS. Means were separated using Tukey's Honest Significant Difference (HSD) at P = 0.05 level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSIONS: Significant differences in disease severity were found on the 13 and 20 July assessments and in AUDPC. The yellow onion cv.'s Yankee, Powell and Safrane and red onion Monstrell had higher AUDPC than the shallot Conservor (Table 1). Significant differences were also found in SLB incidence and DSI on the final assessment date. (Table 2). Differences in yield were found. As expected, the shallots Innovator and Conservor had lower yields than the bulb onions due different bulb shape and smaller size. Conservor had lower yields.

Table 1. Area under the disease progress curve (AUDPC) and disease severity index (DSI) for onion cultivars at the Ontario Crops Research Centre - Bradford, Holland Marsh, Ontario, 2021.

Cultivar	Variety	Source	DSI[2]			AUDPC[1]
			13 July	20 July	27 July	
Yankee	Yellow	Bejo Seeds	42.3 a	54.3 a	74.7 ns	1074.6 a[3]
Powell	Yellow	Bejo Seeds	37.6 ab	49.2 a	64.0	953.8 ab
Safrane	Yellow	Bejo Seeds	36.7 ab	46.1 a	64.7	941.0 ab
Monstrell	Red	Enza Zaden	33.2 ab	46.1 a	60.3	872.5 b
Innovator	Shallot	Bejo Seeds	31.6 bc	36.0 b	70.8	865.5 bc
Conservor	Shallot	Bejo Seeds	23.8 c	32.9 b	51.6	691.5 c

[1] Area under the disease progress curve (AUDPC) was based on the disease severity index for, 13, 20, 27 July and was determined using the following equation:

$$\text{AUDPC} = \sum_{j=1}^{N_{j-1}} \left(\frac{y_j + y_{j+1}}{2}\right)(t_{j+1} - t_j)$$

[2] Disease severity (DSI) was calculated using the following formula:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of leaves in each class})]}{(\text{total no. leaves assessed})\ (\text{no. classes } -1)} \times 100$$

[3] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Tukey's HSD test.
[4] ns = no significant differences were found among treatments at P = 0.05, Tukey's HSD test.

Table 2. Stemphylium leaf blight (SLB) incidence and severity for onion cultivars destructively sampled on Aug. 16, at the Ontario Crops Research Centre - Bradford, Holland Marsh, Ontario, 2021.

Cultivar	SLB incidence	DSI[1]	% Leaves rated 0 or 1[2]	Green leaves/plant	Yield (t/ha)
Safrane	93.2 a	49.7 a[2]	21.9 c	6.7 b	47.8 a[1]
Yankee	86.7 a	45.1 ab	28.8 bc	6.9 b	38.4 abc
Powell	85.7 a	43.5 ab	27.7 bc	6.5 b	42.7 ab
Monstrell	70.6 b	37.7 abc	43.8 ab	6.3 b	33.3 bc
Innovator	73.0 b	34.3 c	48.3 a	9.2 a	30.3 c
Conservor	69.0 b	30.4 c	54.4 a	8.6 a	17.5 d

[1]Disease severity (DSI) was calculated using the following formula:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of leaves in each class})]}{(\text{total no. leaves assessed})\ (\text{no. classes } -1)} \times 100$$

[2] On 5 August the leaves of 20 plants were sorted into classes: 0= no disease, 1 = 1-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75%, 6 > 75% based on the percentage of leaf area infected with Stemphylium.
[3] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Tukey's HSD test.

Funding for this project was provided by Plant Production Systems of the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph partnership.

PESTS: Stemphylium leaf blight (*Stemphylium vesicarium* (Wallr.))
Onion downy mildew (*Peronospora destructor* (Berk.) Casp. in Berk.))

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TITLE: COMPARING ROTOROD AND SPORNADO SPORE TRAPPING METHODS IN THE HOLLAND MARSH, 2021

METHODS: Two spore trapping methods, the Rotorod and Spornado samplers, were compared for the ability to recover airborne *S. vesicarium* and *P. destructor* spores at the Ontario Crops Research Centre - Bradford in the Holland Marsh, 2021. The Rotorod spore sampler, also known as a rotating arm impactor, is setup and adjusted to be just above the onion canopy throughout the season and collects spores on two 1.52 mm wide and 3.15 cm long polystyrene rods lined with a silicone grease. Every Monday, Wednesday and Friday from 19 June to 4 September the rotorod would rotate at 2400 rpm between 06:00 to 12:00 with an air sampling rate of 20.65 L/min/rod. Spores trapped on each rod were identified to genus and counted using a compound microscope. The Spornado passively collects airborne spores in collection cassettes 106 cm above the ground. The number of days between collection varied between three to four days on average. Spores were collected between 24 June to 2 September and were analyzed using qPCR by Sporometrics Inc. (Toronto, ON).
Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C), August (22.2°C) and October (12.8°C), average for September (15.8C), and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C, September 16.4°C and October 9.8°C.
Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm), average for October (77 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm, September 59 mm and October 78 mm. Spore counts from each trap and forecasting risk on onions were analyzed using the Correlations function of the Linear Analysis section of Statistix V.10.

RESULTS: Data are presented in Figures 1 and 2. Onion downy mildew sporulation was first found in a community garden ~5 km from the Holland Marsh on 26 July. On 5 August, downy mildew was found on station and in a commercial onion field. There was no correlation between Rotorod and Spornado *S. vesicarium* spore counts (r=0.06, p=0.756) and a weak negative correlation for *P. destructor* spore counts (r=-0.15, p=0.550). Rotorod *S. vesicarium* counts had a weak positive correlation with high Stemphylium leaf blight risk (r=0.27, p=0.210), but *P. destructor* counts had a weak negative correlation with downy mildew sporulation-infection periods (r=-0.23, p=0.343). Spornado *S. vesicarium* spore counts had a weak positive correlation with a high risk for Stemphylium leaf blight (r=0.17, p=0.442) and *P. destructor* counts had a significant positive correlation with downy mildew sporulation-infection events (r=0.51, p=0.027).

CONCLUSIONS: There continues to be differences in spore trapping and identification between the Rotorod and Spornado spore traps. The Spornado was more accurate at capturing and identifying *S. vesicarium* and *P. destructor* during the 2021 season compared to 2020; however, there continued to be periods where the Spornado indicated no conidia of *S. vesicarium* when there was a high Stemphylium leaf blight risk and conidia of the pathogen were found on the Rotorod. The Spornado was accurate in identifying *P. destructor* during downy mildew sporulation-infection periods. Both spore traps have their benefits. The Spornado is a low maintenance piece of equipment and is not very labour intensive while the Rotorod is more cost effective and results can be available the day of collection.

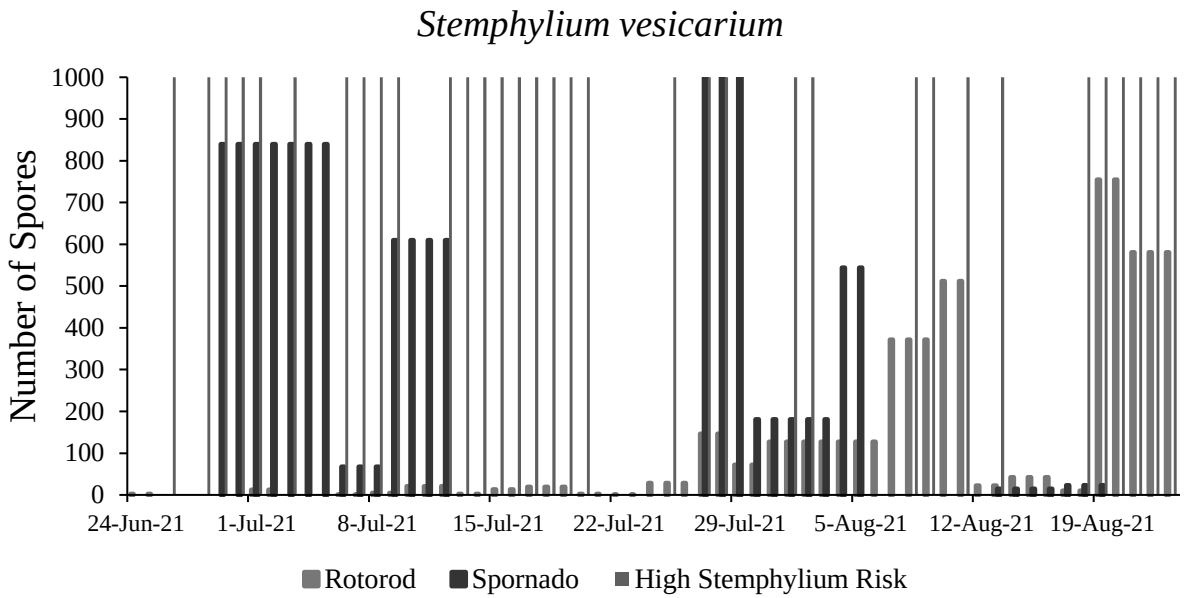

Figure 1. Number of *Stemphylium vesicarium* spores trapped and identified in the Rotorod and Spornado, and days of high risk for Stemphylium leaf blight development on onions predicated using BSPCAST during the growing season at the Ontario Crops Research Centre - Bradford, 2021.

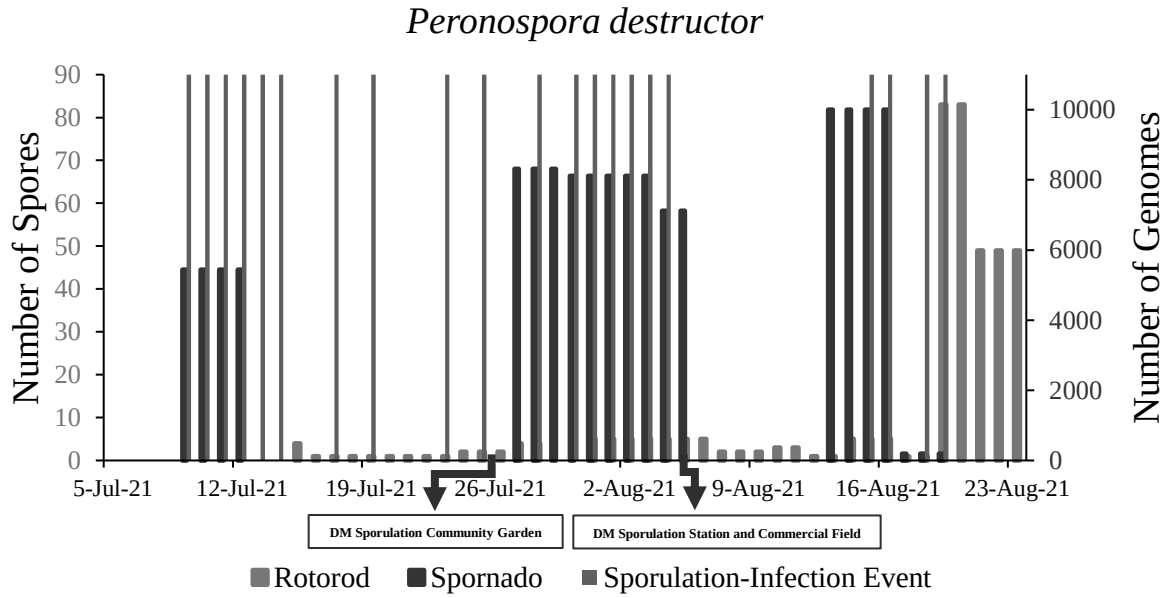

Figure 2. Number of *Peronospora destructor* spores trapped and identified in the Rotorod and Spornado, and onion downy mildew sporulation-infection events predicated using DOWNCAST during the growing season at the Ontario Crops Research Centre - Bradford, 2021.

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Catskill
PEST: Stemphylium leaf blight (*Stemphylium vesicarium* (Wallr.))

AUTHORS: MCDONALD MR & VANDER KOOI K
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TITLE: EVALUATION OF DROPLEG BELUGA TECHNOLOGY ON FUNGICIDE EFFICACY IN ONIONS, 2021

MATERIALS: SERCADIS (fluxapyroxad 300 g/L)

METHODS: Onions, cv. Catskill, were direct seeded (35 seeds/m) on 7 May using a Stanhay Precision Seeder into organic soil (organic matter ≈ 72.4%, pH ≈ 6.7) at the Ontario Crops Research Centre - Bradford, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each experimental unit consisted of eight rows (40 cm apart), 10 m in length. TeeJet AI9503 and Beluga droplegs (Agrotop Spray Technology, Obertraubling, Germany) equipped with SprayMax SMP110015 nozzles were compared for control of stemphylium leaf blight. Beluga heads are designed to spray perpendicular to the crop rows from within the crop canopy. Each dropleg was spaced 40 cm apart on the sprayer boom. Seven droplegs were used with the nozzle body positioned 20 cm into the onion canopy between the onion rows. A standard broadcast arrangement used seven TeeJet AI9503 nozzles spaced 50 cm apart on the boom positioned some 50 cm above the onion crop. SERCADIS at 666 mL/ha was applied on 21, 28 July, and 5 August using a tractor-mounted sprayer calibrated to deliver 500 L solution/ha at 620 kPa. In-field Stemphylium leaf blight (SLB) assessments were conducted on 20 July and 5 August, using the three oldest leaves on 20 randomly chosen onions per replicate. The area of the leaf infected with stemphylium was rated using a 0-4 scale where 0 = no SLB symptoms, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, 4= >50%. The rating for the plant is the sum of the score of the three leaves, with the highest score possible being 12. The number of plants in each class was used to determine the disease severity index (DSI) using the following formula:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of leaves in each class})]}{(\text{total no. leaves assessed})\ (\text{no. classes } -1)} \times 100$$

On 19 August, the green leaves of 20 onion plants randomly chosen from the inner rows of every replicate were removed and sorted into classes based on the percentage of the leaf area infected with symptoms of *Stemphylium* infection. The classes were: 0 = no disease, 1 = 1-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75%, 6 > 75% with symptoms. Dead leaves were counted separately. The number of leaves in each class was used to determine the disease severity index (DSI) using the above formula. On 17 September, onions in two 2.32 m sections of row were pulled from the middle six rows for a yield sample. Onions were weighed and graded for size on 21 October to determine yield. Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm. Data were analyzed using the General Analysis of Variance function of Statistix V.10. Means separation was obtained by using Fisher's Protected LSD test at $P = 0.05$ level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSIONS: No significant differences in Stemphylium leaf blight average ratings, incidence or severity were found among fungicide treatments applied with the standard broadcast (via TeeJet AI9503 nozzles) or Beluga dropleg technology at the in-field or final assessments (Table 1). There were no significant differences in yield between treatments (Table 2).

Table 1. Stemphylium leaf blight (SLB) incidence and severity for onions cv. Catskill, treated with fungicides using TeeJet AI9503 or Dropleg Beluga nozzles at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Nozzle	20 July			5 August			19 August leaf sort[1]		
	SLB[2] rating	% SLB	DSI[3]	SLB rating	% SLB	DSI	% SLB	DSI	% Dead leaves
Beluga	2.3 ns[4]	85.8 ns	18.8 ns	6.0 ns	100.0 ns	50.1 ns	86.5 ns	43.9 ns	19.4 ns
TeeJet	1.6	66.7	13.7	6.2	100.0	51.5	88.6	46.3	23.8

[1] On 19 Aug, leaves of 20 plants/replicate were removed and sorted into the following classes: 0 = 0 stemphylium, 1 = 1-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 =51-75%, 6 = >75% of the leaf area diseased.

[2] On 20 July and 5 Aug, the three oldest leaves/plant on 20 onions were rated on a 0-4 scale: 0 = no stemphylium, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, 4= >50% of leaf diseased. The sum of the 3-leaf ratings for each plant was recorded (12 max. rating).

[3] Disease Severity Index (DSI) was determined using the above classes and the following equation:

$$DSI = \frac{\sum [(\text{class no.})\ (\text{no. plants in each class})]}{(\text{total no. plants assessed})\ (\text{no. classes} - 1)} \times 100$$

[4] ns indicates no significant differences were found among the treatments

Table 2. Yield data for onions, cv. Catskill, treated with fungicide using Dropleg Beluga nozzles and TeeJet AI9503 nozzles grown near the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Nozzle	Yield (t/ha)	% Marketable	Size Distribution (%)[1]			
			Jumbo (>76 mm)	Large (65-76 mm)	Medium (46-64 mm)	Cull (<45 mm)
Beluga	59.5 ns[2]	95.2 ns	1.6 ns	24.6 ns	69.0 ns	4.8 ns
TeeJet	61.5	95.5	1.3	28.8	64.4	4.5

[1] Percentage was determined by weight

[2] ns = no significant differences were found among the treatments

Funding for this project was provided by the Ontario Agri-Food Innovation Alliance and The Fresh Vegetable Growers of Ontario.

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Milestone
PESTS: Stemphylium leaf blight (*Stemphylium vesicarium* (Wallr.) Simmons)
Onion downy mildew (*Peronospora destructor* [Berk] Casp.

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TITLE: EVALUATION OF EXPERIMENTAL PRODUCTS FOR CONTROL OF DISEASES IN YELLOW COOKING ONIONS, 2021

MATERIALS: experimental Suncor products (MEM, MOR-B, HAF-01), SERCADIS (fluxapyroxad 300 g/L),

METHODS: Onions, cv. Milestone, were direct seeded (≈ 35 seed/m) into organic soil (organic matter ≈ 67.3%, pH ≈ 6.8) on 11 May using a Stanhay precision seeder, at the Ontario Crops Research Centre – Bradford, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of four rows (40 cm apart), 6 m in length. Treatments were experimental Suncor products 0.35 % MEM, 0.35% MEM + 0.5% HAF, 3% MOR-B, 0.35% MEM alternated with SERCADIS at 666 mL/ha. A standard fungicide treatment of SERCADIS at 666 mL/ha was also included. An untreated check was also included. Treatments were applied beginning at the 4-leaf stage. Treatments were applied on 25 June, 5, 14, 22 July and 4 August using a CO_2 backpack sprayer equipped with four TeeJet 8002 VS fan nozzles spaced 40 cm apart and calibrated to deliver 400 L/ha at 275 kPa. On 13 August, 20 onions (10 from each of the inside two rows) were pulled from each replicate. Leaves were removed and green leaves sorted into categories based on the percentage of the leaf area infected with stemphylium. The seven categories were: 0 = 0-1%, 1 = 2-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75%, 6 = >75%. Plots were visually inspected for downy mildew lesions weekly. On 12 September onions in two 2.32 m sections of row from the middle two rows per replicate were harvested. On 4 November, onions were sorted by size and weighed to determine yield. Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm.
Data were analysed using the General Analyses of Variance function of the Linear Models section of Statistix V.10. Means separation was obtained using Fisher's Protected LSD test with P = 0.05 level of significance.

RESULTS & DISCUSSION: Stemphylium leaf blight (SLB) developed later in the season and pressure was moderate in 2021. No significant differences in SLB incidence and severity were found among the treatments (Table 1). The weather was conducive for the development of onion downy mildew in 2021 however only a few lesions were found in the entire trial. No significant were found among the treatments for downy mildew.
No significant differences in yield (t/ha) were found among treatments (Table 2). Onions sprayed with MEM + HAF had pythotoxity on the oldest leaves following the first application and the rate of HAF was reduced for the sequent applications. Onions treated with MOR-B had significantly fewer green leaves than all the other treatment and had the lowest yield of any treatment.

CONCLUSIONS: The experimental treatments used in 2021 did not reduce stemphylium incidence. Experimental product MOR-B had the lowest yields.

Table 1. Stemphylium (SLB) incidence and severity for onions, cv. Milestone, treated with experimental products and grown at the Ontario Crops Research Centre – Bradford, Ontario, 2021.

Treatment	SLB Incidence[1] (%)	DSI	% Leaves rated 0-1	Healthy Leaves/Plant
MEM or SERCADIS	73.0 ns[2]	35.1 ns	43.9 ns	7.6 a[3]
MEM + HAF	75.8	37.4	40.4	6.8 bc
MEM	77.6	36.8	41.5	7.3 ab
SERCADIS	79.5	38.6	37.4	7.2 ab
MOR-B	80.3	40.5	36.1	6.6 c
Check	80.9	40.6	37.0	7.3 ab

[1] On 13 August leaves of 20 plants/replicate were removed and sorted into the following classes: 0 = 0-1% stemphylium, 1 = 2-4%, 2 = 5-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75%, 6 = >75% of the leaf area infected with SLB.
[2] ns indicates no significant differences were found among the treatments.
[3] Numbers in a column followed by the same letter at not significantly different at P = 0.05, Fisher's Protected LSD test

Table 2. Yield and size distribution for onions, cv. Milestone, treated with experimental products and grown at the Ontario Crops Research Centre – Bradford, Ontario, 2021.

Treatment	Yield (t/ha)	% Mkb	Size Distribution (%)[1]			
			Jumbo (>76mm)	Large (65-76mm)	Medium (46-64mm)	Cull (<45mm)
MEM or SERCADIS	62.5 ns[2]	97.7 ns	2.9 ns	41.5 ns	53.3 ns	2.3 ns
Check	60.4	97.9	2.3	37.9	57.6	2.1
MEM	58.3	98.4	3.5	49.0	45.9	1.6
SERCADIS	57.1	97.4	2.9	42.9	51.6	2.6
MEM + HAF	56.4	97.5	1.4	34.3	61.9	2.5
MOR-B	54.6	96.2	2.7	36.9	56.6	3.8

[1] Percentage values were determined using weight.
[2] ns= no significant differences were found at P = 0.05, Fisher's Protected LSD test.

Funding for this project was provided by Suncor Energy.

CROP: Onion (*Allium cepa* L.), cv. Milestone
PEST: Onion downy mildew (*Peronospora destructor* (Berk.) Casp. in Berk.)

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TITLE: EVALUATION OF EXPERIMENTAL FUNGICIDES FOR CONTROL OF DOWNY MILDEW ON DRY BULB ONIONS, 2021

MATERIALS: RIDOMIL GOLD 480 SL (metalaxyl-M and S-isomer 480 g/L), ORONDIS GOLD (oxathiapiprolin 35 g/L), A23778A (experimental), A22556B (experimental)

METHODS: Onions, cv. Milestone, were direct seeded at 35 seeds/m on 7 May into organic soil, (organic matter ≈ 68.3%, pH ≈ 6.4) at the Ontario Crops Research Centre - Bradford, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of four rows spaced 40 cm apart, and 5 m in length. Treatments were applied as foliar sprays using a CO_2 back pack sprayer equipped with four TeeJet 8002 fan nozzles calibrated to deliver 500 L/ha at 275 kPa. Treatments were: RIDOMIL GOLD 480 SL at 219 mL, ORONDIS GOLD at 1.0 L/ha, A22556B at 1.0 L/ha and A23778A at 1.0 L/ha. An untreated check was also included. Treatments were applied on 12, 20, 30 July and 9 August. On 12, 20, 30 July and 9 August, all onions in each replicate were visually examined for the presence of downy mildew lesions and if present, the numbers were recorded. On the same dates, plots were visually rated for phytotoxicity using a 0 to 5 scale where 0 = no injury, 1 = slight yellowing, 2 = some tissue death, 3 = over 50% plant tissue brown, 4 = >75% dead tissue, 5 = plant necrosis. On 15 September, onions in two, 2.32 m sections of row per replicate were pulled. On 19 October, onions were removed from storage, sorted into Jumbo (> 76mm), Large (76-64 mm), Medium (<64-45 mm) and Small (<45 mm) size categories, weighed and counted to determine yield. Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm. Yield data were analyzed using the General Analysis of Variance function of Statistix V.10. Means separation was obtained by using Fisher's Protected LSD test at P = 0.05 level of significance.

RESULTS: as presented in Tables 1-3

CONCLUSIONS: The weather in 2021 was conducive to the development of downy mildew in onions but no lesions were detected in trial. No downy mildew was observed in the trial (Table 1). No significant differences in percent marketable or yield were observed among the treatments (Table 2).

Funding for this project was provided by Syngenta Canada.

Table 1. Downy mildew (DM) incidence for onions, cv. Milestone, treated with fungicides and grown at the Ontario Crops Research Centre – Bradford, Ontario, 2021.

Treatment	Product rate mL/ha	DM Lesions/plot[1]			
		20 July	27 July	10 Aug	17 Aug
RIDOMIL GOLD 480SL	219	0	0	0	0
A23778A	1000	0	0	0	0
A22556B	1000	0	0	0	0
ORONDIS GOLD	1000	0	0	0	0
Check	--	0	0	0	0

[1] Data was not analysed statistically

Table 2. Phototoxicity ratings for onions, cv. Milestone, treated with fungicides and grown at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment	Product rate mL/ha	Phototoxicity Ratings[1]			
		20 July	27 July	10 Aug	17 Aug
RIDOMIL GOLD 480SL	219	0[2]	0	0	0
A23778A	1000	0	0	0	0
A22556B	1000	0	0	0	0
ORONDIS GOLD	1000	0	0	0	0
Check	--	0	0	0	0

[1] Phytotoxicity rating 0-10, where 0 = no toxicity, 1 = 1-10% crop injury, 2 = 11-20% crop injury, 3 = 21-30% crop injury, 4 = 31-40% crop injury, 5 = 41-50% crop injury, 6 = 51-60% crop injury, 7 = 61-70% crop injury, 8 = 71-80% crop injury, 9 = 81-90% crop injury, 10 = 91-100% crop injury

[2] Data set consists of zeros, and therefore was not statistically analysed.

Table 3. Yield and size distribution for onions, cv. Milestone, treated with fungicides and grown at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment	Product Rate (ml/ha)	% Mkb	Yield (t/ha)	Size Distribution (%)[1]			
				Jumbo (>76 mm)	Large (76-64 mm)	Medium (64-45 mm)	Cull (<45 mm)
RIDOMIL GOLD 480SL	219	99.4 ns[2]	86.0 ns	2.3 ab	48.1 ns	48.9 ns	0.6 ns
A23778A	1000	98.0	78.4	2.2 ab	44.9	51.0	2.0
A22556B	1000	98.9	79.8	0.0 b	44.6	54.3	1.1
ORONDIS GOLD	1000	98.7	82.0	4.9 a	46.1	47.8	1.3
Check	--	98.0	78.7	1.9 ab	48.6	47.5	2.0

[1] Percentage values were determined using weight.

[2]ns= no significant differences were found at *P*= 0.05, Fisher's Protected LSD test.

CROP: Onion (*Allium cepa* L.), cv. Milestone
PEST: Onion downy mildew (*Peronospora destructor* (Berk.) Casp. in Berk.)

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TITLE: EVALUATION OF FUNGICIDES FOR CONTROL OF DOWNY MILDEW ON DRY BULB ONIONS, 2021

MATERIALS: ORONDIS ULTRA (oxathiapiprolin 30 g/L, mandipropamid 250 g/L), ZAMPRO SC (ametoctradin 300 g/L, dimethomorph 225 g/L), RIDOMIL GOLD MZ 68 WG (metalaxyl-M and S-isomer 4%, mancozeb 64%), DITHANE 750 F (mancozeb 75%), SYLGARD 309 (siloxylated polyether 76%), DIPLOMAT (polyoxin D zinc salt 5%), PICARBUTRAZOX 10SC (picarbutrazox), SERIFEL (Bacillus amyloliquefaciens strain mbi 600), PREV-AM (sodium tetraborohydrate decahydrate 0.99%)

METHODS: Onions, cv. Milestone, were direct seeded on 6 May into organic soil, (organic matter ≈ 68.3%, pH ≈ 6.4) using a Stanhay Precision seeder at the Ontario Crops Research Centre - Bradford, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of four rows spaced 43 cm apart, and 6 m in length. Treatments were applied as foliar sprays using a CO_2 backpack sprayer equipped with four TeeJet 8002 fan nozzles calibrated to deliver 500 L/ha at 275 kPa. Treatments were: ORONDIS ULTRA at 400 mL/ha, ZAMPRO at 1.0 L/ha + Sylgard at 0.25% v/v, T-77 at 500 g/ha, ORONDIS ULTRA at 400 mL/ha alternated with ZAMPRO at 1.0 L/ha + Sylgard at 0.25% v/v, ORONDIS ULTRA at 400 mL/ha alternated with RIDOMIL MZ at 2.5 kg/ha, RIDOMIL MZ at 2.5 kg/ha and DITHANE at 3.25 kg/ha, + SYLGARD at 0.25% v/v. An untreated check was also included. Treatments were applied on 12, 20 July, and 3, and 13 August based on disease forecasting. On 24 July, 9 and 16 August, all onions in each replicate were visually examined for the presence of downy mildew (DM) lesions. On 9 September, onions in two, 2.32 m sections of row (2 x 1 m^2) per replicate were pulled. On 9 October, onions were removed from storage, sorted into size categories, weighed and counted to determine yield.
Yield data were analyzed using the General Analysis of Variance function of Statistix V.10. Means separation was obtained by using Fisher's Protected LSD test at P = 0.05 level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSIONS: The weather in 2021 was conducive to the development of downy mildew in onions but no lesions were detected until early August. No significant differences in the number of downy mildew lesions between treatments were observed in the trial (Table 1). The DIPLOMAT and PREV AM treatments had the highest numbers of lesions. No significant differences in yield or size distribution were observed among the treatments (Table 2).

Table 1. Downy mildew (DM) incidence for onions, cv. Milestone, treated with fungicides and grown at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment[1]	Rate (per ha)	DM Lesions/plot[2]			Total lesions
		24 Jul	9 Aug	16 Aug	
RIDOMIL MZ alt/w ORONDIS ULTRA[3]	2.5 kg	0 ns[4]	0.0 ns	0.0 ns	0.0 ns
PICARBUTRAZOX	880 mL	0	0.3	0.5	0.8
ZAMPRO + SYLGARD	1.0 L + 0.25% v/v	0	0.5	0.8	1.3
ORONDIS ULTRA	400 mL	0	0.8	1.8	2.5
SEREFIL	1.0 kg	0	3.0	2.3	5.3.
PREV-AM	2.0 L	0	8.0	2.5	10.5
DIPLOMAT	926 mL	0	15.5	5.5	21.0
Check	-	0	8.8	7.3	16.0

[1] Treatments were applied on 12, 20 July, 3, 13 August.
[2] The entire plot was visually examined for DM lesions and numbers recorded.
[3] RIDOMIL MZ was applied on 12 July, 3 August. ORONDIS ULTRA was applied on 20 July, 13 August.
[4] ns = no significant differences were found among treatments at P = 0.05, Fisher's Protected LSD test.

Table 2. Yield and size distribution for onions, cv. Milestone, treated with fungicides and grown at the Ontario Crops Research Centre – Bradford, Ontario, 2021.

Treatment	Yield (t/ha)	% Mkb	Size distribution (%)[1]		
			Jumbo (>76 mm)	Large (76-64 mm)	Medium (63-45 mm)
ORONDIS ULTRA	80.7 ns[2]	98.8 ns	4.6 ns	40.1 ns	54.1 ns
SEREFIL	76.8	98.2	2.6	42.1	53.5
ZAMPRO + SYLGARD	76.5	97.6	3.8	38.6	55.3
DIPLOMAT	75.2	98.0	1.0	39.4	57.6
RIDOMIL MZ alt/w ORONDIS ULTRA[3]	74.8	97.3	0.3	43.5	53.5
PICARBUTRAZOX	74.6	97.9	1.6	43.2	53.2
Check	70.4	95.8	1.3	35.4	59.1
PREV-AM	69.5	97.2	0.7	30.4	66.1

[1] Percentage was determined by weight.
[2] ns = no significant differences at P = 0.05, Fisher's Protected LSD test
[3] RIDOMIL MZ was applied on 12 July, 3 August. ORONDIS ULTRA was applied on 20 July, 13 August.

Funding for this project was provided by the Plant Production Systems of the Ontario Agri-Food Innovation Alliance and by the California Garlic and Onion Research Advisory Board.

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Fortress
PEST: Onion smut (*Urocystis colchici* var. *cepulae* Cooke)

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TITLE: **EVALUATION OF VARIOUS FUNGICIDES FOR CONTROL OF ONION SMUT IN YELLOW COOKING ONIONS, 2021**

MATERIALS: EVERGOL PRIME (penflufen 22.7%), RANCONA (ipconazole 9.38 g/L), PRO-GRO (carboxin 30% + thiram 30%), 42-S THIRAM (tetramethylthiuram disulfide 42%), SEPRESTO 75 WS (clothianidin 56.25%, imidacloprid 18.75%), FARMORE F300 ((APRON XL(metalaxyl-M and S-isomer 33.3%)

METHODS: The trial was conducted on organic soil (pH ≈ 6.9, organic matter ≈ 58.1%) naturally infested with *Urocystis colchici* at the Ontario Crops Research Centre - Bradford, Ontario. A randomized complete block design with four replicates per treatment was used. Each experimental unit consisted of four rows, spaced 42 cm apart, 6 m in length. Onions, cv. Fortress, were seeded (≈ 35 seeds/m) on 11 May using a Stanhay Precision Seeder. Treatments applied were: EVERGOL PRIME (penflufen at 0.0087 g ai/1,000 seeds), RANCONA (ipconazole at 100 g ai/100 g seed), and PRO-GRO + FARMORE 300 (carboxin 7.50 g ai, thiram 12.5 g ai/kg seed + APRON XL (metalaxyl-M and S-isomer 33%), MAXIM 4FS (fludioxonil 40.3%), DYNASTY (azoxystrobin 9.6%)). A no-fungicide check was also included. Seed treatments were done by Al Taylor's lab using standard methods. All treatments also included the insecticide SEPRESTO 75 WS (clothianidin 0.18 g ai + imidacloprid 0.6 g ai/1,000 seeds) for maggot control and fungicide 42-S THIRAM (1.875 g ai/kg seed) for damping off control. Three randomly chosen 2 m sections of row to be used as damage plots and a 2.32 m yield section were staked out in each replicate. Emerged onions were counted within the 2 m sections on 31 May to determine initial stands. Beginning on 4 June and continuing weekly, onion plants within the 2 m staked sections were examined for loss due to onion smut or damage caused by other pests. Damaged onions were removed, and numbers and the cause of damage recorded. The remaining onions within the assigned 2 m sections were removed and visually examined for smut damage at the first true-leaf stage (7 June), at the 3-leaf stage (14 June) and at harvest (16 September). On 17 September, onions from the 2.32 m yield section of row were pulled, sorted by size, and weighed to determine yield. Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.10. Means separation was obtained using Fisher's Protected LSD Test at P = 0.05 level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSIONS: At emergence, onions treated with any fungicide treatment had greater plants emerge than the check (Table 1). At the 1st leaf, 3rd leaf and at harvest EVERGOL PRIME was the only treatment to show significantly less incidence of smut compared to the check. No significant differences in yield, onions per meter, or size distribution were found among the treatments, although the EVERGOL PRIME treatment had the highest yield and onions per meter while having the lowest percent of culls numerically (Table 2).

Table 1. Smut incidence for onions, cv. Fortress, treated with various fungicides and grown at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment[1]	4 June Emergence (plants/m)	Smut Incidence (%)		
		1st True Leaf	3rd Leaf Stage	Season Total
EVERGOL PRIME	28.6 a	0.0 a[2]	0.5 a[3]	9.9 a[2]
PRO-GRO + F300	28.8 a	6.2 ab	6.3 b	17.7 ab
RANCONA	26.7 a	7.7 b	9.2 b	20.5 b
Check	24.0 b	9.0 b	5.5 b	23.3 b

[1] All treatments included SEPRESTO 75 WS (clothianidin 0.18 g ai + imidacloprid 0.6 ai/1,000 seeds) and 42-S Thiram (1.875 g /ai/kg seed) for damping off control.
[2] P = 0.0809, but letters showing significant differences were added.
[3] Numbers in a column followed by the same letter are not significant differently at P = 0.05, Fisher's Protected LSD test.

Table 2. Yield and size distribution for onions, cv. Fortress, treated with various fungicides, and grown at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatment[1]	Yield (t/ha)	Onions/m	Size Distribution[2] (%)			
			Jumbo (>76 mm)	Large (76-64 mm)	Medium (<64-45 mm)	Cull (<45 mm)
EVERGOL PRIME	36.3 ns[3]	21.7 ns	1.5 ns	13.5 ns	72.4 ns	12.6 ns
PRO-GRO + F300	25.8	18.0	0.0	19.8	63.6	16.5
RANCONA	29.1	21.0	0.0	19.0	58.4	22.6
Check	26.7	15.8	0.0	33.0	52.5	14.5

[1] All treatments included SEPRESTO 75 WS (clothianidin 0.18 g ai + imidacloprid 0.6 g ai/1,000 seeds) and 42-S Thiram (1.875 g ai/kg seed) for damping off control.
[2] Percentages were determined by weight.
[3] ns = no significant differences were found among the treatments.

Funding was provided by Incotec for seed pelleting, Bayer Crop Science for the Sepresto insecticide, the Plant Production Systems of the Ontario Agri-Food Innovation Alliance and the California Garlic and Onion Research Advisory Board. Dr. Taylor's effort was supported under the United States Multi-State project, W-3168.

CROP: Onion (*Allium crepa*), cv. Mile Stone

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TITLE: EVALUATION OF ONION TOLERANCE TO PYRIDATE (BP1047H) APPLIED POSTEMERGENCE

MATERIALS: BP1047H (pyridate 30% granular), PROWL H_2O (pendimethalin 455 g/l), FRONTIER MAX (dimethenamid-P 920 g/l)

METHODS: Onions, cv. Mile Stone, were direct seeded (12 seeds per 30 cm of row) on May 7 into muck soil (organic matter ≈ 55.6%, pH ≈ 7.3) at the Ontario Crops Research Centre - Bradford, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of four rows spaced 40 cm apart and 6 m in length. Herbicide treatments were applied using a backpack mounted sprayer fitted with AIXR110-02 spray tips calibrated to deliver 200 L/ha at 206.84 kPa. Herbicide treatments are listed in Table 1. Treatments were applied on 30 May, 07 June and 16 June 2021. Pyridate was not applied to the check treatment. All treatments were kept weed-free in order to confirm crop tolerance to pyridate. Onions were grown using best agronomic practices for nutrients and pest management. Onions were harvested on September 17 from two 1.16 m sections of row per plot. Yield samples were graded on October 29 for size and weight to determine marketable yield.
Yield data were analyzed using ARM Version 2021.2 Analysis of Variance function. Means separation was obtained by using Tukey's HSD test at P = 0.05 level of significance.

RESULTS: as presented in Table 1

CONCLUSIONS: Onions were tolerant to pyridate applied at all rates and growth stage timings, when applied alone or when tank mixed with pendimethalin, (Prowl), or dimethenamid-P (Frontier). No significant differences in crop yield were detected among treatments.

Funding for this project was provided by Plant Production Systems of the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph Partnership, Belchim Crop Protection Canada, and the Bradford Co-operative and Muck Crop Growers.

Table 1. Marketable yield of onions, cv. Mile Stone, treated with pyridate beginning at the first leaf stage then followed by repeat applications at 1-2 leaf and 2 leaf stage of onion growth. The trial was conducted at the Ontario Crop Research Centre -Bradford, Ontario, 2021.

	Treatment	Rate (g ai/ha)	Crop growth stage at time of herbicide application	Yield (T/ha)
1	Check			60.7
2	BP1047H	112.5	1 true leaf	57.2
	BP1047H	112.5	1-2 leaf	
	BP1047H	112.5	2 leaf	
3	BP1047H	225	1 true leaf	55.0
	BP1047H	225	1-2 leaf	
	BP1047H	225	2 leaf	
4	BP1047H	300	1 true leaf	58.9
	BP1047H	300	1-2 leaf	
	BP1047H	300	2 leaf	
5	BP1047H	600	1 true leaf	58.1
	BP1047H	150	1-2 leaf	
	BP1047H	150	2 leaf	
6	BP1047H	112.5	1 true leaf	64.5
	PENDIMETHALIN	1080		
7	BP1047H	300	1 true leaf	59.9
	PENDIMETHALIN	1080		
8	BP1047H	112.5	1 true leaf	52.8
	DIMETHENAMID-P	930		
9	BP1047H	300	1 true leaf	45.2
	DIMETHENAMID-P	930		

No significant yield differences were detected among treatments.

Pyridate was not applied to the check treatment.

CROP: Onion (*Allium crepa*), cv. Catskill
PEST: Weed control data was not recorded in this trial.

AUTHORS: SWANTON C AND SMITH P
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TITLE: EVALUATION OF ONION TOLERANCE TO FIERCE

MATERIALS: FIERCE (pyroxasulfone + flumioxazin 76%)

METHODS: Onions, cv. Catskill, were direct seeded (12 seeds per 30 cm of row) on May 6 into muck soil (organic matter ≈ 55.6%, pH ≈ 7.3) at the Ontario Crops Research Centre - Bradford, Ontario.
A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of four rows spaced 40 cm apart and 6 m in length. Herbicide treatments were applied using a backpack mounted sprayer fitted with AIXR110-02 spray tips calibrated to deliver 200 L/ha at 206.84 KPa. Herbicide treatments are presented in Table 1. Treatments were applied on 30 May, 07 June and 16 June 2021. Fierce was not applied to the check treatment. All treatments were kept weed-free in order to confirm crop tolerance to Fierce. Onions were grown using best agronomic practices for nutrients and pest management. Onions were harvested on September 17 from two 1.16 m centre row sections from each plot. Yield samples were graded on October 29 for size and weight to determine marketable yield.
Yield data were analyzed using ARM Version 2021.2 Analysis of Variance function. Means separation was obtained by using Tukey's HSD test at P = 0.05 level of significance.

RESULTS: as presented in Table 1

CONCLUSIONS: Onions were tolerant to Fierce (pyroxasulfone + flumioxazin) at all rates tested when applied as a preemergence treatment or postemergence at the 1 leaf or 5-6 leaf stage of onion growth. No significant differences in crop yield were detected among treatments.

Funding for this project was provided by Plant Production Systems of the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph Partnership, Belchim Crop Protection Canada, and the Bradford Co-operative and Muck Crop Growers.

Table 1. Marketable yield of onions, cv. Catskill treated with varying rates of Fierce and applied PRE and at two leaf stages of onion growth. The trial was conducted at the Ontario Crop Research Centre - Bradford, Ontario, 2021.

	Treatment	Rate (g ai/ha)	Crop stage at time of herbicide application	Yield (T/ha)
1	Check			57.1
2	FIERCE	80	Pre emergence	58.4
3	FIERCE	160	Pre emergence	52.8
4	FIERCE	266	Pre emergence	49.1
5	FIERCE	80	1 leaf	47.3
6	FIERCE	160	1 leaf	41.4
7	FIERCE	266	1 leaf	41.3
8	FIERCE	80	5-6 leaf	49.9
9	FIERCE	160	5-6 leaf	46.7
10	FIERCE	266	5-6 leaf	37.0

No significant yield differences were detected among treatments.

Fierce was not applied to the check treatment.

HOST: Cabbage (*Brassica oleracea* L. var. *capitata* cvs. Bronco, Lodero, Bejo 051632, Kilaton
PEST: Clubroot (*Plasmodiophora brassicae* Woronin)

AUTHORS: MCDONALD MR & VANDER KOOI K
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TITLE: EVALUATION OF MYCOINSECTICIDES TO CONTROL CLUBROOT IN CABBAGE, 2021

MATERIAL: BOTANIGARD (*Beauveria bassiana* Strain GHA 11.3%), BIOCERES EC (*Beauveria bassiana* strain ANT-3 at least $1x10^{10}$ spores/mL)

METHODS: A field trial to evaluate the efficacy of mycoinsecticidesto reduce clubroot incidence in cabbage cultivars was conducted at the Ontario Crops Research Centre – Bradford on muck soil (pH ≈ 6.3, organic matter 70.2%) naturally infested with *P. brassicae* pathotype 2. The mycoinsecticide *Beauveria bassiana* can also colonize plants as an endophyte and may reduce disease and insect damage. Treatments were: Bronco treated with BOTANIGARD or BIOCERES and untreated Bronco, Lodero (red cabbage), Kilaton, and Bejo 051632. A randomized complete block design with four replicates per treatment was used. Each experimental unit consisted of three rows, six meters in length, spaced 55 cm apart with 30 cm in-row spacing. Cabbage was seeded 18 May into 128-cell plug trays filled with soilless mix and grown in a greenhouse. On 4 June, BOTANIGARD at 10 mL/L and BIOCERES at 8 mL/L were applied to two trays each of Bronco transplants at 500 mL/tray. On 17 June all cabbage plants were hand-transplanted into the field. On 21 July, holes caused by insect feeding were counted on the 2nd oldest leaf of five consecutive plants per replicate. On 30 July, the tops were cut from 10 consecutive plants pulled from each row (20 total) and weighed to determine top fresh weight. The roots were visually assessed for symptoms of clubroot and sorted into classes based on the following scale: 0 = no clubs, 0.2 = 1 very small club (≤2 cm), 1 = small clubs on less than 1/3 of roots, 2 = small or intermediate clubs on 1/3 to 2/3 of roots, and 3 = intermediate or large clubs on over 2/3 of roots. The proportion of roots in classes 1-3 was used to calculate clubroot incidence (CI). The disease severity index (DSI) was calculated using the following formula:

$$DSI = \frac{\sum [(\text{class no.})\ (\text{no. roots in each class})]}{(\text{total no. roots/sample})\ (\text{no. classes } -1)} \times 100$$

Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and below average for July (19.7°C). The 10-year average temperatures were: June 18.6°C and July 21.7°C. Monthly rainfall was above the 10-year average for July (105 mm) and below average for June (56 mm). The 10-year rainfall averages were: June 94 mm and July 75 mm. Data were analysed using the General Analysis of Variance function of the Linear Models section of Statistix V10.0. Means separation was obtained using Fisher's Protected LSD test at P = 0.05 level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSIONS: Significant differences in clubroot incidence, severity, and fresh top weight were found among the treatments (Table 1). Resistant cultivars Kilaton and 051632 had significantly lower incidence and severity of clubroot than all other cultivars. Treatments with endophytes did not reduce clubroot incidence or severity. The data for Bronco were separated out for further assessment as this was the only cultivar treated with B. bassiana. Feeding damage caused by *Lepidoptera* species was significantly lower in cabbage treated with BIOCERES than the untreated control (Table 2).

Table 1. Clubroot incidence and severity and fresh top weight of clubroot susceptible (S) and resistant (R) cabbage cultivars treated with mycoinsecticide endophytes grown at the Ontario Crops Research Centre – Bradford, Ontario, 2021.

Cultivar	Endophyte	Clubroot incidence[1] (%)	DSI[2] (0-100)	Insect Damage[3]	Fresh top wgt/plant[4] (g)
Kilaton (R)	none	1.3 a[5]	1.0 a	-	417.5 a
051632 (R)	none	7.5 a	1.9 a	-	228.3 b
Bronco (S)	none	95.0 b	61.9 b	45.2 b	128.6 bc
Bronco (S)	BIOCERES	98.8 b	65.0 b	31.7 a	156.6 bc
Lodero (S)	none	100.0 b	67.5 b	-	46.6 c
Bronco (S)	BOTANIGARD	100.0 b	72.8 b	41.0 ab	39.1 c

[1] Clubroot incidence was determined considering only roots in classes 1, 2 & 3 as clubbed. Class 0.2 (roots with very small clubs) were grouped with class 0.

[2] Roots of 20 plants were sorted into the following classes: 0 = 0 clubbing, 0.2 =1 very small club (<2 cm), 1 = <1/4 root clubbed, 2 = 1/4-1/2 root clubbed, 3 = >1/2 root clubbed. DSI was calculated with the following formula:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of plants in each class})]}{(\text{total no. plants per sample})\ (\text{no. classes} - 1)} \times 100$$

[3] Total number of holes on five leaves caused by insect larvae feeding assessed on 21 July for Bronco cabbage treatments.

[4] Average fresh top weight of 20 plants before head formation.

[5] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD test.

Table 2. Clubroot incidence and severity, insect damage and fresh top weight of cabbage, cv. Bronco, treated with mycoinsecticide endophytes and grown at the Ontario Crops Research Centre – Bradford, Ontario, 2021.

Cultivar	Endophyte	Clubroot incidence[1] (%)	DSI[2] (0-100)	Feeding Damage[3]	Fresh top wgt/plant[4] (g)
Bronco	BIOCERES	98.8 ns[5]	65.0 ns	31.7 a[6]	156.6 ns
Bronco	BOTANIGARD	100.0	72.8	41.0 ab	39.1
Bronco	none	95.0	71.9	45.2 b	103.8

[1] Clubroot incidence was determined considering only roots in classes 1, 2 & 3 as clubbed. Class 0.2 (roots with very small clubs) were grouped with class 0.

[2] Roots of 20 plants were sorted into the following classes: 0 = 0 clubbing, 0.2 =1 very small club (<2 cm), 1 = <1/4 root clubbed, 2 = 1/4-1/2 root clubbed, 3 = >1/2 root clubbed. DSI was calculated with the following formula:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of plants in each class})]}{(\text{total no. plants per sample})\ (\text{no. classes} - 1)} \times 100$$

[3] Total number of holes on five leaves caused by insect larvae feeding assessed on 21 July for Bronco cabbage treatments.

[4] Average fresh top weight of 20 plants before head formation.

[5] ns = no significant differences were found

[6] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD test.

Funding for this project was provided by the Ontario Agri-Food Innovation Alliance and the Fresh Vegetable Growers of Ontario.

CROPS: Canola (*Brassica napus*) cv. InVigor L233P
PEST: Clubroot (*Plasmodiophora brassicae* Woronin)

AUTHORS: CHESNEY SG[1], GOSSEN BD[2] & MCDONALD MR[1]
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TITLE: THE INTERACTION OF BORON AND CACLIUM ON THE SEVERITY OF CLUBROOT IN CANOLA

MATERIALS: HYDRATED LIME (> 94% calcium hydroxide), SOLUBOR (20.5% B, disodium octaborate tetrahydrate)

METHODS: A field trial was conducted at the Ontario Crops Research Centre - Bradford, Ontario on muck soil (pH ≈ 6.4, organic matter ≈ 70%) naturally infested with *Plasmodiophora brassicae* pathotype 2. The trial was laid out as a randomized complete block design with four replicates. Each plot (experimental unit) was 1.75 m x 3 m. The treatments were applications of calcium (Ca) and boron (B) conducted as a factorial with two rates of HYDRATED LIME to achieve the pH of 7.0 and 7.5 (5.42 and 9.24 t/ha) and one rate of boron (1.64 kg/ha elemental B) applied as 8 kg/ha of SOLUBOR. An untreated check was also included.

Prior to treatment application and before seeding, soil samples were taken from each replicate/treatment to a 15 cm depth to determine pH and resting spore concentrations. Treatments (powders) were applied by hand on 23 June 2021 as a broadcast and incorporated by rototilling to about 15 cm depth. Each plot was then seeded with seven rows of InVigor L233P (BASF) canola using an Earthway push seeder with a 1002-10 seeding disc on 07 July, two weeks after treatment application. Weeds were managed through applications of LIBERTY (BASF) herbicide and hand-weeding.

On 18 August, plants were pulled and 50 plants per plot were assessed for clubroot symptoms using a 0 to 3 scale where 0 = no clubbing, 0.25 = small club, 1 = clubs on 1/3 of the root, 2 = clubs on 1/3 to 2/3 of the root and 3 = clubs on more than 2/3 of the root. Disease severity index (DSI) was calculated using the following equation:

$$DSI = \frac{\Sigma[(class\ no.)(no.\ plants\ in\ each\ class)]}{(total\ no.\ plants\ per\ sample)(no.\ class - 1)} \times 100$$

In addition, fresh and dry weight was measured on the above-ground portions of 10 plants per plot.

Compared to the previous 10-year average, mean daily air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C). The 10-year mean temperatures were 18.6°C in June, 21.7°C in July, and 20.2°C in August. Monthly precipitation was above the 10-year average for July (105 mm) and below average for June (56 mm) and August (41 mm). The 10-year means were 94 mm in June, 75 mm in July, and 83 mm in August. Data was analyzed using the PROC GLIMMIX using Tukey's test at $P = 0.05$ and PROC CORR using Kendall Spearman (P=0.001) in SAS 9.4 (SAS Institute, Cary, IN).

RESULTS: as presented in Table 1 and Figure 1

CONCLUSIONS: The target pH for both levels of Ca application were not achieved in three of four replicates. There was a negative correlation between pH and DSI with disease severity decreasing as the pH increased (Figure 1), confirming that a high pH is needed to decrease clubroot severity. There was no interaction of boron and calcium on severity of clubroot. There were also no significant differences between the treated plots and untreated plots for DSI, incidence, and fresh and dry weights (Table 1). The trial will be repeated in 2022 except that lime will be applied in fall 2021 and a higher concentration of SOLUBOR (8 kg rather than 1.6 kg/ha) will be utilized. qPCR analysis will be performed to determine the effect on resting spore concentration in the soil.

Table 1. The effect of SOLUBOR (boron) and HYDRATED LIME (calcium hydroxide) on clubroot incidence and severity (disease severity index; DSI) and fresh and dry weights for canola cv. InVigor L233P grown on muck soil naturally infested with *Plasmodiophora brassicae* at the Ontario Crops Research Centre - Bradford, Ontario, 2021

SOLUBOR (kg/ha)	HYDRATED LIME (t/ha)	Incidence (%)	DSI[1] (%)	Fresh weight[2] (kg)	Dry weight[2] (g)
0	0	100 ns[3]	73 ns	0.39 ns	36 ns
0	5.4	81	56	0.58	50
0	9.2	80	54	0.38	39
8	0	94	59	0.43	43
8	5.4	100	59	0.42	36
8	9.2	94	54	0.39	37

[1]Roots of 50 plants were assessed using the following classes: 0 = no clubbing, 0.25 = small club, 1 = clubs on 1/3 of the root, 2 = clubs on 1/3 to 2/3 of the root and 3 = clubs on more than 2/3 of the root. DSI was calculated with the following equation:

$$DSI = \frac{\Sigma[(class\ no.)(no.\ plants\ in\ each\ class)]}{(total\ no.\ plants\ per\ sample)(no.\ class - 1)} \times 100$$

[2]Weight of 10 plants

[3]ns indicates no significant differences found among treatments at P=0.05, Tukey's Test

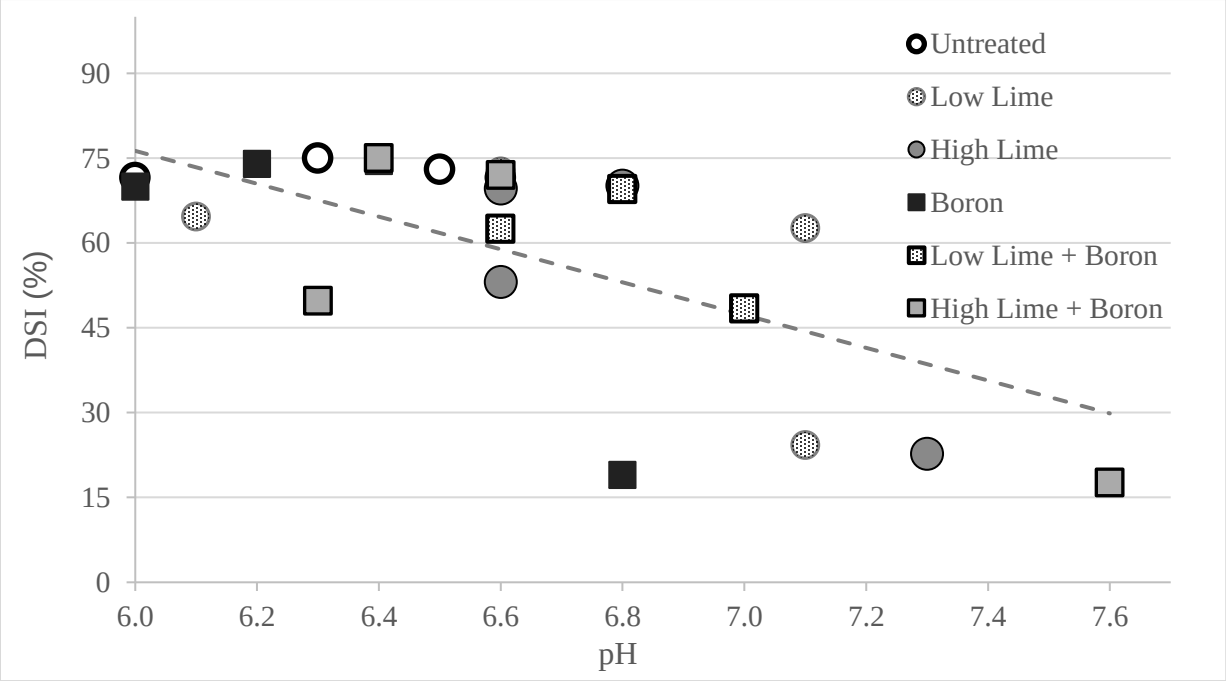

Figure 1: Correlation (r^2=-0.42, *P>0.001*) of pH and clubroot severity (disease severity index, DSI) on canola treated with HYDRATED LIME targeting a pH of 7.0 and 7.5 and SOLUBOR at a rate of 1.64 kg/ha elemental B grown on muck soil naturally infested with *Plasmodiophora brassicae* at the Ontario Crops Research Centre-Bradford, Ontario, 2021.

Funding for this project was provided by the Ontario Agri-Food Innovation Alliance, the Agriculture Development Fund of the Province of Saskatchewan, and the Canadian Agri-Food Partnership through AAFC and the Canola Council of Canada

CROP: Canola (*Brassica rapa* L.) cv. L233P
Perennial Ryegrass (*Lolium perenne* L.)
Smooth Bromegrass (*Bromus inermis* Leyss.)
PEST: Clubroot (*Plasmodiophora brassicae* Woronin)

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TITLE: USE OF GRASS CROPS AND LIME TO REDUCE CLUBROOT SEVERITY BEFORE CANOLA PLANTING, 2021

MATERIALS: HYDRATED LIME (>94% Calcium Hydroxide)
ROUNDUP (7 g L^{-1} Glyphosate)

METHODS: A trial was conducted at the Ontario Crops Research Centre - Bradford, Ontario on a muck soil (pH 6.3, organic matter 70.2%) naturally infested with *Plasmodiophora brassicae*. The trial was arranged as a randomized complete block design with four replicates. Each experimental unit (plot) was 1.75 m × 3 m with 0.75 m length between experimental units. HYDRATED LIME (5.42 t ha^{-1}) was applied to plots on June 23, evenly applying the material on the top of the experimental unit then incorporating the hydrated lime by tilling the soil approximately 15-20 cm deep. On June 30, perennial ryegrass and smooth bromegrass were evenly seeded on experimental units at 230 g per experimental unit. Grass crops were left for 8 weeks with minor weed control to keep weeds in check. ROUNDUP (3 L ROUNDUP mixed with 400 L water to spray at 400 L ha^{-1}) was applied August 25, and the plots were tilled 48 hrs later. Three rows 0.4 m apart were created in each experimental unit using a shovel and a Earthway seeder fitted with a 1002-10 disc was used to seed canola cv. L233P on September 1.

At 6 weeks after seeding (October 13, 2021), clubroot incidence and disease severity were assessed on plants in the center 1 m area using a 0–3 rating scale to place plants into different classes based on the amount of clubbing, where 0 = no clubbing, 1 =< 1/3 clubbing of roots, 2 = 1/3 to 2/3 of root area with clubs, and 3= > 2/3 of root clubbed. A disease severity index (DSI) was calculated as follows:

DSI=$\sum$ (class #)(# of plants in class) / (total number of plants)(# of classes -1)

Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C), August (22.2°C) and October (12.8°C), average for September (15.8C), and below average for July (19.7°C). The 10-year average temperatures were: June 18.6°C, July 21.7°C, August 20.2°C, September 16.4°C and October 9.8°C.
Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm), average for October (77 mm) and below average for June (56 mm) and August (41 mm). The 10-year rainfall averages were: June 94 mm, July 75 mm, August 83 mm, September 59 mm and October 78 mm.

Data were analyzed using a Factorial Analysis of Variance a type 1 error at $P = 0.05$ Using Statistix V.10. Means separation was obtained using a LSD function with P=0.05.

RESULTS: Clubroot incidence and severity were very low in the first replicate of Ryegrass plots treated with HYDRATED LIME in the first replicate was omitted. Results of the data are visible in Table 1. A Factorial analysis of variance found only the HYDRATED LIME treatments showed significant differences in incidence and DSI. Differences from HYDRATED LIME although significant were small. Incidence

dropped from 97% to 92% and disease severity from 85% to 77% (Table 2). Seed choices and he combination of Seed and HYDRATED LIME had no significant differences.

CONCLUSIONS: Treatments with HYDRATED LIME reduced clubroot incidence and disease severity regardless of seed choice. Use of either grass had a reduction in clubroot disease and severity, but was not significant and did not factor in with HYDRATED LIME application.

Table 1. Clubroot incidence and severity after the application of lime and grass crops in muck soil naturally infested with *P. brassicae* at the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Seed	Lime (5.42 t ha^{-1})	pH after application	Incidence (%)	DSI (%)
Check	N	6.6	99 ns[1]	88 ns
	Y	6.7	95	83
Bromegrass	N	6.7	94	84
	Y	6.9	93	76
Ryegrass	N	6.7	98	83
	Y	6.8	89	71

[1] no significant differences among treatments.

Table 2. Clubroot incidence and severity after the application of lime and grass crops in muck soil naturally infested with *P. brassicae* at the Ontario Crops Research Centre - Bradford, Ontario, 2021. Lime application data was pooled across all seed treatment options.

Lime application	Incidence (%)	DSI (%)
None	97 a[1]	85 a
5.42 t ha^{-1}	92 b	77 b

[1] Means followed by a different letter are significantly different based on Tukeys LSD with a type 1 error of 0.05.

CROPS: Canola (*Brassica napus*) cv. InVigor L233P, Shanghai pak choi (*Brassica rapa* L. spp. *chinensis* var. *communis*) cv. Mei Qing Choi

PEST: Clubroot (*Plasmodiophora brassicae* Woronin)

AUTHORS: CHESNEY SG[1], GOSSEN BD[2], MCDONALD MR[1]
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TITLE: EVALUATION OF INDUCED SUSCEPTIBILITY TO CLUBROOT INFECTION USING SPLIT-ROOT PLANTS OF CANOLA

MATERIALS & METHODS: Growth room studies were conducted at the University of Guelph using split-root canola plants to test the hypotheses that infection with an avirulent pathotype induces resistance to a virulent pathotype and infection with a virulent pathotype induces susceptibility to an avirulent pathotype. The treatments were avirulent/virulent (induced resistance) and virulent/avirulent (induced susceptibility). The study was arranged in a randomized complete block design with four replicates and 10 plants per experimental unit.

Seeds of canola cv. InVigor L233P (BASF; resistant to pathotype 6 and susceptible to pathotype 2) were germinated in germination pouches. When the seedling's roots reached 0.5 to 4 cm in length, the root tips were trimmed with a razor. The plants were transplanted into plastic pots filled with soilless mix (LA4 Sunshine Soil Mix). Seeds of Shanghai pak choi were also germinated in germination pouches and transplanted at the same time as a susceptible control. The seedlings grew for 10 days to allow side root growth. Pots for the split-root system were created by taping two edgeless 8 cm x 6 cm x 6 cm plastic pots together with a bamboo skewer placed between the two pots. The pots were then filled with soilless mix and compacted. Small plastic bags were placed underneath each pot to catch any water that drained through and prevent cross contamination. Ten days after transplanting the seedlings were uprooted and washed to remove the soilless mix. The roots of each seedling were then divided into two sections and placed into each side of the potting system to create a plant with split roots. The seedling's stem was supported by the bamboo skewer. The location of the roots in each pot was marked with a toothpick to allow inoculum to be placed directly on the root.

Two repetitions of the study were conducted. The first side of the split-root system was inoculated with 5 mL of *P. brassicae* resting spores at a concentration of 1 x 10^7 resting spores/mL at 10 days after splitting the roots (Day 0) with pathotype 2 (virulent) or pathotype 2 (avirulent). The inoculum was obtained from clubbed roots collected at the Ontario Crops Research Centre-Bradford in 2011 (pathotype 6) and 2018 (pathotype 2). The second side of the system was inoculated with the opposite pathotype. In the first run of the study, the second side of the split-root system was inoculated 4, 7, or 14 days after the first side was inoculated. In the second run, the second side was inoculated 2 or 4 days after the first side. Untreated controls for both pathotypes on each side of the system were included for each inoculation timing as well as a non-inoculated check. Seedlings of Shanghai pak choi were also inoculated at each inoculation timing as a positive control to confirm the viability of the inoculum and suitability of conditions for infection.

Roots were assessed for clubroot symptoms at 6 weeks after each inoculation timing on the second side of the system. The controls inoculated on the first side of the system were assessed at the last inoculation timing. The presence and severity of infection on each side of each plant was assessed, taking care to note which side was inoculated with which pathotype. Roots were visually assessed using a 0 to 3 scale and separated into classes; 0: no clubs, 1: clubs on 1/3 of the roots, 2: clubs on 1/3 to 2/3 of the roots and 3: clubs on more than 2/3 of the roots. A disease severity index (DSI) was calculated for each side of each experimental unit as the following:

$$DSI = \frac{\Sigma[(class\ no.)(no.plants\ in\ each\ class)]}{(total\ no.plants\ per\ sample)(no.class - 1)} \times 10$$

Statistical analysis was preformed using SAS 9.4 (SAS Institute, Cary, IN). Each inoculation timing was analyzed as a factorial with inoculation treatment (pathotype x side) as one factor and timing as the other. DSI and incidence was analyzed using PROC GLIMMIX and Tukey's test at $P = 0.05$ level of significance.

RESULTS: In the initial study, clubroot severity decreased over time across inoculation timings, with the highest DSI occurring in the day 0 and 4 timings (Table 1) and lowest from the inoculation on day 7 and 14 timings (data not shown). Inoculation of the susceptible check, Shanghai pak choi with pathotype 2 resulted in high DSI in all inoculation timings (mean 80%) but inoculation with pathotype 6 resulted in lower DSI (mean 41%). There were no differences between the virulent side of the avirulent/virulent treatment and the water/virulent check, which indicated induced resistance (inhibition of infection resulting from previous exposure to an avirulent pathotype) was not transferred up through the plant and back down the other side of the root system in this study (Table 1). There were also no differences between the avirulent side of virulent/avirulent treatment and the water/avirulent check (Table 1). Clubs did form on the avirulent side when a virulent pathotype was used on the opposite side, which could be evidence of induced susceptibility. However, there were also instances of cross contamination, e.g., clubs forming on the water side of the water/virulent and virulent/water treatments (Table 1). This infection occurred in the positive controls, on sides of the system that were not inoculated.
Clubroot severity was extremely low in the repetition of the study. However, severity in Shanghai pak choi was high for both pathotypes (mean pathotype 2=59%, pathotype 6=100%). There was no indication of an effect from induced resistance or induced susceptibility (Table 1).

CONCLUSIONS: There was some indication of induced susceptibility in the initial study with clubs forming on the avirulent sides when a virulent pathotype was inoculated first, but this response may have also been caused by cross-contamination. Severity in the repetition was too low to detect either induced resistance or susceptibility.

Table 1: Clubroot incidence and severity (disease severity index, DSI) of split-root canola plants grown under controlled conditions and inoculated with either pathotype 2 (virulent) or pathotype 6 (avirulent) of *Plasmodiophora brassicae*; the roots on one side of each plant were inoculated with one pathotype on Day 0 on Side A and then inoculated on Side B on Day 4 (initial study) or Day 2 (repetition)

First inoculation /	Incidence (%)[1]		DSI (%)[3]	
Second inoculation	Side A	Side B	Side A	Side B
Initial Study (4-day interval)				
Water / Water	0.0 b[2]	0.0 b	0.0 c	0.0 c
Avirulent / Water	0.0 b	0.0 b	0.0 c	0.0 c
Virulent / Water	100.0 a	2.5 b	85.0 ab	1.6 c
Water / Virulent	2.5 b	85.0 a	0.8 c	65.8 b
Water / Avirulent	0.0 b	0.0 b	0.0 c	0.0 c
Avirulent / Virulent	7.5 b	90.0 a	3.3 c	68.3 ab
Virulent / Avirulent	100.0 a	13.0 b	86.9 a	9.6 c
Repetition (2-day interval)				
Water / Water	0.0 b[2]	0.0 b	0.0 b	0.0 b
Avirulent / Water	0.0 b	0.0 b	0.0 b	0.0 b
Virulent / Water	15.0 a	0.0 b	7.5 a	0.0 b
Water / Virulent	0.0 b	0.0 b	0.0 b	0.0 b
Water / Avirulent	0.0 b	2.5 b	0.0 b	1.67 b
Avirulent / Virulent	0.0 b	0.0 b	0.0 b	0.0 b
Virulent / Avirulent	5.0 ab	0.0 b	2.5 b	0.0 b

[1]Roots of 10 split-root plants were assessed using the following classes: 0 = no clubbing, 1 = clubs on 1/3 of the root, 2 = clubs on 1/3 to 2/3 of the root and 3 = clubs on more than 2/3 of the root.
[2]Means in a column and repetition followed by the same letter do not differ based on Tukey test at ($P < 0.05$).
[3]DSI of Shanghai pak choi in the initial study: P2-virulent (0 days: 100, 4 days: 93) and P6-avirulent (0 days: 40, 4 days: 33) and the repetition: P2-virulent (0 days: 63.33, 2 days: 80) and P6-avirulent (0 days: 100, 2 days: 100).

Funding provided by Canadian Agri-Food Partnership of AAFC and the Canola Council of Canada.

CROP: Small onions (*Allium cepa* L. *var. aggregatum*), cvs. CO5 and CO6

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TITLE: EVALUATION OF SMALL ONION (*ALLIUM CEPA* L. *VAR. AGGREGATUM*) PRODUCTION IN ORGANIC SOIL IN THE HOLLAND MARSH, 2021

METHODS: Small onions, sometimes called potato onions, cv. CO5 and CO6, were evaluated. The seed was obtained from India and provided by Dr. Jay Subramanian, Dept. of Plant Agriculture, Univ. of Guelph. The onions were seeded into 288 cell plug trays (3 seeds/cell) on 14 April. On 20 May, plugs were transplanted by hand 10cm apart into organic soil (organic matter ≈ 72.1%, pH ≈ 5.9) at the Ontario Crops Research Centre – Bradford, Ontario. A randomized complete block arrangement with three replicates per treatment was used. Each experimental unit consisted of four rows (40 cm apart), 5 m in length. On 14 September, onions in a 1 m section of row were pulled from a middle row for a yield sample. Onions were divided between sprouted and unsprouted before being weighed on 24 September to determine yield and percent sprouted.
Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm.
Data were analyzed using the General Analysis of Variance function of Statistix V.10. Means separation was obtained by using Fisher's Protected LSD test at $P = 0.05$ level of significance.

RESULTS: as presented in Table 1

CONCLUSIONS: There were no significant differences in yield or sprouting between cultivars (Table 1). More work needs to be done to find methods to reduce sprouting.

Table 1. Yield data for small onions, cv. CO5 and CO6, grown in organic soil near the Ontario Crops Research Centre – Bradford, Ontario, 2021.

Cultivar	Total Yield (t/ha)	Marketable Yield (t/ha)	Sprouted Weight (t/ha)	Sprouted (%)[1]
CO5	31.1 ns[2]	18.4 ns	12.6 ns	41.3 ns
CO6	31.0	15.3	15.8	50.6

[1] Percentage was determined by weight
[2] ns = no significant differences were found among the treatments

Funding for this project was provided by the Plant Production Systems of the Ontario Agri-Food Innovation Alliance.

CROP: Garlic (*Allium sativum* L.), cv. Music
PEST: Stem and bulb nematode (*Ditylenchus dipsaci*) (Kühn, 1857) Filip'ev, 1936

AUTHORS: BLAUEL T, VANDER KOOI K and MCDONALD M R
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TITLE: EVALUATION OF NEMATICIDES FOR CONTROL OF STEM AND BULB NEMATODE IN GARLIC, 2020-21

MATERIALS: AGRI-MEK SC (abamectin 84 g/L), PREV-AM (sodium tetraborohydrate decahydrate 0.99%), PROMAX (thyme oil 3.5%), VELUM PRIME (fluopyram 500g/L)

METHODS: The field trial was conducted in a mineral soil field (organic matter 3.1%, pH 7.4) free of stem and bulb nematode (SBN) near Cookstown, Ontario. A randomized complete block design with five (5) replicates per treatment was used. Garlic cloves (seed) used were infested with 6 SBN/g clove. Nematode counts were determined at the University of Guelph Ontario Crops Research Centre - Bradford using the Baermann pan method. The treatments were: AGRI-MEK SC, PREV-AM, PROMAX and VELUM PRIME applied as a soak (S) or drench (D). Seed soak treatments, and the associated soaking times, were: AGRI-MEK S at 0.9 mL/L for 4-hours, PREV-AM S at 8 mL/L for 4-hours, PROMAX S at 37.4 mL/L for 4-hours and VELUM PRIME S at 1.7 mL/L for 2- and 4-hours. Soak treatments were applied by placing cloves in a mesh bag in 10 L of each treatment solution for each respective time period. Garlic were air dried following the soaking treatment. The drench treatments were VELUM PRIME (D) at 500 mL/ha using a standard water volume rate of 1000 L/ha and a 1.5 times water volume rate of 1500 L/ha. Drench treatments were applied directly over the cloves at planting at an application rate of 90 mL/m using a beaker. An untreated infested seed check was also included. Each experimental unit consisted of 25 garlic cloves planted ~5 cm deep and 10 cm apart in 2.5 m long single rows spaced 40 cm apart. The trial was planted on 27 October 2020. Emergence and plant heights were recorded on 14 June 2021. Garlic was harvested on 4 August. Bulbs were counted, weighed, assessed for basal plate rot and sorted into classes using a 0-4 rating scale, where: 0 = no damage, 1 = 1-24% basal plate missing; 2 = 25-50% basal plate missing; 3 = > 50% basal plate missing and 4 = completely desiccated bulb. These data were used to calculate a disease severity index (DSI) using the formula below.

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of garlic bulbs in each class})]}{(\text{total no. garlic bulbs assessed})\ (\text{no. classes } -1)} \times 100$$

Stem and bulb nematodes were extracted and quantified from a 10 g sample of cloves after harvest using the Baermann pan method.

Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C and August 20.2°C. Average temperatures in fall 2020 were: October 6.5°C, November 6.2°C and December -2.2°C.

Monthly rainfall was above the 10-year average for July (105 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm and August 83 mm. Average precipitation in fall 2020 were: October 1.0 mm, November 0.1 mm and December 1.5 mm.

Data were analyzed using the PROC GLIMMIX function in SAS version 9.4. Means separation was obtained using Tukey's HSD test with $P = 0.05$ level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSIONS: The VELUM PRIME and AGRI-MEK treatments reduced nematode damage and increased marketable yield compared to the untreated check (Table 2). The organic product PREV-AM

resulted in higher damage and lower marketable yield than the untreated check. The 2-hour soak with VELUM PRIME was as effective as the 4-hour soak for disease severity (2.7 and 3.8%) and percent marketable yield (98.8 and 96.4%), respectively. There was no advantage to using a higher amount of water for the VELUM PRIME drench. VELUM PRIME was very effective for management of SBN in garlic as a soak or drench. The organic products PREV-AM and PROMAX did not protect garlic from SBN damage. The low counts of SBN in the untreated check and PROMAX treatments may be the result of the nematodes leaving the dead bulbs before harvest. No significant differences in emergence and plant height were found among treatments (Table 1).

Table 1. Garlic emergence and plant heights on 14 June after nematicide application for stem and bulb nematode infested seed cloves near Cookstown, Ontario, 2021.

Treatment	App Method[1]	Soak Time (hr)	% Emergence (of 25 plants)	Plant Height (cm)
Check	-	-	93.6 ns[2]	85.0 ns
VELUM PRIME	S	4	92.8	92.7
PROMAX	S	4	92.0	84.9
VELUM PRIME	1.5x D[3]	-	90.4	90.2
VELUM PRIME	Std D[3]	-	89.6	92.3
AGRI-MEK	S	4	88.0	87.4
VELUM PRIME	S	2	85.6	87.4
PREV-AM	S	4	85.6	81.0

[1] Application Method: S = Soak; D = Drench.
[2] ns indicates that no significant differences were found among the treatments at $P = 0.05$, Tukey's HSD test.
[3] The Std drench rate was applied at 1000 L/ha and the 1.5x drench rate was 1500 L/ha.

Table 2. Percent marketable bulbs, nematode disease severity index (DSI), marketable yield and nematode counts from harvested garlic treated with various nematicides to control stem and bulb nematode (SBN) near Cookstown, Ontario, 2020-2021.

Treatment	App. Method[1]	Soak Time (hours)	% Marketable Bulbs	DSI[2]	Marketable Yield (g/plot)	Harvest SBN Count (SBN/g clove)
VELUM PRIME	S	4	96.6 a[3]	3.8 a	1653.9 a	0.0 ns[4]
VELUM PRIME	S	2	98.1 a	2.7 a	1505.5 a	0.2
VELUM PRIME	Std D[5]	-	95.4 a	6.5 a	1463.5 a	13.0
AGRI-MEK	S	4	92.9 a	6.9 a	1316.2 ab	1.4
VELUM PRIME	1.5x D[5]	-	85.8 ab	13.5 ab	1283.8 ab	12.8
PROMAX	S	4	65.1 bc	34.1 bc	833.7 bc	0.1
Check	-	-	52.8 c	44.1 c	689.5 c	0.6
PREV-AM	S	4	10.9 d	86.6 d	66.7 d	6.2

[1] Application Method: S = Soak; D = Drench
[2] DSI was calculated using the following equation:

$$DSI = \frac{\sum [(\text{class no.})\ (\text{no. of garlic bulbs in each class})]}{(\text{total no. garlic bulbs assessed})\ (\text{no. classes} - 1)} \times 100$$

[3] Numbers in a column followed by the same letter are not significantly different at $P = 0.05$, Tukey's HSD test.
[4] ns indicates that no significant differences were found among the treatments at $P = 0.05$, Tukey's HSD test.
[5] The Std drench rate was 1000 L/ha and the 1.5x drench rate was 1500 L/ha.

Funding for this project was provided by the California Garlic and Onion Research Advisory Board and the Fresh Vegetable Growers of Ontario representing the Ontario Garlic Growers Association.

CROP: Garlic (*Allium sativum* L.), cv. Music
PEST: Stem and bulb nematode (*Ditylenchus dipsaci*) (Kühn, 1857) Filip'ev, 1936

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TITLE: INOCULATING GARLC SEED WITH STEM AND BULB NEMATODE TO PRODUCE INFESTED SEED, 2020-21

RATIONALE: Garlic trials that test the effectiveness of products to control stem and bulb nematode (SBN; *Ditylenchus dipsaci*) can be limited by the level and consistency of SBN infection in the garlic seed cloves. Low to moderate infestations of SBN in garlic can often go unnoticed in garlic fields until major damage is seen at harvest. Therefore, garlic cloves with this level of infestation are optimal to use in nematicide trials on garlic; however, it can be difficult to guarantee consistent infestation throughout a trial. The goal of this trial was to determine the best method to inoculate garlic seed cloves to produce a uniform level of SBN infestation and infection.

METHODS: Clean garlic cloves with no SBN infestation were inoculated with a 140 SBN/clove water solution using three different soak treatments. The treatments included: Non-agitated for 16 hours, Non-agitated for 24 hours and Agitated for 24 hours. A clean seed check was also included. For the non-agitated treatments, cloves were placed in separate 2 L buckets and were left to soak in the SBN inoculation suspension for the two periods of time. For the Agitated treatment, cloves were placed in a 2 L bucket with the SBN suspension and set on a shaker at 75 rpm for 24 hours. After each treatment, cloves were placed into mesh bags and were air dried before planting. The trial was conducted in a mineral soil field (organic matter 3.1%, pH 7.4) free of stem and bulb nematode (SBN) near Cookstown, Ontario. A randomized complete block design with four (4) replicates per treatment was used. Each experimental unit consisted of 20 garlic cloves planted ~5 cm deep and 10 cm apart in 2 m long single rows spaced 40 cm apart. The trial was planted on 27 October 2020. Garlic was harvested on 4 August 2021. Bulbs were counted, weighed, assessed for basal plate rot and sorted into classes using a 0-4 rating scale, where: 0 = no damage, 1 = 1-24% basal plate missing; 2 = 25-50% basal plate missing; 3 = > 50% basal plate missing and 4 = completely desiccated bulb. These data were used to calculate a damage severity index (DSI) using the formula below.

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of garlic bulbs in each class})]}{(\text{total no. garlic bulbs assessed})\ (\text{no. classes } -1)} \times 100$$

Stem and bulb nematodes were extracted and quantified from a 25 g sample of cloves after harvest using the Baermann pan method.
Average temperatures in fall 2020 were: October 6.5°C, November 6.2°C and December -2.2°C. In 2021, average temperatures were: January -4.9, February -9.2°C, March 0.6°C, April 7.0°C, May 10.9°C, June 19.6°C, July 18.8°C and August 21.1°C. Total rainfall in fall 2020 were: October 26 mm, November 31 mm and December 44 mm. In 2021, monthly rainfall were: January 13 mm, February 16 mm, March 42 mm, April 38 mm, May 53 mm, June 81 mm, July 115 mm and August 46 mm.
Data were analyzed using the General Analysis of Variance function of the Linear Analysis section of Statistix V.10. Means separation was obtained using Tukey's HSD test with $P = 0.05$ level of significance.

RESULTS: Data are presented in Table 1.

CONCLUSIONS: There were no significant treatments among the SBN inoculated treatments and the clean seed check. The Non-agitated 16hr inoculated treatment resulted in numerically higher garlic bulb damage incidence and severity, and lower percent marketability. The Clean Seed checks were likely infected with SBN by water runoff as the trial was on a minor slope. Although there are no significant differences, inoculating garlic seed cloves with a SBN suspension may be a potential method to create a

more consistent level of SBN infestation for nematicide trials on garlic. Future inoculations should use more than 140 SBN/clove.

Table 1. Percent stem and bulb nematode (SBN) damage, nematode damage severity index (DSI), percent marketable bulbs, marketable yield and SBN clove counts from harvested garlic inoculated with SBN near Cookstown, Ontario, 2020-2021.

Treatment	SBN Damage Incidence (%)	DSI[1]	% Marketable Bulbs	Marketable Yield (g/plot)	Harvest SBN Count (SBN/g clove)
Non-agitated 16hr	21.0 ns[2]	15.8 ns	82.9 ns	940.4 ns	0.1 ns
Non-agitated 24hr	19.4	12.2	87.5	965.0	0.5
Agitated 24hr	14.1	7.3	93.6	1285.0	3.0
Clean Seed	11.8	6.9	92.5	812.5	0.0

[1] DSI was calculated using the following equation:

$$\text{DSI} = \frac{\sum [(\text{class no.})\ (\text{no. of garlic bulbs in each class})]}{(\text{total no. garlic bulbs assessed})\ (\text{no. classes} - 1)} \times 100$$

[2] ns indicates that no significant differences were found among the treatments at $P = 0.05$, Tukey's HSD test.

CROP: Onion (*Allium cepa* L.) cv. Traverse
Carrot (*Daucus carota* subsp. *sativus*) cv. Navedo

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TITLE: EVALUATION OF COVER CROPS FOLLOWING ONIONS AND CARROT CROPS ON MUCK SOIL, 2021

MATERIALS: Daikon radish, Nitro Plus (5% faba bean, 10% nitro radish, 15% crimson clover, 10% Austrian winter peas, 10% forage peas and 50% oats), barley, fall rye

METHODS: Two field trials were conducted to determine effective cover crops after onion and carrot harvest near the Ontario Crops Research Centre - Bradford, Ontario. Onion, cv. Traverse and carrot, cv. Navedo were seeded on 8 and 27 May respectively. Onion was mechanically harvested on 20 September and carrot on 13 and 14 October. Yield data of both crops were recorded to obtain baseline productivity information for further research. A randomized complete block design with four treatments and four replications was used for both trials. Plot size for each experimental unit was 17 x 14 m^2. Crops seeded after onion harvest were daikon radish at 15 kg/ha, Nitro plus (5% faba bean, 10% nitro radish, 15% crimson clover, 10% Austrian winter peas, 10% forage peas and 50% oats) at 45 kg/ha, barley and radish mix at 70 and 10 kg/ha, respectively and barley at 90 kg/ha. The cover crops were broadcast seeded on 21 September into lightly disked soil. An additional ten percent by weight of extra seeds were used to compensate for errors during broadcasting. Plots were cultivated and rolled after seeding. Treatments after carrot harvest were bare ground (check), over seeding of barley before carrot harvest at 100 kg/ha, barley seeded after carrot harvest at 100 kg/ha and fall rye after harvest at 100 kg/ha. Pre-harvest seeding was done using a broadcaster on 5 October and post-harvest seeding of barley and fall rye was done using a CASE 5100 seed drill at a depth of 3-4 cm into lightly disked soil on 18 October.
Cover crop biomass was sampled on 2 and 16 November for onion and carrot trials, respectively. Plants in the carrot field were left to grow until the weather became unfavourable, (severe frost) since plants were very small (less than 2 cm in height). Three 0.25 m^2 quadrats in the onion trial and four quadrats in the carrot trial were randomly selected within each replicate plot for sampling the aboveground biomass. Plants were cut at ground level and both fresh and dry weight of samples were assessed. The samples included both dead and living plant material and plants within the quadrant were counted. The percent of green canopy cover was also measured simultaneously from two randomly chosen spots in each plot using Canopeo, a mobile application developed by Oklahoma State University. Cover crops were left to overwinter, and their survival and soil coverage will be analyzed next year in April. Data were subjected to analysis of variance using R 4.1.0 version. Mean separation was carried out using Fisher's Least Significant Difference at 5% level of significance.

RESULTS: as presented in Tables 1 - 3

OBSERVATIONS: GOAL 2XL (oxyfluorfen 240 g/l) herbicide applied to the daikon radish plots at 140 ml per hectare in September resulted in complete crop failure in all four replicates.

CONCLUSIONS: No significant differences in yield of onion or carrot were observed, as expected (Table 1). The yields will be used as baseline data for future trials.
Crop stand was good in cover crops following onions. The percent of canopy coverage ranged from 30 to 47 percent (Table 2) which could probably be increased through uniform mechanical seeding. There were no significant differences in above ground dry biomass, canopy cover percentage and plant count among the treatments.

Cover crops following carrots did not establish well, with height less than 5 cm. Plant height was greater in the pre-harvest sown barley (greater than 8 cm), but plant count was significantly lower than the other treatments. There were significant differences in dry biomass, plant counts and canopy coverage among treatment with highest numbers in fall rye and lowest in pre-harvest barley. Increasing seed rate or altering seeding date (gap between seeding and carrot harvest) could support for better crop stand in pre-harvest barley treatment. Techniques like seed priming could also be relevant for better crop establishment after carrot harvest. Further trials are necessary to discover appropriate species of cover crop and its cultivation practice in carrot fields.

Table 1. Total and marketable baseline yield data from onion and carrot trials near the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Onion Trial			Carrot Trial		
Post-harvest Treatments	Total Yield (MT/ha)	Marketable Yield (MT/ha)	Pre and Post-harvest Treatments	Total Yield (MT/ha)	Marketable Yield (MT/ha)
Daikon Radish	39.4 ns[1]	30.5 ns	Control	92.6 ns	75.9 ns
NITRO Plus	41.5	33.5	PH Barley[2]	104.8	81.1
Barley/Radish	42.1	31.6	Barley	101.3	77.6
Barley	40.3	30.2	Fall Rye	97.8	81.2

[1] ns indicates no significant differences were found among the treatments at P = 0.05
[2] PH Barley– Preharvest broadcast barley application one week before harvest

Table 2. Average canopy coverage percent, plant count of cover crops and above ground dry mass following onion grown near the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatments	Canopy Coverage (%)	Avg. Plant Count m^2	Avg. Dry Weight m^2 (g)
Daikon Radish	-	-	-
NITRO Plus	30.3 ns[1]	151 ns	34.2 ns
Barley/Radish	47.2	179	50.0
Barley	39.1	165	38.1

[1] ns indicates no significant differences were found among the treatments at P = 0.05

Table 3. Average canopy coverage percent, plant count of cover crops and above ground dry mass following carrot grown near the Ontario Crops Research Centre - Bradford, Ontario, 2021.

Treatments	Canopy Coverage (%)	Avg. Plant Count m^2	Avg. Dry Weight m^2 (g)
Control	0.7 d[1]	-	-
PH Barley[2]	0.8 c	44 c	1.2 c
Barley	1.6 b	189 b	2.1 b
Fall Rye	3.5 a	251 a	3.5 a

[1] Numbers in a column followed by same letter are not significantly different at P = 0.05, Fischer's Protected LSD test
[2] PH Barley– Preharvest broadcast barley application one week before harvest

Funding for this project was provided by Ontario Ministry of Agriculture, Food and Ministry of Rural Affairs and by the Ontario Agri-Food Innovation Alliance

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TITLE: DEMONSTRATION OF BIOFUMIGANT COVER CROPS ON ORGANIC (MUCK) SOIL, 2021

MATERIALS: Caliente 199 (*Brassica juncea* L.), sorghum Sudan grass (*Sorghum vulgare* var. *sudanese* Hitchcock (Marks and Townsend, 1973), Barley (*Hordeum vulgare* L. (Hitchcock, 1971) Fall Rye (*Secale cereale* L.) and Pearl millet (P*ennisetum glaucum*)

METHODS: Cover crops of various species were seeded into organic soil (organic matter ≈ 64.7%, pH ≈ 6.9) at a site near the Ontario Crops Research Centre – Bradford, Ontario to determine the effect of biofumigant mustards and other cover crops on soil borne pathogens and to determine the overall benefit of cover crop use on organic soil. A randomized complete block design with four replicates per treatment was used. Treatment areas were 14 x 17 m and were seeded with a CASE 5100 grain drill. Biofumigant mustard, Caliente 199 at 4.5 kg/ha (three treatment plots) and barley 72 kg/ha (one treatment) was initially seeded on 27 April at 4.5 kg/ha, the plots needed to be reseeded on 14 May due to poor emergence. On 13 August, plants in all treatments were chopped using a flail mower and the crop residue rototilled into the soil. As the mustard plants decompose, glucosinolates are released and work as a biofumigant. Soil was left undisturbed for 10 days to allow time for the material to break down. On 23 August cover crops of sorghum Sudan grass (56 kg/ha), pearl millet (10 kg/ha) and fall rye at 90 kg/ha were seeded into the previous seeded biofumigant treatments of Caliente 199. The treatment area previously seeded to barley was sown to Caliente 199 (12 kg/ha). All treatments were seeded using the hand push seeder using various plates to deliver the desired seeding rate. Fresh biomass was determined on 2 November for all the treatments. Plants in three 1 m^2 sections were cut at ground level and weighed. Plant and weed counts for each section were also assessed. The green canopy cover was measured in three areas in each replicate using the Canopeo App developed by the Soil Physics Research Group at Oklahoma State University. Soil samples for DNA multiscan analysis were taken prior to seeding and after the fumigation process in the late seeded biofumigant treatments. Data were analyzed using Statistixs V. 10, and a General Analysis of Variance for linear models was used. Means were compared using Fisher's Protected LSD test at P = 0.05 level of significance.

RESULTS: as presented in Table 1

OBSERVATIONS: Proper seeding depth of various cover crops is important to ensure good stands. Plots with pearl millet and sorghum were severely affected by frost before sampling for canopy percentage and biomass.

CONCLUSIONS: All species of cover crops established well on both the early and late seeding dates. All crops had good canopy coverage except for Caliente 199. The pearl millet may not be suited for cover crop use in organic soil, as it started to set seed stalks early and this may have contributed to the overall weight of the plants. More work is needed to test the efficacy of these crops in organic muck soils.

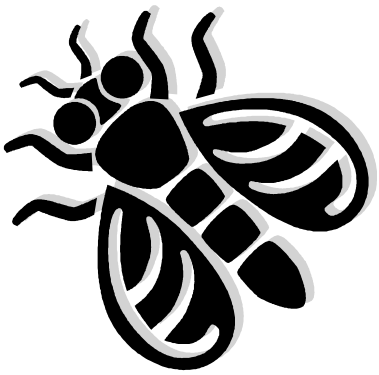
The percent of canopy coverage ranged from 17 to 81 percent with highest percentage in rye and lowest in sorghum and pearl millet. There were significant differences in dry biomass and plant counts among treatments with highest numbers in Caliente 199 and lowest in pearl millet. Major weeds observed in the plots were chickweed, goosefoot and groundsel. Weed counts and fresh weight were highest for the pearl millet treatment. The lowest weed counts were observed in the rye and Caliente 199 treatments.

Table 1. Plant growth data for various cover crop species, grown near the Ontario Crops Research Centre – Bradford, 2021.

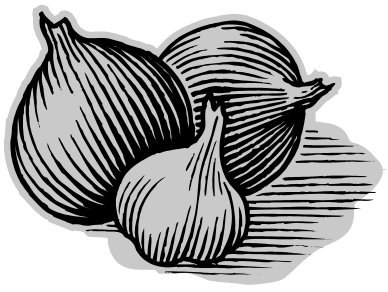
Crop	Canopy Coverage %	Avg. Plant Count m^2	Avg. Dry Weight m^2 (g)	Avg. Weed Count m^2	Avg. Weed Fresh Weight m^2 (g)
Caliente 199	54.8 b[1]	185 a	320.7 a	56 b	28.2 b
Sorghum	18.9 c	158 a	127.2 b	158 a	94.0 b
Rye	81.8 a	101 b	310.2 a	43 b	33.0 b
Pearl Millet	17.6 c	96 b	42.4 c	165 a	200.6 a

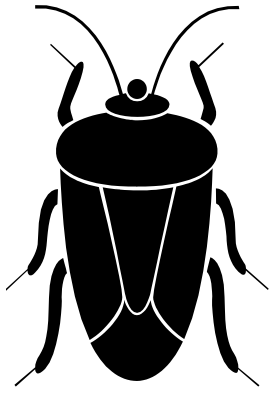
[1] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD test.

Funding for this project was provided by Ontario Ministry of Agriculture and Food and Ministry of Rural Affairs and by the Ontario Agri-Food Innovation Alliance



Integrated Pest Management Report - 2021





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TITLE: THE INTEGRATED PEST MANAGEMENT PROGRAM SUMMARY FOR MUCK VEGETABLE CROPS, 2021

An Integrated Pest Management (IPM) program is provided to growers in the Holland/Bradford Marsh, Ontario, by the University of Guelph Ontario Crops Research Centre - Bradford. This project was funded in part through the Ontario Agri-Food Innovation Alliance. Funding was also provided in part by the Bradford Cooperative Storage Ltd., agrochemical companies, and growers participating in the Muck Crops Research Station IPM Program. The main objectives of the project are: to scout growers' fields for diseases, weeds, and insect pests, to provide growers with disease and insect forecasting information, to identify and diagnose diseases, insect pests and weeds, and to implement roto-rod spore traps to trap and analyze spores of various vegetable crop pathogens.

SCOUTING

In 2021, 55 commercial vegetable fields, totalling 540 acres (onion 265 A., carrot 223 A., celery 37 A., potato 10 A.), were intensively scouted for 19 growers. Fields were scouted twice per week during the growing season and growers received scouting reports after each field survey.

DIAGNOSTICS, EXTENSION & DISSEMINATION OF INFORMATION

Any grower, whether participating in the IPM program or not, may bring in samples (plant, insect, or weed) for diagnosis. The on-site tools available for diagnosis are visual inspection and laboratory inspection using a microscope and culturing. Diagnoses are made by comparison to known symptoms, published descriptions of pathogens, insect pests and weeds, and personal experience. Following assessment, the extension advice given was based on Ontario Ministry of Agriculture and Food and Rural Affairs (OMAFRA) recommendations for pesticides.

From 14 May to 20 October, 2021, the diagnostic laboratory of the OCRC-B received 84 samples for diagnosis. Of these, 70% were diagnosed with infectious diseases (59 samples), 6% with insect issues (5 samples) and 24% were diagnosed with an abiotic disorder (20 samples). These samples were associated with the following crops: onion (42%), carrot (32%), celery (11%) and other crops (15%). For extension services, data collected from growers' fields and research station plots were compiled twice per week, analyzed and summarized. The results were compiled in an 'IPM report' and updated twice per week and circulated to participating growers, academia, industry, OMAFRA staff, posted on the OCRC-B website (new site - https://bradford-crops.uoguelph.ca/), and a copy was displayed at the Bradford Co-op.

PEST PREDICTIVE MODELS

The IPM program provides disease and insect forecasting based on spore traps, disease forecasting models BOTCAST (for botrytis leaf blight of onion), DOWNCAST (for onion downy mildew), BREMCAST (for lettuce downy mildew) BSPCAST (for Stemphylium leaf blight of onion), an onion white rot model and a Sclerotinia white mold of carrot model, degree day models, and insect traps. These disease and insect forecasts alert growers by predicting the potential for disease and insect pest incidence.

CROP PEST SUMMARIES

At the end of the scouting program, 100 onions were examined after lodging or 100 carrot samples were collected from each scouted field and assessed for damage from insects and diseases/physiological disorders. The onion samples were examined by hand pulling 10 onions from 10 random locations throughout each field. The carrot samples were collected by hand pulling 20 carrots near each of the four corners and middle (5 locations total) of each field.

CARROT

Insects

In 2021, carrot fields were scouted for carrot weevil (*Listronotus oregonensis*), carrot rust fly (*Psila rosae*), aster leafhopper (*Macrosteles quadrilineatus*) and other insect pests. Degree day models were used to predict the occurrence of the various life stages of these insects. Insect damage caused by carrot weevil and rust fly was minimal this season, similar to 2020 (Table 1). However, high populations of aster leafhopper and, presumably, a high aster yellows infectivity, resulted in more fields showing symptoms of infection with aster yellows than in previous years.

Table 1. Average percent carrot weevil and carrot rust fly damage on carrots at harvest in scouted fields in the Holland Marsh, 2021.

Location within Holland Marsh	% Damaged Carrots	
	Weevil damage	Rust fly damage
West	0.0	0.0
South	0.0	0.3
Central	0.1	0.7
North	0.8	0.2
East	0.0	0.0
Average	0.2	0.3

Carrot weevil adults were first found in wooden Boivin traps on 21 May in carrot fields (Fig. 1). The threshold of 1.5 or more weevils/trap was reached by 4 June in most regions of the Holland Marsh. Overall, 52% of fields in the IPM program reached the 1.5 weevil/trap threshold, and 24% of fields reached the 5 weevil/trap threshold.

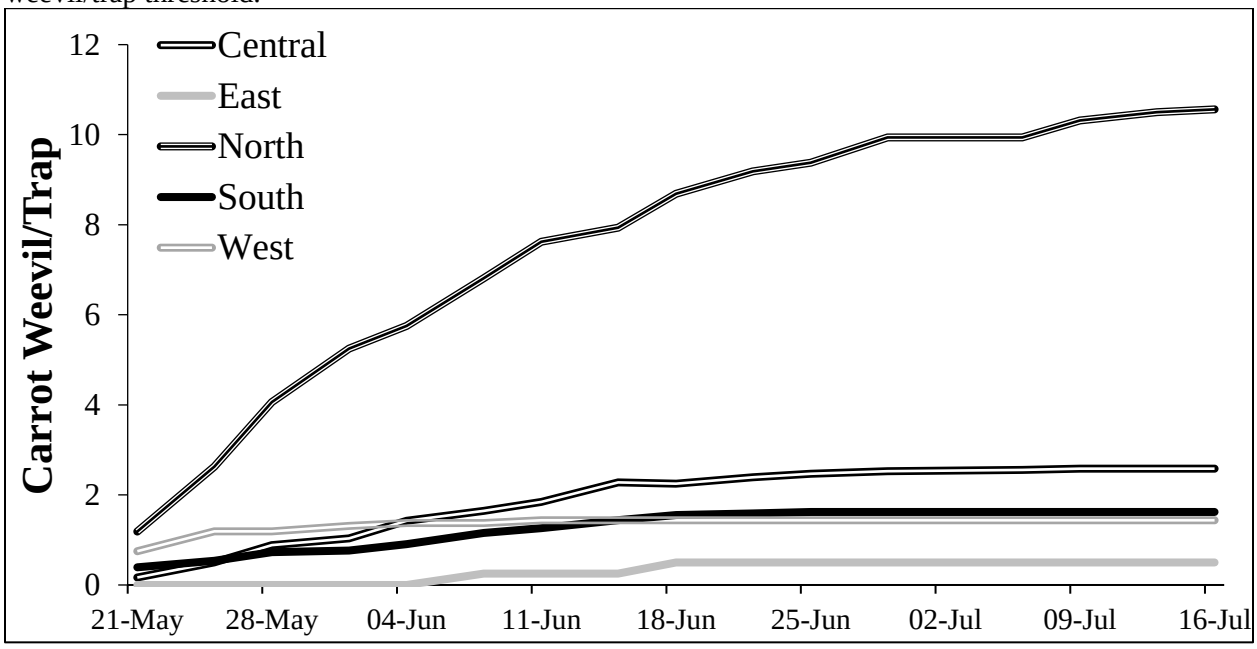


Figure 1. Average cumulative number of carrot weevils/trap in different regions of the Holland Marsh, 2021.

Carrot weevil counts were similar to previous years and damage remained low. The increased uptake of growers now using Rimon and Exirel, which are very effective at controlling carrot weevil, has contributed to decreased carrot weevil damage.

Orange sticky traps and degree day models were used to monitor and estimate carrot rust fly (Fig. 2). Carrot rust flies were first found on sticky traps on 25 May, shortly after the degree day model predicted first generation emergence (21 May). The highest rust fly activity during the first generation, across all regions, was on 29 June, when 52% of scouted fields had exceeded the threshold of 0.1 flies/trap/day. The highest activity during the second generation on 13 August when 40% of scouted fields had exceeded the threshold.

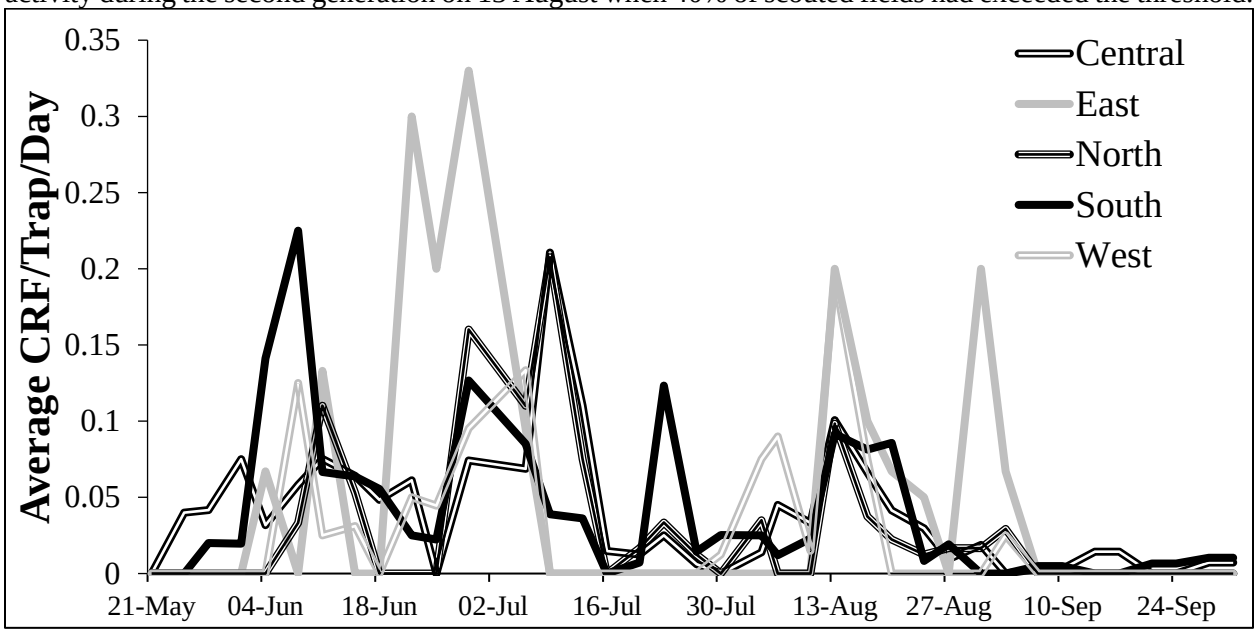


Figure 2. Average carrot rust flies (CRF)/trap/day in different regions of the Holland Marsh, 2021.

Aster leafhoppers are pests of carrots, celery, lettuce and leafy greens. Aster leafhoppers were first found on orange sticky traps on 21 May in carrots and celery (Fig. 3). Sticky traps and sweepnetting (100 sweeps per field) were used to estimate populations occurring within fields. Counts peaked around mid-June to mid-July during which 72% of fields were above the 20 ALH/trap threshold.

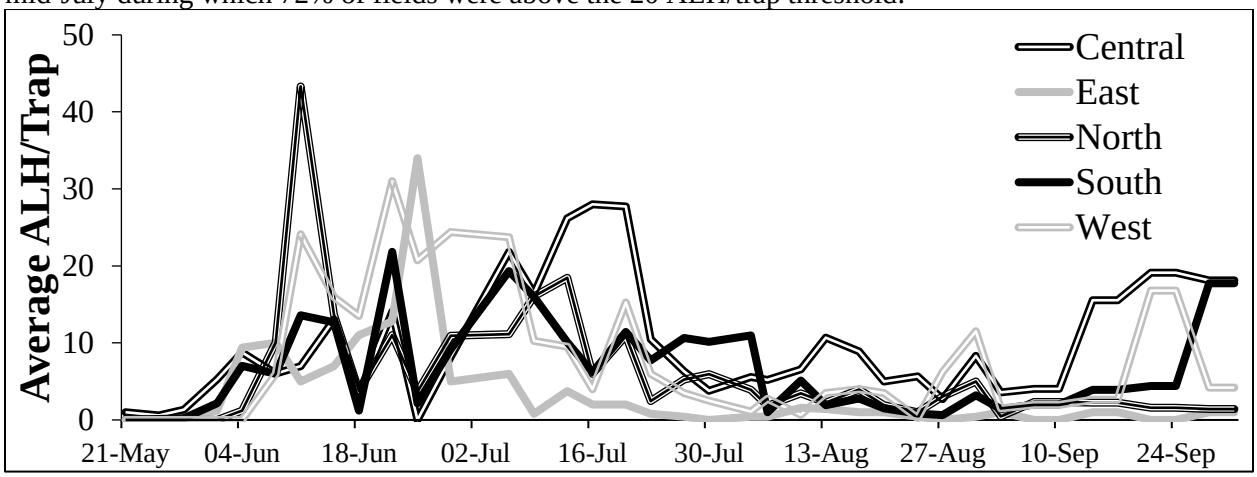


Figure 3. Average aster leafhoppers/trap in different regions of the Holland Marsh, 2021.

Diseases

Carrot fields were scouted for diseases throughout the growing season. Leaf blights, which are caused by the fungi *Alternaria dauci* and *Cercospora carotae*, were first seen on 6 July. Three scouted carrot fields reached the leaf blight threshold of 25% of plants infected during the growing season.

Samples of 100 carrots were taken from each scouted fields and roots were assessed for diseases (Table 2). All fields had multiple diseases; however, disease severity was generally low. Cavity spot (*Pythium* spp.)

and forking (nematodes and/or *Pythium* spp.) were the most common throughout carrot fields, similar to previous years in the Holland Marsh. Crater rot, Fusarium dry rot, aster yellows and crown gall were also present and disease incidence and severity were higher compared to previous years. This is likely due to the wet conditions at the end of the season and high populations of aster leafhopper.

Table 2. Disease incidence on carrot samples collected from commercial fields in the Holland Marsh, Ontario in 2021.

DISEASE	CAUSAL AGENT	FIELDS INFECTED (%)	INCIDENCE (%)
Cavity Spot	*Pythium* spp.	100	1-49
Forking/Split	Nematodes and/or *Pythium* spp.	100	2-19
Crater Rot	*Rhizoctonia* spp.	96	0-30
Fusarium Dry Rot	*Fusarium* spp.	88	0-26
Aster Yellows	*Phytoplasma*	50	0-7
Crown Gall	*Agrobacterium tumefaciens*	21	0-8

ONION

Insects

Onion fields were scouted for onion maggot (*Delia antiqua*) (Fig. 4), onion thrips (*Thrips tabaci*) (Fig. 5), cutworms and other insect pests.

The degree day model predicted first generation onion fly emergence on 16 May. The first onion flies were found on yellow sticky traps on 20 May and counts were low throughout the season, similar to previous years in the marsh (Fig. 4).

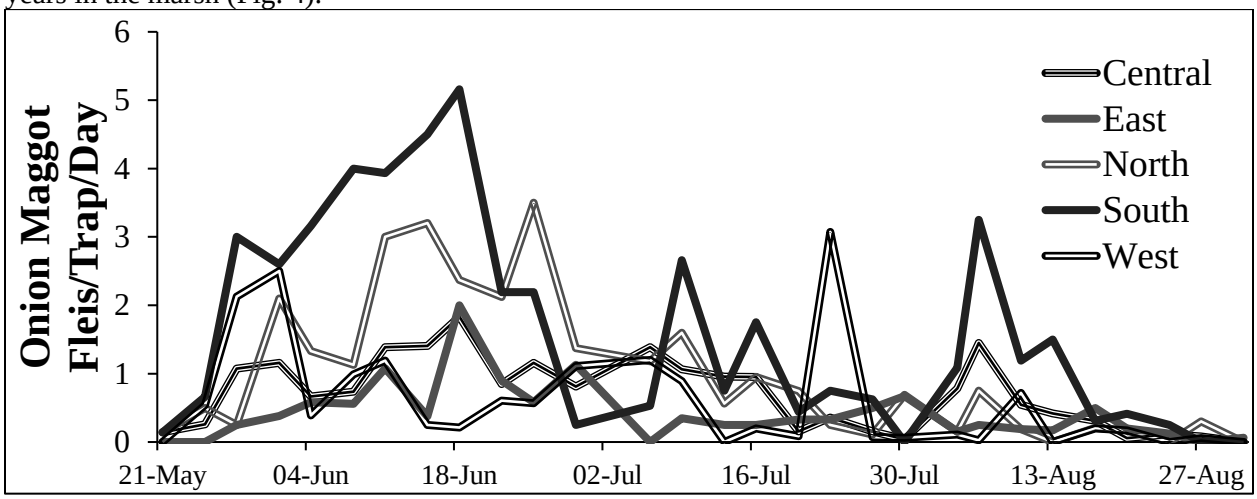


Figure 4. Average onion flies/trap/day in different regions of the Holland Marsh, 2021.

Thrips populations were similar to the 2020 season. Thrips were firsts identified on 17 June and populations fluctuated throughout the season. Thrips counts peaked on 3 August. Two onion fields surpassed the 3 thrips/leaf threshold in July.

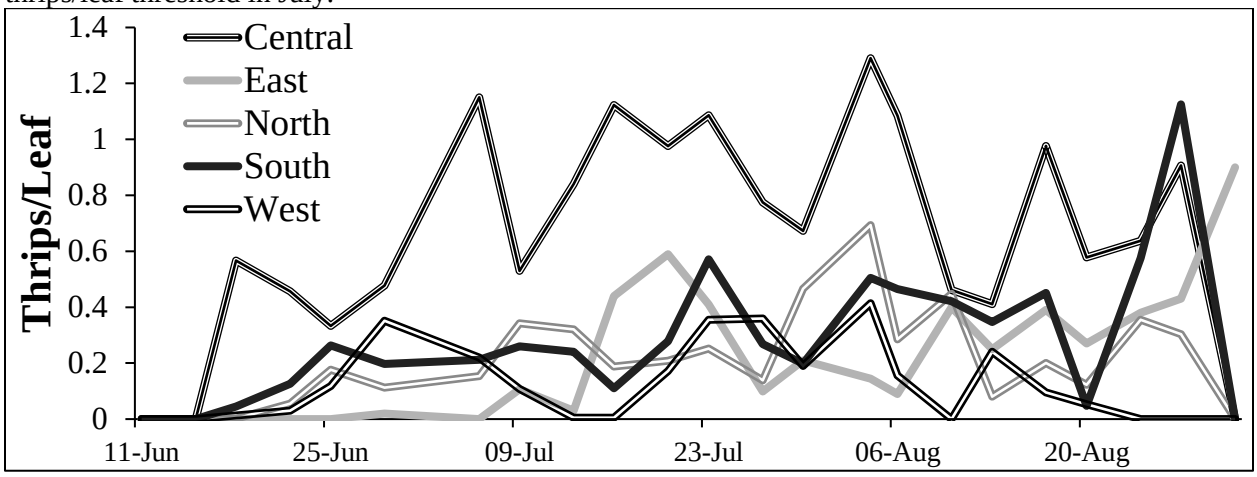


Figure 5. Average thrips/leaf in different regions of the Holland Marsh, 2021.

Diseases

Onion fields were scouted for botrytis leaf blight (*Botrytis squamosa*), downy mildew (*Peronospora destructor*), purple blotch (*Alternaria porri*), white rot (*Stromatinia cepivora*), pink root (*Setophoma terrestris*), stemphylium leaf blight (*Stemphylium vesicarium*) and other diseases.

Stemphylium leaf blight continued to be the main disease on onions in 2021 (Table 3). First symptoms of Stemphylium leaf blight in scouted fields were seen on 25 June. All scouted onion fields showed symptoms of the disease by the end of the season. Conditions were favourable for onion downy mildew during multiple periods throughout the season, starting at the beginning of July. Disease forecasting indicated a high risk of disease, known as sporulation-infection periods, and recommended sprays several times between the beginning of July to mid-August. Onion downy mildew was found in one scouted onion field. Pink root was found in all onion fields, but disease severity was generally low. Botrytis spores were detected on 18 June, but symptoms of botrytis leaf blight on onions were very rare, although they were found in one onion trial at the Station.

Table 3. Disease incidence on onion samples examined in commercial fields in the Holland/Bradford Marsh, Ontario in 2021.

DISEASE	CAUSAL AGENT	FIELDS INFECTED (%)	INCIDENCE (%)
Stemphylium leaf blight	*Stemphylium vesicarium*	100	12-100
Pink root	*Setophoma terrestris*	100	20-95
Purple blotch	*Alternaria porri*	62	0-15
Smut	*Urocystis cepulae*	54	0-3
Bacterial rot/soft rot	*Pectobacterium carotovorum*	23	0-2
White rot	*Stromatinia cepivora*	15	0-8

CELERY

Insects

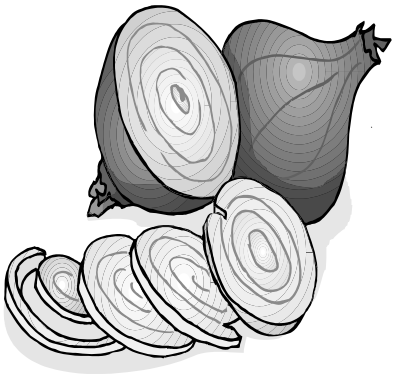
In 2021, four celery fields were scouted for carrot weevil, aster leafhopper, tarnished plant bug (*Lygus lineolaris*) and aphids. Insect traps and degree day models were used to predict the occurrence of the various life stages of carrot weevil, aster leafhopper and tarnished plant bug. Tarnished plant bug populations and damage were very low. Carrot weevil damage in celery fields was also very low. Aster yellows was found

in all scouted celery fields due to the high aster leafhopper populations. No leaf miner, aphid, caterpillar or cutworm damage was reported.

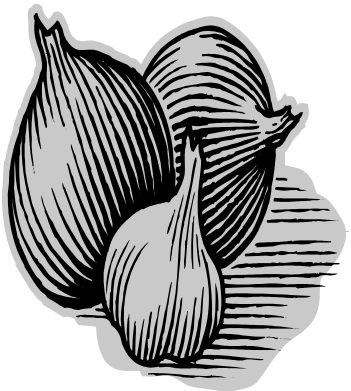
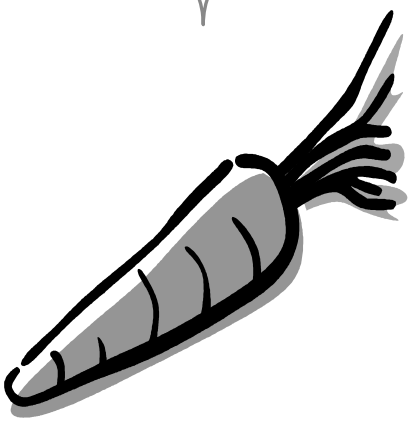
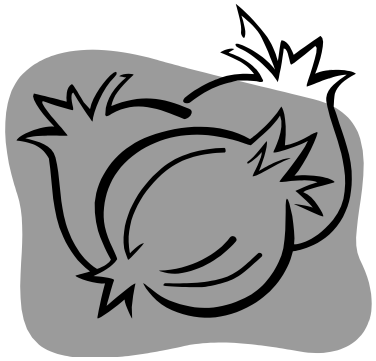
Diseases

Celery leaf curl, or celery anthracnose (*Colletotrichum fioriniae*), was found in all scouted celery fields but incidence was low overall with several plants per field infected with the disease, on average. Black heart was also identified in all fields. Leaf blights were common, but disease severity remained relatively low throughout the season.

This project was funded in part through the Knowledge Translation and Transfer (KTT) Funding Program, a program of the Ontario Agri-Food Innovation Alliance. Funding for the IPM program was also provided by the Bradford Co-operative Storage Ltd., growers participating in the program, FS Partners, Bayer Crop Science, BASF, Corteva and Syngenta Crop Protection.


Cultivar Trials 2021

CARROT CULTIVAR TRIAL SEASON SUMMARY – 2021

Daytime air temperatures in early May fluctuated in the low teens digits and nighttime air temperatures fluctuated from single digits to below zero. A week prior to seeding, the weather changed with daytime temperatures quickly climbing to the mid-twenties but nighttime temperatures remained in the single digits. There was no rainfall for fourteen days prior to seeding; however, soil conditions were adequate for carrot seeding. In the marsh, most of the carrot seeding occurred within the two-week period of 17-28 May. Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C), August (22.2°C) and October (12.8°C), average for September (15.8°C), and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C, September 16.4°C and October 9.8°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm), average for October (77 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm, September 59 mm and October 78 mm.

The carrot trial was seeded on 19 and 20 May. On 18 May, irrigation water was applied to aid in forming favourable carrot hills and provide soil moisture for seed germination. On 26 May, an additional half an inch of irrigation water was needed to provide good moisture conditions for seed germination. Emergence and plant vigour were good. On the 29 May the carrots were in the bunny ear stage. Three quarters of an inch of irrigation water was applied on 31 May to help the seedlings through a dry period. On 10 June irrigation water was applied at half an inch to aid the carrots through the first true leaf growth stage. A much needed 24.5 mm rainfall occurred on 26 through 27 of June. This rainfall helped the carrots establish well with no visible decrease in stand.

The pre-emergence herbicide Gesagard was applied 20 May. The lack of rainfall and irrigation after the Gesagard application meant there was limited weed suppression. The below average rainfall in May and June created low weed pressure. Only two applications of Lorox + Assist Oil were required on 19 and 30 of June to clean up the trial. These herbicide applications provided good weed control for the balance of the growing season. The trial was hand weeded a few times through the growing season to keep it free of weeds.

Carrot weevils were first found at the Muck Station on 19 May (1.0 weevils/trap/day). By 25 May, weevil numbers had quickly climbed to the spray threshold of 1.5 cumulative weevils/trap. Insecticides Exirel and Rimon were applied three times (17 June, 5 and 10 July) to provide control for carrot weevil damage. There was no weevil damage (dead carrot seedlings) observed in the variety trial.

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CARROT CULTIVAR TRIAL SEASON SUMMARY – 2021 – continued

The trial average for carrot weevil damage at evaluation was only 0.15%. Carrot rust flies were first found on 25 May. There were three rust fly peaks occurring 30 May, 15 July and 10 August (0.3, 0.07, 0.26 flies/trap/day, respectively). At evaluation there was a trial average of 2.95% rust fly damage observed. This was an increase of almost 3% compared to the 2020 trial average of only 0.1% rust fly damage. Aster leafhoppers were first found on 19 May. On 13 July, leafhopper numbers had peaked at 64 leaf hoppers/trap. Leafhopper numbers stayed high throughout the remainder of the month. Leafhoppers population significantly decreased in August to below threshold levels. The high pressure of Aster leafhoppers correlated with noticeable aster yellows infection found in the yield samples.

Alternaria and Cercospora leaf blights were first found on 8 July and were controlled throughout the growing season with three applications of fungicides (see Cultivar Management Procedures). To observe cultivar tolerances to these pathogens, regular fungicide sprays were discontinued on 2 September. Throughout the months of September & October, leaf blight incidence increased in most cultivars. Leaf blight was at a moderate level of infection in most varieties at harvest in October. Differences in leaf blight incidence among cultivars were evaluated and noted. In the jumbo cultivars, the first replicate had a significantly higher blight rating than the other two replicates. By Grower Field Week, starting on 9 September, some bolting was noted in a few cultivars in the trial. At harvest, twenty-four cultivars had no seeders present and in cultivars where seeders were present the total numbers were very low.

On 9 September, grower field day, most carrot roots that were pulled appeared to be progressing well with good lengths, weight, and smoothness. A significant rainfall event of 116.5 mm started on the evening of 21 through to the morning of 22 September. This record rainfall created flooding conditions within the trial. The first replicate had water levels even to the top of the hill and soil saturation in the second and third replicates. It took several days for the water to drain away. Weather conditions in October were favourable for the entire harvest period which began on 18 October. At harvest, carrots had good diameters and average lengths, but were disappointing in quality. There were high numbers of forked and split carrots in the yield samples. Night temperatures in the mid teens for two weeks before harvest appeared to encourage blight development. The carrot tops had moderate levels of leaf blight and weakened petiole attachment. Small pockets of sclerotinia were found in the trial at harvest. Bacterial canker rot and tip rot was quite noticeable throughout the first replicate. Carrot samples were placed in the Filacell storage immediately after harvest.

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CARROT CULTIVAR TRIAL SEASON SUMMARY – 2021 – continued

At evaluation in late December, the trial average yield for cellos was disappointing with only 989 bu/A. This is a drop of approximately 200 bu/A compared to 2020. The jumbos trial yield average was 1231 bu/A which is very similar to the 2020 trial average of 1274 bu/A. The cellos were of average width and length but were a little poor in quality and therefore slightly disappointing. The jumbos had good width but were slightly shorter than desired and this shortness contributed to a lower than desired yield. In both the cellos and jumbos, the percentage of cull carrots was high with over 25% of the harvest yield. Most of the culls in the jumbos were small, undersized carrots. In the cellos, most of the culls were forked with some splits and rot making up the other culls. Canker rot was noted during evaluation with jumbo types having a higher incidence. At evaluation, the trial percent marketable average for cellos was low at 65.7% and jumbos were not much better at 76.1%. The first replicate of cellos had a 5% significantly lower percent marketable yield compared to the third replicate. It appears the flooding of mid-September affected not only the quality but also yield. The percent marketable for cellos was significantly different between the first and the third replicate. For cellos, the stand average was 20 carrots/foot compared to the desired trial seeding average of 25 carrots/foot. For jumbos, the stand average was 13 carrots/foot compared to the desired trial seeding average of 18 carrots/foot. The low stand for the jumbos was disappointing because in the spring, the emergence and establishment of carrots appeared to be good. The trial average for cavity spot incidence was 82.6% and this is almost double compared to 2020 (44%) and 2019 (45%). Even though cavity spot incidence was very high, the trial average for severity remained light/moderate-sized lesions. It appeared the September flooding contributed to an increase in percentage of incidence of cavity spot but did not increase the severity. Most of the cello cultivars had poor uniformity of length and width. The jumbos were more uniform in length and width but still were below potential. Exterior colour for all cultivars was good and consistent for all carrots within the samples with some marbling noticed. Most of the jumbo cultivars only had a few visible lenticels. The cellos and jumbos both had average trial ratings for appearance. Most cultivars had a rougher exterior skin with some ringy surfaces, yet another effect from the September flooding. Interior colour blending was good, with a few carrots having any translucency in the core or red/green rings around the core. Green shoulders were not present in most cello cultivars, and if found, were mostly in the jumbos and just starting to develop. There was the odd cultivar that had a small number with galls (see Carrot Management Procedures). Visible aster yellows infection was found throughout the trial. At evaluation, no significant differences were found in percent infected aster yellow roots.

CARROT CULTIVAR TRIALS - 2021

MANAGEMENT PROCEDURES

Fertilizer:

40 kg/ha Nitrogen (Calcium Ammonium Nitrate 27-0-0) + 75 kg/ha Phosphorous (MESZ 10-40-0) + 200 kg/ha Potassium (ASPIRE 0-0-58) + 75 kg/ha of K-Mag (0-0-22) + 3.5 kg/ha of Boron (10%) was worked into the soil.

Seeded:

All trials were seeded on 19 & 20 May using a push cone seeder. If seed had a germination rate of 95 to 100%, a target of 26-22 seeds per foot was desired for Cello type carrots and 15-18 seeds per foot for Jumbo type carrots. All trials were seeded on beds 86 cm apart. The seeding rate was done according to percent germination. **RIDOMIL 1G** was applied at 25 kg/ha in the seed furrow. The Main Trial was replicated three times and the Adaptation Trial was not replicated.

Weed Control:

Pre-emergence:	1 application: **GESAGARD 480** at 6.0 L/ha on 20 May.
Post-emergence:	1 application: **LOROX L** at 300 ml/ha + **ASSIST OIL** at 1.0 L/ha on 19 June.
	1 application: **LOROX L** at 1.0 L/ha + **ASSIST OIL** at 1.0 L/ha on 30 June.

Minor Elements:

Four foliar sprays: Magmax on 2 September (2.0 L/ha), 6 Aug (3.0 L/ha), 10 July and 26 August (4.0 L/ha).
Four foliar sprays: Alexin on 22 July & 2 September (2.0 L/ha), 6 August (3.0 L/ha) and 26 August (4.0 L/ha).
Three foliar sprays: Calimax on 10 & 22 July (2.0 L/ha) and 6 August (3.0 L/ha).
Two foliar sprays: Suprafeed on 26 August and 2 September (2.0 kg/ha).
Two foliar sprays: Maganese Sulfate on 22 July and 26 August (2.0 kg/ha).
One foliar spray: Epsom Salts on 22 July (2.0 kg/ha).

Insect and Disease Control:

According to IPM recommendations.

EXIREL at 1.5 L/ha on 17 June.
RIMON at 840 ml/ha on 5 July.
RIMON at 840 ml/ha + **CLOSER** 300 ml/ha on 10 July.

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CARROT CULTIVAR TRIALS - 2021 - continued

Insect and Disease Control continued:

UPCYDE at 288 ml/ha and Minor Elements on 22 July.
DITHANE DG at 2.25 kg/ha + **DIBROM** 530 ml/ha and Minor Elements on 6 August.
DITHANE DG at 2.25 kg/ha + **UPCYDE** 288 ml/ha and Minor Elements on 26 August.
QUARDIS TOP at 1.0 L/ha + **SILENCER** at 83 ml/ha and Minor Elements on 2 September.

Harvest:

The Main and Adaptation Trials were harvested on 18-28 October. All trials were immediately placed in a temperature and humidity controlled storage (1°C, 95 % RH) respectively.

Irrigation:

Irrigation water was applied five times during the 2021 growing season.

18 May in the amount of ½ inch
26 May in the amount of ½ inch
31 May in the amount of ¾ inch
10 June in the amount of ½ inch
5 August in the amount of ¾ inch

EVALUATION PROCEDURES

The cultivars were evaluated on 6 – 29 December after 6 weeks in storage.

 # Carrots Harvested:

Total number of carrots harvested from 2.32 m of row.

Harvest Weight:

Weights from the harvested 2.32 m of row.

Marketable Yield t/ha + B/A:

Marketable yield includes the packaging size, 2.0 cm to 4.4 cm (¾" to 1¾") as well as the oversize > 4.4 cm (> 1¾").

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% Oversize:

The percentage of carrots > 4.4 cm (> 1¾ ") and greater.

Majority of Culls:

Sp = Splits F = Forked Sm = Small (< 2.0 cm) R = Rot A = Aster Yellows

Shape:

GP = Gold Pak N = Nantes Imp = Imperator Cyl = Cylindrical LD = Long Danver SP = Spartan Bonus

Appearance:

Appearance is based on qualities of straightness of root and smoothness.
10.0 = very straight and smooth, 6.0 = a few rough carrots in mix, 1.0 = bends and curves in root with very rough surface.

Resistance to Greening:

The higher the number, the less green tissue on the crown of the carrot 10.0 = no green tissue, 6.0 = moderate green tissue, 1.0 = total green tissue.

External Colour:

DO = Dark Orange O = Orange BO = Bright Orange LO = Light Orange LY = Light Yellow

Internal Colour:

DO = Dark Orange O = Orange BO = Bright Orange LO = Light Orange YO = Yellow Orange

Blight Rating:

Regular fungicide applications were discontinued on 2 September to allow the cultivars to be evaluated for tolerance to leaf blights. Evaluation took place at harvest. 10.0 = Most Desirable, no lesions; 8.0 = Good, mild lesions on leaves, no lesions on petioles; 6.0 = Moderate, lesions on leaves, some lesions on petioles; 3.0 = Poor, numerous lesions on leaves, numerous lesions on petioles; 1.0 = Severe, tops completely rotted, crop cannot be harvested.

Score:

The average of the 9 marks from Uniformity of Shape to Blight Rating. 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average.

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CARROT CULTIVAR TRIALS - 2021 - continued

% Cavity Spot & Degree:

The number indicates the percentage of roots with cavity spots.
The letters indicate the degree to which the roots were infected.
VL = Very Light, cavity spots are few and barely visible. Lesion size < 1 mm.
L = Light, few small spots. Lesion size 1 - 2 mm.
M = Medium, roots borderline marketable. Lesion size 2 - 5 mm.
H = Heavy, large cavity spots, roots unmarketable. Lesion size 5 - 10 mm.
VH = Very Heavy, many large cavity spots, roots unmarketable. Lesion size > 10 mm.

Example: 50 H = 50% of the roots were heavily infected with cavity spots, roots unmarketable

Shape of Crown:

CV = Convex (no indentation around crown) CC = Concave (indentation around crown)

Root Length (cm):

Twenty centimetres is approximately eight inches.

Root Width (cm):

One inch is approximately two and a half centimetres.

Seeding Rate:

Number of seeds per foot as specified by seed company.

Stand per Foot:

Stand per Foot times 3.28 equals Stand per Metre.

Top Length (cm):

Small = 20-30 centimetres Medium = 30-45 centimetres Large = 45 centimetres and greater

Leaf Colour:

LG = Light Green G = Green DG = Dark Green PG = Pale Green

Leaf Structure:

F = Fine leaf structure ST = Standard leaf structure C = Course heavy leaf structure

… / continued

% Weevil & Rust Fly Damage:

Percent of carrot roots damaged by carrot weevil & carrot rust fly that were found in the 2.32 m harvest sample.

% Aster Yellows:

Percent of Aster yellows infected roots that were found in the 2.32 m harvest sample.

Average Number of Seeders:

Average number of seeders found in each cultivar of 15 m of row.

Zero		***One***	***Two***	***Three***	***Four***	***Seven***
Brillyance	SV DN 5904	Olancha	Orange Blaze	Extremo	B 3187	Caravel
SV 2384	Brava	Volcano		Cellobunch	480621	
Naval	Belgrado	Jefferson		Jacinto		
Navedo Jumbo	Berlin	Speedo				
Enterprise	480620	Narvik				
SV DN 5934	480151					
Navedo – Cello	Baldio					
Trophy Pack	480619					
PV 5311	Bastia					
Jackson - Cello	Jackson - Jumbo					
Istanbul	Intrepid - Inicium					
Intrepid – In & Mycr	Intrepid					

Root Gall:

Root gall was found in the 2021 carrot cultivar trial at low levels.

No galls found					***Galls found in***	
Narvik	SV DN 5904	Belgrado	480620	Cellobunch	***One Replicate***	***Two Replicates***
SV 2384	Volcano	Jacinto	480151	Intrepid - Inicium	Navedo – Cello	Jackson - Cello
Naval	Istanbul	Brillyance	Baldio	Bastia	Jackson - Jumbo	
Navedo Jumbo	Brava	Berlin	Extremo	480621	Intrepid	
Enterprise	Orange Blaze	Trophy Pack	480619	PV 5311	Jefferson	
SV DN 5934	Caravel	Speedo	Olancha	Intrepid – In & Mycr	B 3187	

CARROT CULTIVAR MAIN TRIAL CELLO TYPES - 2021

Cultivar	Source	# Carrots Harvested	# > 4.4 cm	# 2.0 to 4.4 cm	Total Harvest Weight (kg)	Weight > 4.4 cm (kg)	Weight 2.0 to 4.4 cm (kg)	Marketable Yield t/ha	Marketable Yield B/A
SV 2384	Sto	168 ab*	11 e-h	118 a	20.12 cde	3.27 d-g	13.01 a	81.4	1310 ab
ORANGE BLAZE	Sem	117 def	21 a-d	61 de	16.72 fgh	5.43 a-d	7.29 de	63.6	1024 b-g
JACINTO	Nor	115 ef	15 c-g	65 de	12.35 j	3.40 d-g	5.97 e	46.9	754 gh
NARVIK	Bejo	171 ab	12 d-h	98 ab	21.51 bcd	3.09 d-g	13.13 a	81.1	1306 ab
NAVEDO - CELLO	Bejo	168 ab	28 a	82 bcd	25.43 a	7.13 ab	11.20 ab	91.6	1475 a
BRILLYANCE	Sto	165 abc	12 c-h	83 bcd	19.57 c-f	3.12 d-g	10.89 abc	70.1	1128 b-f
NAVAL	Bejo	155 abc	17 b-f	79 bcd	21.50 bcd	4.35 b-e	10.66 abc	75.1	1208 abc
OLANCHA	Nor	137 b-f	7 fgh	82 bcd	15.65 ghi	1.94 efg	8.64 b-e	52.9	852 d-h
ENTERPRISE	Sto	163 abc	13 c-h	86 bcd	19.09 def	3.89 c-g	8.76 b-e	63.2	1018 b-g
TROPHY PACK	Sto	151 a-e	20 a-e	62 de	14.96 hij	3.90 c-g	6.07 e	49.9	803 fgh
PV 5311	Nor	109 f	5 gh	66 de	12.89 ij	1.45 fg	6.94 e	41.9	675 h

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES - 2021 - continued

Cultivar	Source	# Carrots Harvested	# > 4.4 cm	# 2.0 to 4.4 cm	Total Harvest Weight (kg)	Weight > 4.4 cm (kg)	Weight 2.0 to 4.4 cm (kg)	Marketable Yield t/ha	Marketable Yield B/A
CARAVEL	ILL	158 abc*	26 ab	49 e	22.50 abc	7.31 a	7.20 de	72.5	1168 a-d
JACKSON - CELLO	Bejo	181 a	5 h	99 ab	17.55 e-h	1.07 g	10.07 a-d	55.7	897 c-h
ISTANBUL	Bejo	170 ab	18 a-e	68 cde	20.44 cde	4.63 a-e	8.12 b-e	63.7	1026 b-g
CELLOBUNCH	Sto	164 abc	22 abc	67 cde	23.58 ab	6.46 abc	7.89 cde	71.7	1155 a-e
INTREPID - IN & MYC	SN	172 ab	5 h	93 abc	16.99 fgh	1.27 fg	9.02 b-e	51.5	829 e-h
B 3187	Bejo	152 a-d	7 gh	75 b-e	18.31 efg	1.87 efg	8.87 b-e	53.7	865 d-h
SV DN 5934	Sem	130 c-f	7 gh	67 cde	18.45 efg	2.01 efg	8.87 b-e	54.4	875 c-h
INTREPID - INICIUM	SN	154 a-d	11 d-h	67 cde	17.88 e-h	3.40 d-g	6.87 e	51.4	827 e-h
JEFFERSON	Bejo	136 b-f	14 c-h	50 e	19.28 def	3.93 c-f	6.69 e	53.1	855 d-h
INTREPID	SN	164 abc	5 gh	74 b-e	16.63 fgh	1.43 fg	7.51 de	44.7	720 gh
Trial Average		**152**	**13**	**76**	**18.64**	**3.54**	**8.75**	**61.4**	**989**

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES - 2021 - continued

Cultivar	Source	% Marketable	% Oversize	Majority of Culls	Shape	Uniformity of Shape	Uniformity of Length	Uniformity of Width	Appearance	Resistance to Greening
SV 2384	Sto	80.9 a*	15.7 b-f	F	IMP	8.0 abc	3.7 fgh	5.0 fgh	5.7 def	8.0 e
ORANGE BLAZE	Sem	76.0 ab	32.0 a	F	GP	5.3 e	5.3 cde	6.0 c-f	6.7 a-d	8.7 cde
JACINTO	Nor	75.9 abc	27.9 ab	SM	IMP	8.0 abc	6.0 bcd	5.0 fgh	6.0 cde	10.0 a
NARVIK	Bejo	75.8 abc	14.7 b-f	SM	N	8.0 abc	6.8 ab	6.7 bcd	7.0 abc	8.3 de
NAVEDO - CELLO	Bejo	71.9 a-d	27.9 ab	SM	N	7.3 bcd	5.7 bcd	6.3 b-e	6.7 a-d	8.7 cde
BRILLYANCE	Sto	71.2 a-d	15.5 b-f	SM	N	7.3 bcd	8.0 a	7.0 abc	7.3 ab	9.3 abc
NAVAL	Bejo	69.5 a-e	20.5 a-e	SM	N	9.0 a	6.7 abc	7.3 ab	7.7 a	9.3 abc
OLANCHA	Nor	67.7 a-e	12.7 c-f	SP	CPIMP	9.0 a	3.0 h	4.7 gh	6.3 b-e	9.7 ab
ENTERPRISE	Sto	66.7 a-e	20.2 a-e	F	IMPCYL	7.0 bcd	5.0 def	4.3 h	5.3 ef	9.3 abc
TROPHY PACK	Sto	66.6 a-e	26.1 abc	SM	IMP	7.0 bcd	6.7 abc	6.3 b-e	7.3 ab	9.7 ab
PV 5311	Nor	65.9 a-e	11.5 def	F	IMP	8.0 abc	4.7 d-g	4.3 h	6.3 b-e	10.0 a

Listed in order of % Marketable. 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES - 2021 - continued

Cultivar	Source	% Marketable	% Oversize	Majority of Culls	Shape	Uniformity of Shape	Uniformity of Length	Uniformity of Width	Appearance	Resistance to Greening
CARAVEL	ILL	64.6 b-e*	32.8 a	SM	N	9.0 a	7.0 ab	8.0 a	7.7 a	8.3 de
JACKSON - CELLO	Bejo	63.5 b-e	6.1 f	SM	GP	6.3 de	6.7 abc	6.3 b-e	5.7 def	10.0 a
ISTANBUL	Bejo	61.5 b-e	21.9 a-d	F	IMP	6.3 de	5.0 def	6.0 c-f	5.3 ef	9.7 ab
CELLOBUNCH	Sto	60.7 b-e	27.2 ab	F/SM	IMPCYL	5.3 e	5.7 bcd	6.7 bcd	5.3 ef	9.0 bcd
INTREPID - IN & MYC	SN	59.8 cde	7.3 ef	F	IMP	7.0 bcd	5.3 cde	5.0 fgh	6.3 b-e	8.7 cde
B 3187	Bejo	58.5 de	9.9 def	F	IMP	8.3 ab	3.3 gh	5.0 fgh	4.7 f	9.7 ab
SV DN 5934	Sem	58.4 de	11.3 def	F	CYL	7.3 bcd	4.0 e-h	5.7 d-g	6.0 cde	9.0 bcd
INTREPID - INICIUM	SN	56.0 de	17.6 b-f	F	IMP	7.3 bcd	4.0 e-h	5.3 e-h	5.3 ef	9.0 bcd
JEFFERSON	Bejo	54.7 e	20.4 a-e	F	IMP	5.3 e	3.7 fgh	5.7 d-g	5.3 ef	9.0 bcd
INTREPID	SN	53.8 e	8.7 def	F	IMP	6.7 cde	4.7 d-g	4.3 h	4.7 f	9.0 bcd
		65.7	**18.5**			**7.3**	**5.3**	**5.8**	**6.1**	**9.2**

Listed in order of % Marketable. 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES - 2021 - continued

Cultivar	Source	External Colour	External Colour Rating	Internal Colour	Internal Colour Rating	% Core of Total Width	Blight Rating	Score	% Cavity Spot & Degree	Shape of Crown
SV 2384	Sto	O	6.0 cd*	O	7.0 abc	35.8 g	8.7 ab	6.19 f-i	83LM d-g	CV
ORANGE BLAZE	Sem	O	5.7 cd	O	4.7 f	38.8 d-g	8.0 a-d	6.05 ghi	87LM d-h	CC
JACINTO	Nor	O	6.3 bcd	LO	5.3 ef	41.6 c-f	8.2 a-d	6.67 d-g	88M e-h	CV
NARVIK	Bejo	LO	8.3 a	LO	7.0 abc	37.7 fg	9.0 ab	7.45 ab	75LM b-e	CC
NAVEDO - CELLO	Bejo	O	7.0 abc	LO	6.3 b-e	42.9 bcd	8.3 abc	6.86 b-e	68LM bc	CC
BRILLYANCE	Sto	O	6.7 bcd	LO	6.3 b-e	48.2 a	8.7 ab	7.43 abc	38L a	CC
NAVAL	Bejo	O	7.0 abc	LO	7.0 abc	42.0 b-e	9.3 a	7.71 a	73L bcd	CC
OLANCHA	Nor	O	5.7 cd	O	7.0 abc	38.3 efg	8.0 a-d	6.48 e-h	98LM h	CV
ENTERPRISE	Sto	O	6.7 bcd	O	7.0 abc	37.5 fg	8.7 ab	6.38 e-i	92M fgh	CV
TROPHY PACK	Sto	O	7.0 abc	O	6.7 a-d	44.7 abc	6.7 cde	7.24 a-d	87L d-h	CV
PV 5311	Nor	O	6.3 bcd	O	7.0 abc	36.8 g	8.0 a-d	6.67 d-g	93LM fgh	CV

Listed in order of % Marketable. 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES - 2021 - continued

Cultivar	Source	External Colour	External Colour Rating	Internal Colour	Internal Colour Rating	% Core of Total Width	Blight Rating	Score	% Cavity Spot & Degree	Shape of Crown
CARAVEL	ILL	LO	7.7 ab*	LO	4.7 f	46.1 ab	9.0 ab	7.48 ab	63L b	CC
JACKSON - CELLO	Bejo	O	7.0 abc	LO	5.7 def	39.3 d-g	6.3 de	6.81 c-f	97M gh	CV
ISTANBUL	Bejo	O	5.7 cd	O	7.7 a	39.2 d-g	7.3 b-e	6.52 e-h	82LM c-f	CV
CELLOBUNCH	Sto	O	5.7 cd	O	5.7 def	44.8 abc	8.2 a-d	6.19 f-i	82LM c-f	CC
INTREPID - IN & MYC	SN	O	7.0 abc	O	7.3 ab	38.6 efg	8.8 ab	6.67 d-g	93LM fgh	CV
B 3187	Bejo	O	6.7 bcd	O	7.3 ab	41.1 c-f	6.7 cde	6.43 e-h	97LM gh	CV
SV DN 5934	Sem	O	7.0 abc	O	5.7 def	41.3 c-f	7.3 b-e	6.38 e-i	95M fgh	CC
INTREPID - INICIUM	SN	O	6.0 cd	O	7.7 a	38.9 d-g	8.7 ab	6.38 e-i	88LM e-h	CV
JEFFERSON	Bejo	O	5.3 d	LO	6.0 cde	36.5 g	5.7 e	5.76 i	87LM d-h	CV
INTREPID	SN	O	6.0 cd	O	6.0 cde	36.8 g	9.0 ab	5.90 hi	88LM d-h	CV
			6.5		**6.4**	**40.3**	**8.0**	**6.65**	**84 LM**	

Listed in order of % Marketable. 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES - 2021 - continued

Cultivar	Source	Root Length (cm)	Root Width (cm)	Seeding Rate	Stand per Foot	Top Length (cm)	Leaf Colour	Leaf Structure	% Weevil Damage	% Rust Fly Damage	% Aster Yellows
SV 2384	Sto	22.3 bc*	3.3 hi	25	22 abc	58.1 b-e	DG	FST	0.2 a	1.9 a	0.6 a
ORANGE BLAZE	Sem	20.7 d	3.6 cde	25	15 def	59.8 abc	LG	ST	0.0 a	0.3 a	0.9 a
JACINTO	Nor	20.0 de	3.4 e-h	22	15 ef	58.9 a-e	LG	ST	0.5 a	6.7 bc	0.3 a
NARVIK	Bejo	17.5 fgh	3.8 abc	25	22 ab	47.9 h	G	ST	0.4 a	1.5 a	0.4 a
NAVEDO - CELLO	Bejo	18.8 ef	3.7 a-d	25	22 ab	56.8 def	G	ST	0.0 a	4.1 abc	2.2 a
BRILLYANCE	Sto	17.3 gh	3.7 a-d	25	22 abc	54.5 f	LG	FST	0.0 a	1.0 a	0.8 a
NAVAL	Bejo	17.4 gh	3.9 a	25	20 abc	51.0 g	DG	ST	0.2 a	1.1 a	0.9 a
OLANCHA	Nor	24.0 a	3.3 ghi	22	18 b-f	61.0 ab	G	ST	0.0 a	3.3 abc	1.2 a
ENTERPRISE	Sto	21.0 cd	3.3 ghi	25	21 abc	58.8 b-e	DG	ST	0.0 a	1.4 a	1.2 a
TROPHY PACK	Sto	17.9 fgh	3.6 b-e	25	20 a-e	61.8 a	LG	ST	0.0 a	3.1 abc	1.3 a
PV 5311	Nor	22.3 bc	3.3 hi	22	14 f	56.0 ef	DG	FST	0.0 a	4.1 abc	1.2 a

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES - 2021 - continued

Cultivar	Source	Root Length (cm)	Root Width (cm)	Seeding Rate	Stand per Foot	Top Length (cm)	Leaf Colour	Leaf Structure	% Weevil Damage	% Rust Fly Damage	% Aster Yellows
CARAVEL	ILL	16.9 h*	3.8 ab	20	21 abc	56.4 def	G	ST	0.0 a	0.4 a	1.5 a
JACKSON - CELLO	Bejo	18.3 fg	3.2 i	25	24 a	54.7 f	G	ST	0.4 a	1.9 a	0.4 a
ISTANBUL	Bejo	20.2 de	3.6 c-f	25	22 ab	56.8 def	G	FST	0.2 a	7.3 c	0.8 a
CELLOBUNCH	Sto	20.0 de	3.4 e-h	25	22 abc	57.3 c-f	G	ST	0.2 a	0.4 a	0.6 a
INTREPID - IN & MYC	SN	20.9 d	3.3 hi	24	23 ab	59.3 a-d	DG	ST	0.6 a	1.9 a	0.2 a
B 3187	Bejo	22.9 ab	3.3 hi	25	20 a-d	58.4 b-e	G	ST	0.0 a	6.6 bc	0.2 a
SV DN 5934	Sem	20.1 de	3.4 e-h	23	17 c-f	58.2 b-e	DG	ST	0.0 a	1.8 a	0.8 a
INTREPID - INICIUM	SN	20.7 d	3.4 f-i	24	20 abc	59.9 abc	G	ST	0.7 a	6.3 bc	0.4 a
JEFFERSON	Bejo	20.3 d	3.5 d-g	25	18 b-f	58.9 a-e	G	C	0.0 a	6.7 bc	1.0 a
INTREPID	SN	21.0 cd	3.4 e-h	24	22 abc	60.1 abc	G	ST	0.6 a	2.3 ab	0.2 a
Trial Average		**20.0**	**3.5**	**24.1**	**20**	**57.4**			**0.2**	**3.1**	**0.8**

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

CARROT CULTIVAR MAIN TRIAL JUMBO TYPES - 2021

Cultivar	Source	# Carrots Harvested	# > 4.4 cm	# 2.0 to 4.4 cm	Total Harvest Weight (kg)	Weight > 4.4 cm (kg)	Weight 2.0 to 4.4 cm (kg)	Marketable Yield t/ha	Marketable Yield B/A
SPEEDO	Vil	75 d*	34 def	33 b	17.07 fg	9.61 de	5.67 bc	76.4	1230 bc
VOLCANO	Vil	83 d	35 def	34 b	16.43 g	9.94 de	4.48 b-e	72.1	1161 bc
EXTREMO	Vil	74 d	40 de	15 cde	16.91 fg	12.31 bcd	2.00 fg	71.6	1152 bc
480620	Pure	72 d	30 ef	28 bcd	18.17 efg	10.15 de	4.67 b-e	74.1	1192 bc
480619	Pure	94 cd	37 def	31 bcd	19.66 def	10.48 cde	4.93 bcd	77.0	1240 bc
480621	Pure	94 cd	34 def	32 bc	20.57 cde	11.15 cde	5.09 bcd	81.2	1307 abc
BRAVA	Bejo	126 ab	57 ab	22 b-e	22.52 bcd	14.89 b	2.74 d-g	88.2	1420 ab
SV DN 5904	Sem	84 d	30 ef	29 bcd	19.11 efg	9.28 de	5.06 bcd	71.7	1154 bc
BALDIO	Bejo	91 cd	45 bcd	14 de	19.77 def	12.57 bcd	2.28 efg	74.3	1196 bc
BASTIA	Bejo	137 a	53 abc	32 bc	23.72 b	13.90 bc	3.81 c-f	88.6	1426 ab
480151	Pure	93 cd	41 cde	21 b-e	19.66 def	11.44 b-e	3.06 d-g	72.5	1167 bc
NAVEDO - JUMBO	Bejo	137 a	25 f	62 a	23.43 bc	8.11 e	8.98 a	85.5	1376 abc
BERLIN	Bejo	108 bc	61 a	5 e	26.93 a	18.54 a	0.71 g	96.3	1550 a
JACKSON - JUMBO	Bejo	130 ab	12 g	58 a	16.36 g	2.94 f	6.81 ab	48.8	785 d
BELGRADO	Bejo	117 ab	45 bcd	8 e	22.62 bcd	12.51 bcd	1.26 g	68.8	1108 c
Trial Average		**101**	**39**	**28**	**20.19**	**11.19**	**4.10**	**76.5**	**1231**

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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CARROT CULTIVAR MAIN TRIAL JUMBO TYPES - 2021 - continued

Cultivar	Source	% Marketable	% Oversize	Majority of Culls	Shape	Uniformity of Shape	Uniformity of Width	Uniformity of Length	Appearance	Resistance to Greening
SPEEDO	Vil	89.5 a*	55.2 bc	F	TUBE	9.0 a	6.7 a	8.0 a	5.7 de	8.3 b
VOLCANO	Vil	87.8 a	59.7 abc	F	GP	6.3 def	5.7 a	6.7 a	8.0 ab	8.0 bc
EXTREMO	Vil	84.0 ab	72.3 a	SM	GP	7.3 b-e	6.7 a	7.0 a	8.3 a	8.0 bc
480620	Pure	81.5 abc	55.8 bc	SP	GPN	6.0 ef	6.3 a	7.0 a	7.0 a-d	7.3 bc
480619	Pure	78.7 abc	53.9 bc	SM	N	8.7 ab	6.3 a	8.3 a	7.0 a-d	6.7 c
480621	Pure	78.4 abc	54.1 bc	SM	TUBE	8.7 ab	5.0 a	7.3 a	6.7 bcd	7.3 bc
BRAVA	Bejo	78.1 abc	66.1 ab	SM	GP	7.3 b-e	6.7 a	7.0 a	7.3 abc	8.7 ab
SV DN 5904	Sem	75.5 bc	48.2 cd	SP	TUBE	8.0 abc	4.7 a	8.3 a	8.0 ab	8.7 ab
BALDIO	Bejo	75.2 bc	63.5 abc	SM	GPN	6.3 def	4.7 a	8.0 a	7.3 abc	8.3 b
BASTIA	Bejo	74.5 bc	58.7 abc	SM	GP	7.7 a-d	5.3 a	6.0 a	6.3 cd	8.0 bc
480151	Pure	73.8 bc	58.3 abc	SP	GP	6.7 c-f	5.0 a	7.0 a	6.7 bcd	7.7 bc
NAVEDO - JUMBO	Bejo	72.9 bc	34.3 d	F	IMPCYL	7.0 c-f	6.3 a	8.0 a	6.3 cd	8.3 b
BERLIN	Bejo	71.2 cd	68.6 ab	SM	GP	5.7 f	6.3 a	6.7 a	7.3 abc	8.0 bc
JACKSON - JUMBO	Bejo	60.3 d	18.4 e	F	GP	6.7 c-f	7.3 a	7.0 a	5.7 de	10.0 a
BELGRADO	Bejo	59.9 d	54.5 bc	SM	GPN	7.7 a-d	6.7 a	7.0 a	4.7 e	7.7 bc
Trial Average		**76.1**	**54.8**			**7.3**	**6.0**	**7.3**	**6.8**	**8.1**

Listed in order of % Marketable. 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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CARROT CULTIVAR MAIN TRIAL JUMBO TYPES - 2021 - continued

Cultivar	Source	External Colour	External Colour Rating	Internal Colour	Internal Colour Rating	% Core of Total Width	Blight Rating	Score	% Cavity Spot & Degree	Shape of Crown
SPEEDO	Vil	LO	8.0 a*	LO	5.0 a	40.7 i	9.2 ab	7.24 a	80LM bc	CC
VOLCANO	Vil	LO	8.3 a	LO	5.7 a	50.5 c-g	9.0 ab	6.95 a	32L a	CC
EXTREMO	Vil	LO	8.0 a	LO	6.0 a	53.3 b-e	7.3 cd	7.33 a	78LM b	CC
480620	Pure	LO	7.3 a	LO	7.7 a	48.2 fgh	6.0 d	6.95 a	78M b	CC
480619	Pure	LO	8.7 a	LO	6.0 a	44.3 hi	7.0 cd	7.38 a	80LM bc	CC
480621	Pure	LO	7.7 a	O	7.0 a	47.1 gh	7.7 bc	7.10 a	85LM bcd	CC
BRAVA	Bejo	O	7.0 a	LO	6.3 a	57.1 ab	6.0 d	7.19 a	82L bcd	CC
SV DN 5904	Sem	LO	7.0 a	LO	5.0 a	48.4 e-h	6.0 d	7.10 a	88LM bcd	CC
BALDIO	Bejo	LO	7.7 a	LO	6.0 a	54.5 bc	9.0 ab	6.90 a	87M bcd	CC
BASTIA	Bejo	DO	6.7 a	O	6.3 a	52.9 b-f	8.3 abc	6.62 a	97LM d	CC
480151	Pure	LO	7.3 a	LO	6.3 a	49.2 d-h	9.3 a	6.67 a	82M bcd	CC
NAVEDO - JUMBO	Bejo	LO	8.3 a	LO	5.7 a	50.2 c-g	8.0 abc	7.14 a	81LM bcd	CC
BERLIN	Bejo	LO	6.7 a	LO	4.3 a	60.5 a	7.0 cd	6.43 a	93M bcd	CC
JACKSON - JUMBO	Bejo	O	6.7 a	O	6.3 a	48.8 e-h	6.0 d	7.10 a	96M cd	CV
BELGRADO	Bejo	LO	7.7 a	O	5.7 a	54.3 bcd	8.3 abc	6.71 a	87M bcd	CV
Trial Average			**7.5**		**6.0**	**50.7**	**7.6**	**6.99**	**82LM**	

Listed in order of % Marketable. 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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CARROT CULTIVAR MAIN TRIAL JUMBO TYPES - 2021 - continued

Cultivar	Source	Root Length (cm)	Root Width (cm)	Seeding Rate	Stand per Foot	Top Length (cm)	Leaf Colour	Leaf Structure	% Weevil Damage	% Rust Fly Damage	% Aster Yellows
SPEEDO	Vil	20.2 cde*	4.7 de	18	10 de	50.4 f	LG	ST	0.0 a	0.0 a	2.2 a
VOLCANO	Vil	21.4 abc	5.2 abc	18	11 de	57.3 b	DG	FST	0.0 a	1.0 a	0.8 a
EXTREMO	Vil	20.1 cde	5.5 ab	18	10 de	68.3 a	LG	F	0.0 a	18.9 b	3.1 a
480620	Pure	22.1 ab	5.1 a-d	18	9 e	57.6 b	LG	ST	0.0 a	2.4 a	3.3 a
480619	Pure	20.3 b-e	5.1 a-d	18	12 cd	46.2 g	G	FST	0.0 a	0.9 a	3.2 a
480621	Pure	21.0 a-d	5.0 cd	18	12 cd	46.9 g	LG	ST	0.3 a	2.0 a	1.1 a
BRAVA	Bejo	19.0 efg	5.4 abc	18	17 ab	56.8 bc	LG	FST	0.0 a	1.3 a	2.1 a
SV DN 5904	Sem	20.2 cde	5.1 bcd	18	11 de	67.3 a	G	ST	0.0 a	0.7 a	0.8 a
BALDIO	Bejo	19.2 def	5.3 abc	18	12 cde	53.4 def	G	F	0.0 a	0.0 a	3.3 a
BASTIA	Bejo	19.9 cde	5.4 abc	18	18 a	57.7 b	LG	FST	0.7 a	0.9 a	1.5 a
480151	Pure	20.3 b-e	5.2 abc	18	12 cde	53.9 cde	G	ST	0.0 a	2.9 a	0.7 a
NAVEDO - JUMBO	Bejo	22.7 a	5.1 bcd	18	18 a	56.9 bc	G	ST	0.2 a	3.0 a	2.7 a
BERLIN	Bejo	17.4 g	5.5 abc	18	14 bc	51.8 ef	G	FST	0.0 a	2.4 a	2.8 a
JACKSON - JUMBO	Bejo	19.6 cde	4.3 e	18	17 ab	55.9 bcd	G	ST	0.5 a	5.1 a	0.3 a
BELGRADO	Bejo	17.8 fg	5.6 a	18	15 ab	54.0 cde	G	FST	0.0 a	0.9 a	3.1 a
Trial Average		**20.1**	**5.2**	**18**	**13**	**55.6**			**0.1**	**2.8**	**2.1**

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

CARROT CULTIVAR MAIN TRIAL CELLO TYPES EVALUATION NOTES – 2021

SV 2384: *Stokes sample,* Good length but very uneven, Okay to average width very uneven, Uniformity of shape even, Some carrots with bends and curves, Tapered tips 70% matured 30% immature, Average appearance, Some ringy carrots slight concern, Average to good weight uneven, Smoothness a little poor, Fair exterior colour uneven, Odd noticeable cavity spot, 1 to 2 or 4 to 5 cavity spots per root, Good interior blending even, Red ring around core (50-90%), Small to average core size, Average to good Packer, Slicer potential, Okay Jumbo, Jumbos are an oversized packer.

Orange Blaze: *Seminis sample,* Average to good length uneven, Average to good width uneven, Uniformity of shape a little uneven, Odd carrot with bends and curves, Tapered and full tips 70% matured 30% immature, Average appearance, Odd carrot a touch ringy, Good weight uneven, Fairly smooth, Fair exterior colour slightly uneven, Cavity spot is a little noticeable, 2 to 3 or 4 to 5 cavity spots per root, Average interior blending a little uneven, Yellow or red ring around core (10-40%), Average core size, Good Packer, Average Jumbo.

Jacinto: *Norseco sample,* Average length slightly uneven, Okay to average width uneven, Uniformity of shape even, A few carrots with bends and curves, Tapered tips 70% matured 30% immature, Average appearance, A touch ringy, Poor to average weight uneven, Smoothness a little poor, Good exterior colour even, Odd noticeable cavity spot, 3 to 4 cavity spots per root, Poor to average interior blending uneven, Red ring around core (40-90%), Average core size, Okay Packer, Poor Jumbo.

Narvik: *Bejo sample,* Nantes carrot, Okay length a little even, Average to good width slightly uneven, Uniformity of shape even, Odd carrot with bends and curves, Full tips matured, Odd noticeable lenticel, Average to good appearance, Odd ringy carrot, Good weight, Fairly smooth, Fair exterior colour even, Exterior colour a little pale, 2 to 4 cavity spots per root, Good interior blending even, Red ring around core (40%), Average core size, Good Packer, Okay Jumbo a few bit short.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES EVALUATION NOTES – 2021 - continued

Navedo: *Bejo sample,* Nantes style, Average to good length slightly uneven, Average to good width uneven, Uniformity of shape even, Odd carrot with bends and curves, Full tips matured, Average appearance, Odd ringy carrot, Good weight a little uneven, Fairly smooth, Fair exterior colour slightly uneven, 2 to 3 cavity spots per root, Average interior blending a little uneven, Translucent core throughout (20%), Red ring around core (40%), Average & large core size, Good Packer, Good Jumbo.

Brillyance: *Stokes sample,* Nantes style, Okay to average length slightly even, Average to good width slightly uneven, Uniformity of shape very even, Odd carrot with bends and curves, Full tips matured, Odd noticeable lenticel, Good appearance, Odd ringy carrot, Good weight a little uneven, Good smoothness, Fair exterior colour slightly even, 1 to 2 or 2 to 3 cavity spots per root, Average interior blending even, Yellow or green ring around core (40-50%), Average to large core size, Average to good Packer, Okay Jumbo, Some carrots a bit short.

Naval: *Bejo sample,* Nantes carrot, Poor to okay length slightly uneven, Some short, Average width slightly uneven, Uniformity of shape even, Full tips matured, Good appearance, Good weight, Good smoothness, Good exterior colour slightly uneven, 1 to 2 or 3 to 4 cavity spots per root, Good interior blending even, Red ring around core (20-40%), Average core size, Okay to average Packer, Okay Jumbo, Jumbos are an oversized nantes and a few are a bit short.

Olancha: *Norseco sample,* Cut & Peel carrot, Good length very uneven, Mixed lengths & widths, Okay to average width uneven, Uniformity of shape very even, Odd carrot with bends and curves, Tapered tips matured, Average appearance, Some ringy carrots, Poor to average weight uneven, Smoothness a little rough, Fair to good exterior colour a little uneven, Some noticeable cavity spots slight concern, 3 to 4 or 6 to 7 cavity spots per root, Nice interior blending slightly even, Yellow or red ring around core (40-60%), Average core size, Okay Packer, Poor Jumbo.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES EVALUATION NOTES – 2021 - continued

Enterprise: *Stokes sample,* Average length & width uneven, Uniformity of shape even, Odd carrot with bends and curves, Tapered and full tips matured, Average appearance, Slightly ringy slight concern, Average weight uneven, Smoothness a little rough, Fair exterior colour slightly even, Odd noticeable cavity spot, 2 to 3 or 5 to 6 cavity spots per root, Good interior blending even, Red ring around core (50-80%), Average core size, Okay to average Packer, Okay Jumbo, Jumbos are an oversized packer.

Trophy Pack: *Stokes sample,* Okay length even, Length a bit short, Okay width slightly even, Uniformity of shape very even, Odd carrot with bends and curves, Tapered tips 70% matured 30% immature, Good appearance, Some ringy carrots, Poor to average weight, Smoothness uneven, Good exterior colour even, 4 to 5 cavity spots per root, Interior blending uneven, Red ring around core (60-100%), Average to large core size, Okay to average Packer, Okay Jumbo, Jumbos are an oversized packer.

PV 5311: *Norseco sample,* Cut & Peel blood, Good length very uneven, Mixed lengths & widths, Okay to average width uneven, Uniformity of shape even, Some carrots with bends and curves, Tapered tips matured, Average appearance, A few ringy carrots, Average weight uneven, Fairly smooth, Fair to good exterior colour slightly uneven, Some noticeable cavity spots slight concern, 2 to 3 or 4 to 5 cavity spots per root, Average interior blending slightly even, Red ring around core (40-70%), Average core size, Average Packer, Poor Jumbo.

Caravel: *Illinois sample,* Nantes carrot, Okay length even, Lengths a little short, Average width even, Uniformity of shape very even, Odd carrot with bends and curves, Full tips matured, Odd noticeable lenticel, Good to nice appearance, Odd ringy carrot, Good weight, Good smoothness, Fair exterior colour even, Exterior colour a little pale, 2 to 3 cavity spots per root, Average interior blending a little uneven, Translucent core throughout (10-40%), Yellow ring around core (40-70%), Average core size, Good Packer, Average Jumbo a little short.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES EVALUATION NOTES – 2021 - continued

Jackson: *Bejo sample,* Okay length even, Average width slightly uneven, Uniformity of shape a little even, Odd carrot with bends and curves, Tapered and full tips matured, Some ringy carrots slight concern, Average appearance, Average weight, Smoothness a little rough, Good exterior colour slightly uneven, Some noticeable cavity spots, 4 to 6 cavity spots per root, Average interior blending slightly uneven, Red ring around core (40-70%), Average core size, Okay to average Packer, Poor Jumbo, Jumbos are an oversized packer.

Cello

Istanbul: *Bejo sample,* Average length uneven, Average to good width slightly uneven, Uniformity of shape a little uneven, A few carrots with bends and curves, Tapered tips matured, Rougher appearance, Ringy carrots a concern, Average weight Smoothness is rough, Fair exterior colour slightly uneven, Odd noticeable cavity spot, 3 to 4 cavity spots per root, Nice interior blending even, Red ring around core (40-70%), Average core size, Average Packer, Odd carrot with mouse damage, Poor to average Jumbo, Jumbos are an oversized packer.

Cellobunch: *Stokes sample,* Good length slightly uneven, Good width even, Uniformity of shape a little uneven, A few carrot with bends and curves, Full tips matured, Appearance a little rough, Some ringy carrots slight concern, Average weight even, Smoothness a little rough, Fair exterior colour uneven, Some noticeable cavity spots, 3 to 4 cavity spots per root, Poor to average interior blending a little uneven, Translucent core throughout (10-30%), Yellow or green ring around core (10-60%), Average core size, Average Packer, Average Jumbo, Jumbos are an oversized packer.

Intrepid: *Seminova sample,* Okay to good length uneven, Average width slightly uneven, Uniformity of shape even, Some carrots with bends and curves, Tapered tips matured, Average appearance, Some ringy carrots, Average weight a little uneven, Fairly smooth, Fair exterior colour even, Some noticeable cavity spots, 2 to 3 or 5 to 6 cavity spots per root, Good interior blending even, Red ring around core (70-80%), Average core size, Average Packer, Poor Jumbo, Jumbos are an oversized packer.

Inicium & Mychorriza

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES EVALUATION NOTES – 2021 - continued

B 3187: *Bejo sample,* Cut & Peel blood, Good length very uneven, Average width uneven, Lenghts & widths mixed, Uniformity of shape even, Some carrots with bends and curves, Tapered tips 80% matured 20% immature, Average appearance, Ringy carrot concern, Average weight uneven, Rough smoothness, Fair exterior colour slightly uneven, Some noticeable cavity spots slight concern, 3 to 4 or 6 to 7 cavity spots per root, Nice interior blending even, Red ring around core (50-100%), Average core size, Average to good Packer, Poor Jumbo.

SV DN 5934: *Seminis sample,* Average length very uneven, Average width slightly uneven, Uniformity of shape very even, Some carrots with bends and curves, Full tips matured, Average appearance, A touch ringy, Average to good weight uneven, Smoothness a little poor, Fair exterior colour, Some noticeable cavity spots, 5 to 7 cavity spots per root, Average interior blending slightly uneven, Red ring around core (50-90%), Average to large core size, Average to good Packer, Slicer potential, Average Jumbo.

Intrepid: *Seminova sample,* Average to good length uneven, Average width slightly uneven, Uniformity of shape even,
Inicium Odd carrot with bends and curves, Tapered tips 80% matured 20% immature, Appearance a little rough, Odd ringy carrot, Average weight uneven, Smoothness a little rough, Exterior colour uneven, 3 to 5 cavity spots per root, Good interior blending even, Red ring around core (60-90%), Average to large core size, Average Packer, Poor Jumbo, Jumbos are an oversized packer.

Jefferson: *Bejo sample,* Okay to average length uneven, Average width slightly uneven, Uniformity of shape a little uneven, A lot of carrots with bends and curves, Tapered tips matured, A little rough to average appearance, A little ringy, Average weight uneven, Smoothness uneven, Fair exterior colour uneven, Odd noticeable cavity spot, 2 to 5 cavity spots per root, Average interior blending a little even, Red ring around core (40-70%), Average core size, Average Packer, Okay Jumbo, Jumbos are an oversized packer.

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CARROT CULTIVAR MAIN TRIAL CELLO TYPES EVALUATION NOTES – 2021 - continued

Intrepid: *Seminova sample,* Average length & width very uneven, Mixed lengths & widths, Uniformity of shape even, A lot of carrots with bends and curves, Tapered tips 70% matured 30% immature, Rough appearance, Some ringy carrots, Average weight uneven, Smoothness uneven, Fair exterior colour uneven, Odd noticeable cavity spot, 4 to 5 cavity spots per root, Average interior blending even, Red ring around core (60-70%), Average to large core size, Okay to average Packer, Poor Jumbo.

CARROT CULTIVAR MAIN TRIAL JUMBO TYPES EVALUATION NOTES – 2021

Speedo: *Vilmorin sample,* Nantes style, Good length slightly uneven, Good width very even, Uniformity of shape very even, Odd carrot with bends and curves, Full tips matured, Lenticels slightly noticeable, A little rough to average appearance, Some ringy carrots, Good weight even, Smoothness a little rough, Fair exterior colour even, A little marbling, 2 to 3 or 3 to 4 cavity spots per root, Poor to average interior blending slightly uneven, Translucent core throughout (20-60%), Yellow ring around core (40-90%), Average to large core size, Good Packer, Good Jumbo bit more weight would be good.

Volcano: *Vilmorin sample,* Good length & width slightly uneven, Uniformity of shape a little even, Odd carrot with bends and curves, Slightly tapered and full tips matured, Odd noticeable lenticel, Good appearance, Good weight, Good smoothness, Fair exterior colour even, Exterior colour slightly pale, 1 to 2 cavity spots per root, Poor to average interior blending slightly uneven, Translucent core throughout (10-80%), Yellow ring around core (10-80%), Large core size, Okay Packers bit short, Good to nice Jumbo.

Extremo: *Vilmorin sample,* Good length slightly even, Good width even, Uniformity of shape even, Odd carrot with bends and curves, Tapered and full tips matured, Odd noticeable lenticel, Good appearance, Good weight even, Nice smoothness, Fair exterior colour even, A little marbling, Exterior colour slightly pale, 2 to 4 cavity spots per root, Average interior blending slightly even, Red or yellow ring around core (20-60%), White in cores (20-30%), Large core size, Odd carrot with mouse damage, Poor Packer, Good to nice Jumbo.

480620: *Pureline sample,* Good length uneven, Good to nice width even, Uniformity of shape a little even, Odd carrot with bends and curves, Full tips matured, A few noticeable lenticels, Good appearance, Good weight a little even, Good smoothness, Fair exterior colour even, Exterior colour slightly pale, Some noticeable cavity spots, 2 to 3 or 4 to 6 cavity spots per root, Good interior blending even, Translucent core throughout (10-20%), Large core size, Good Packer bit short, Some carrots with harvest cracks, Odd one with canker rot, Nice Jumbo.

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CARROT CULTIVAR MAIN TRIAL JUMBO TYPES EVALUATION NOTES – 2021 - continued

480619: *Pureline sample,* Good length slightly uneven, Good width even, Uniformity of shape even, Full tips matured, Noticeable lenticels, Good appearance, Good weight even, Good smoothness, Fair exterior colour slightly even, Exterior colour slightly pale, Odd noticeable cavity spots, 2 to 3 or 6 to 7 cavity spots per root, Average interior blending even, White in cores (30-60%), Large core size, Good Packer bit short, Nice Jumbo odd one bit short.

480621: *Pureline sample,* Average to good length uneven, Nice width even, Uniformity of shape even, Full tips matured, Odd noticeable lenticel, Average appearance, Good to excellent weight even, Fairly smooth, Fair exterior colour even, Exterior colour slightly pale, Some noticeable cavity spot, 3 to 4 cavity spots per root, Good interior blending even, Translucent core throughout (10-30%), Large core size, Good Packer bit short, Good to nice Jumbo.

Brava: *Bejo sample,* Okay to average length even, A few short carrots, Average width even, Uniformity of shape even, Slightly tapered full tips matured, Odd noticeable lenticel, Good appearance, Some ringy carrots, Good to excellent weight, Fairly smooth, Fair exterior colour even, 2 to 5 cavity spots per root, Average interior blending even, Red ring around core (20-30%), White in cores (30-60%), Extra large core size, Poor Packer, Good to nice Jumbo bit short.

SV DN 5904: *Seminis sample,* Average length uneven, Nice width very even, Uniformity of shape very even, Full tips matured, Odd noticeable lenticel, Good appearance, Excellent weight even, Good smoothness, Fair exterior colour slightly uneven, Exterior colour slightly pale, Odd noticeable cavity spot, 3 to 4 or 4 to 5 cavity spots per root, Interior blending uneven, Translucent core throughout (40-80%), Red ring around cores (20-40%), White in cores (10-20%), Average to large core size, Average Packers, Nice Jumbo.

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CARROT CULTIVAR MAIN TRIAL JUMBO TYPES EVALUATION NOTES – 2021 - continued

Baldio: *Bejo sample,* Okay length uneven, Good to nice width even, Uniformity of shape a little uneven, Odd carrot with bends and curves, Full tips matured, Odd noticeable lenticel, Average to good appearance, Good to excellent weight even, Good smoothness, Fair exterior colour, Exterior colour slightly pale, Odd noticeable cavity spot, 2 to 3 or 5 to 6 cavity spots per root, Poor to average interior blending uneven, Translucent core throughout (10-40%), White in cores (30-40%), Extra-large core size, Poor Packer, Nice Jumbo some a bit short.

Bastia: *Bejo sample,* Okay to average length uneven, Good width slightly uneven, Uniformity of shape even, Odd carrot with bends and curves, Tapered and full tips matured, Odd noticeable lenticel, Average appearance, Some ringy carrots, Good weight a little uneven, Fairly smooth, Fair exterior colour slightly even, Odd noticeable cavity spot, 3 to 5 cavity spots per root, Average interior blending a little uneven, Yellow ring around core (20-30%), Large core size, Poor Packer, Good Jumbo.

480151: *Pureline sample,* Average length uneven, Good width slightly even, Uniformity of shape a little even, Odd carrot with bends and curves, Slightly tapered full tips matured, A few noticeable lenticels, Average to good appearance, A few ringy carrots, Good weight even, Smoothness a little poor, Fair exterior colour even, Exterior colour slightly pale, Some noticeable cavity spots, 2 to 3 or 6 to 7 cavity spots per root, Average interior blending slightly uneven, Translucent core throughout (10-40%), White in cores (30%), Yellow ring around core (30-40%), Large to extra large core size, Average Packer bit short, Good Jumbo.

Navedo: *Bejo sample,* Good length slightly uneven, Good width even, Uniformity of shape even, Full tips matured, Odd noticeable lenticel, Appearance a little rough, Some ringy carrots, Good weight even, Smoothness a little rough, Fair exterior colour even, Exterior colour slightly pale, Odd noticeable cavity spot, 2 to 3 or 5 to 6 cavity spots per root, Average interior blending, White in cores (10-60%), Large core size, Good Packer, Average Jumbo.

Jumbo

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CARROT CULTIVAR MAIN TRIAL JUMBO TYPES EVALUATION NOTES – 2021 - continued

Berlin: *Bejo sample,* Okay length slightly uneven, Good to nice width slightly uneven, Uniformity of shape a little uneven, Full tips matured, Lenticels slightly noticeable, Average to good appearance, Excellent weight, Fairly smooth, Fair exterior colour, Exterior colour slightly pale, Some noticeable cavity spots, 2 to 3 or 6 to 7 cavity spots per root, Poor interior blending uneven, Red ring around core (20%), White in cores (50-70%), Extra-large core size, Poor Packer, Nice Jumbo some a bit short.

Jackson: *Bejo sample,* Okay length even, Average width even, Uniformity of shape even, Odd carrot with bends and curves, Tapered tips matured, Average appearance, Some ringy carrots, Average weight, Fairly smooth, Good exterior colour slightly even, Noticeable cavity spots concern, 5 to 8 cavity spots per root, Average interior blending slightly uneven, Red ring around core (30-100%), Large core size, Average Packer, Slightly poor Jumbo, Jumbos are an oversized packer.

Jumbo

Belgrado: *Bejo sample,* Poor to okay length uneven, Lengths short, Good width slightly even, Uniformity of shape a little even, Full tips matured, A few noticeable lenticels, Average appearance uneven, Some ringy carrots, Good to excellent weight, Smoothness a little poor, Fair exterior colour, Exterior colour slightly pale, Some noticeable cavity spots, 3 to 4 cavity spots per root, Average interior blending, Translucent core throughout (10%), White in cores (10-30%), Extra-large core size, Poor Packer, Nice Jumbo some a bit short.

CARROT CULTIVAR ADAPTATION TRIAL - 2021

Cultivar	Source	# Carrots Harvested	# > 4.4 cm	# 2.0 to 4.4 cm	Total Harvest Weight (kg)	Weight > 4.4 cm (kg)	Weight 2.0 to 4.4 cm (kg)	Marketable Yield t/ha	Marketable Yield bu/A	% Marketable	% Oversize	Majority of Culls
CA20-2011	Illinos	89	36	34	25.01	14.72	6.25	104.9	1688	83.8	58.9	F
CA20-2008	Illinos	114	51	33	23.43	13.84	4.47	91.6	1474	78.1	59.1	SP

Listed in order of % Marketable.

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CARROT CULTIVAR ADAPTATION TRIAL - 2021 - continued

Cultivar	Source	Shape	Uniformity of Shape	Uniformity of Length	Uniformity of Width	Appearance	Resistance to Greening	External Colour	External Colour Rating	Internal Colour	Internal Colour Rating	Score	Blight Rating
CA20-2011	Illinos	CYL	7.0	8.0	7.0	8.0	7.0	LO	9.0	LO	6.0	7.43	7.0
CA20-2008	Illinos	GPN	8.0	9.0	7.0	8.0	9.0	LO	8.0	LO	5.0	7.71	8.0

Listed in order of % Marketable. 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

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CARROT CULTIVAR ADAPTATION TRIAL - 2021 - continued

Cultivar	Source	% Core of Total Width	% Cavity Spot & Degree	Shape of Crown	Root Length (cm)	Root Width (cm)	Seeding Rate	Stand per Foot	Leaf Heights (cm)	Leaf Colour	Leaf Structure	% Weevil Damage	% Rust Fly Damage	Average # of Seeders
CA20-2011	Illinos	46.1	35L	CC	24.6	5.4	20.0	12	62.5	G	ST	2.2	1.1	0.0
CA20-2008	Illinos	42.3	50L	CC	19.7	5.2	23.0	15	60.0	G	ST	0.0	0.9	0.0

Listed in order of % Marketable.

ADAPTATION CARROT CULTIVAR TRIAL EVALUATION NOTES - 2021

CA 20 2011: *Illinios sample*, Jumbo/Packer is a 60/40 split, Nice length even long, Good width even, Uniformity of shape very even, Odd carrot with bends and curves, Full tips matured, Odd noticeable lenticel, Good appearance, Good to excellent weight even, Good smoothness, Fair exterior colour slightly pale even, 2 to 3 cavity spots per root, Average interior blending, White in cores (30%), Large core size, Good packer nantes style, Nice to excellent Jumbo long with weight.

CA 20 2008: *Illinios sample*, Jumbo, Good length very even, Average to good width slightly uneven, Uniformity of shape even, Odd carrot with bends and curves, Full tips matured, Odd noticeable lenticel, Nice appearance, Good weight a little uneven, Good smoothness, Fair exterior colour slightly pale very even, Very little cavity spot really good for 2021 season, 1 to 2 cavity spots per root, Average interior blending uneven, Translucent core throughout (10%), Yellow ring around core (40%), Average to large core size mixed, A little canker rot, A little mouse damage, Average packer some too short, Average to good Jumbo some could use a bit more weight.

LONG TERM AVERAGES OF CARROT CULTIVAR TRIALS

CULTIVAR	SOURCE	# Years Tested	Length (cm)	Length (Inches)	Width (cm)	Marketable t/ha	Martketable bu/A	% Marketable	Avg Leaf Length (cm)
DOMINION	Sto	5	25.4	10.0	4.0	92.3	1486	85.5	45.7
SIX SHOOTER	HM	5	24.8	9.8	3.4	87.4	1408	82.3	41.2
ACHIEVE	Sto	7	23.8	9.4	5.2	98.0	1578	82.8	53.6
ORANGE PAK	Nor	7	23.7	9.3	3.5	85.1	1369	87.1	--
ENTERPRISE	Sto	17	23.5	9.3	3.4	78.1	1266	79.7	51.2
CANADA SUPER X	Sol	14	23.3	9.2	3.4	80.8	1376	82.7	--
SV 2384	Sem	10	23.1	9.1	3.3	76.3	1227	78.0	48.7
SIX PAK	HM	20	23.0	9.1	3.5	79.0	1273	85.5	--
SUNRISE	Cro	15	23.0	9.1	3.5	86.0	1438	85.6	--
CELLOBUNCH	Sem	32	22.5	8.9	3.5	91.0	1490	82.0	48.1
FONTANA	Bejo	13	22.4	8.8	5.1	108.7	1750	88.5	46.9
ENVY	Sem	16	22.3	8.8	3.9	89.6	1442	81.9	51.4
OLYMPUS	Sto	5	21.8	8.6	3.4	73.8	1188	73.9	45.8
BASTIA	Bejo	14	21.7	8.5	5.2	95.1	1532	82.7	47.5

Listed in order of length.

* 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

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LONG TERM AVERAGES OF CARROT CULTIVAR TRIALS - continued

CULTIVAR	SOURCE	# Years Tested	Blight Rating *	% Cavity Spots	SCORE *	% Weevil Damage	% Rust Fly Damage	Avg # of Seeders
DOMINION	Sto	5	7.3	73.0	6.82	1.3	1.3	1.1
SIX SHOOTER	HM	5	7.1	45.0	6.96	5.0	2.7	1.1
ACHIEVE	Sto	7	7.4	74.1	6.74	4.3	4.7	2.8
ORANGE PAK	Nor	7	6.9	--	6.82	--	--	--
ENTERPRISE	Sto	17	7.9	58.0	6.62	9.8	7.9	0.6
CANADA SUPER X	Sol	14	7.0	--	6.95	--	--	--
SV 2384	Sem	10	8.1	69.0	6.14	12.4	9.3	0.4
SIX PAK	HM	20	7.9	--	6.98	--	--	--
SUNRISE	Cro	15	8.4	--	6.82	--	--	--
CELLOBUNCH	Sem	32	7.2	59.5	6.51	8.5	6.2	2.1
FONTANA	Bejo	13	5.6	51.0	6.33	4.8	3.8	1.3
ENVY	Sem	16	7.5	74.6	6.53	8.7	10.4	1.1
OLYMPUS	Sto	5	8.3	86.0	6.31	15.8	4.5	1.1
BASTIA	Bejo	17	7.4	80.2	6.79	6.9	6.7	1.4

Listed in order of length.

* 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

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LONG TERM AVERAGES OF CARROT CULTIVAR TRIALS - continued

CULTIVAR	SOURCE	# Years Tested	Length (cm)	Length (Inches)	Width (cm)	Marketable t/ha	Martketable bu/A	% Marketable	Avg Leaf Length (cm)
VOLCANO	Vil	5	21.3	8.4	4.6	74.9	1207	87.1	49.3
ISTANBAL	Bejo	6	21.3	8.4	3.5	64.9	1045	69.4	49.8
ORANGE SHERBET	Sto	10	21.2	8.3	--	73.4	1310	84.0	--
CAROPAK	Sem	8	20.9	8.2	--	74.1	1323	85.0	--
BELGRADO	Bejo	14	20.8	8.2	5.4	102.3	1648	79.7	47.7
BLANES	Bejo	5	20.7	8.1	5.3	93.9	1512	80.2	48.2
PARAMOUNT	Sem	7	20.6	8.1	--	82.1	1467	85.0	--
CROFTON	RZ	6	19.9	7.8	3.2	61.9	997	81.5	37.8
BERLIN	Bejo	10	19.8	7.8	5.5	100.5	1619	78.7	46.7
DOMINATOR	Nun	13	19.7	7.8	--	63.9	1141	85.0	--
NEW HALL - Cello	Bejo	9	18.7	7.4	3.5	66.6	1071	70.9	46.0
NAVAL	Bejo	11	17.9	7.0	3.6	81.3	1309	78.1	44.6

Listed in order of length.

* 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

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LONG TERM AVERAGES OF CARROT CULTIVAR TRIALS - continued

CULTIVAR	SOURCE	# Years Tested	Blight Rating *	% Cavity Spots	SCORE *	% Weevil Damage	% Rust Fly Damage	Avg # of Seeders
VOLCANO	Vil	5	8.5	28.0	7.11	14.6	16.6	0.5
ISTANBAL	Bejo	6	6.9	63.0	6.78	7.7	20.6	0.0
ORANGE SHERBET	Sto	10	--	--	6.75	--	--	--
CAROPAK	Sem	8	--	--	6.85	--	--	--
BELGRADO	Bejo	14	6.8	75.0	6.38	8.6	7.9	1.6
BLANES	Bejo	5	8.3	59.0	6.41	10.7	22.0	0.0
PARAMOUNT	Sem	7	--	--	6.75	--	--	--
CROFTON	RZ	6	6.6	62.0	6.77	16.6	2.1	0.1
BERLIN	Bejo	10	8.3	75.0	6.37	9.2	12.2	0.7
DOMINATOR	Nun	13	--	--	6.80	--	--	--
NEW HALL	Bejo	9	7.7	66.0	6.29	11.7	10.6	2.7
NAVAL	Bejo	11	7.8	54.9	7.04	10.8	9.7	0.2

Listed in order of length.

* 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

CARROT CULTIVAR STORAGE TRIAL - 2020 - 2021

Cultivar	Source	% Marketable	% Weight Loss	% Decay	Degree of Rot **	% Root Sprouts	% Top Sprouts
VOLCANO	Vil	97.9 a*	12.5 bcd	1.8 a	9.0 e	47 a-d	90 d-g
ISTANBUL	Bejo	97.0 a	9.3 abc	2.6 bc	7.3 a-d	47 abc	85 d-g
NEW HALL - CELLO	Bejo	96.8 a	10.3 a-d	2.6 b	8.7 de	43 d	92 cde
BELGRADO	Bejo	95.7 ab	10.5 a-d	4.1 bc	7.0 de	85 ab	95 abc
BERLIN	Bejo	94.9 abc	11.1 a-d	4.9 bcd	8.7 de	67 abc	82 e-h
CELLOBUNCH	Sto	94.6 abc	15.9 d	4.9 bcd	7.0 a-d	55 cd	85 efg
ENTERPRISE	Sto	94.2 abc	11.2 a-d	5.2 bcd	9.0 a-d	50 abc	85 abc
SV 2384	Sto	93.6 abc	13.4 bcd	5.8 bcd	6.7 a-d	43 a	80 bc
NEW HALL - JUMBO	Bejo	92.6 a-d	10.4 a-d	6.9 bcd	6.0 ab	90 ab	95 cd
BASTIA	Bejo	92.5 a-d	12.6 bcd	7.3 bcd	8.0 cde	15 ab	80 a
SV DN 5853	Sem	91.9 a-d	14.3 cd	7.6 bcd	7.3 a-d	47 abc	82 d-g
NAVEDO	Bejo	91.5 a-d	9.5 abc	8.1 bcd	8.0 a-d	45 cd	90 cde
BENTLEY	Pure	91.1 a-d	11.5 a-d	8.5 bcd	8.0 b-e	92 cd	90 j
NARVIK	Bejo	91.1 a-d	11.2 a-d	8.5 bcd	8.0 a-d	77 abc	87 hij

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

** 10.0 = No Disease, 6.0 = Moderate, 1.0 = Severe (liquified)

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CARROT CULTIVAR STORAGE TRIAL - 2020 - 2021 - continued

Cultivar	Source	% Marketable	% Weight Loss	% Decay	Degree of Rot **	% Root Sprouts	% Top Sprouts
JACKSON - JUMBO	Bejo	90.5 a-d*	12.9 bcd	9.1 bcd	8.0 abc	65 cd	85 f-i
SPEEDO	Vil	90.0 a-d	12.1 a-d	9.4 bcd	6.3 ab	20 bcd	90 ab
BLANES	Bejo	89.9 a-d	10.2 a-d	9.8 cd	7.0 a-d	75 a-d	90 e-h
BALDIO	Bejo	89.8 a-d	10.9 a-d	10.0 cd	7.0 de	80 abc	90 g-j
ORANGE BLAZE	Sem	89.6 a-d	13.7 cd	10.1 cd	6.0 a-d	90 bcd	95 efg
NAVEL	Bejo	88.4 a-d	7.8 ab	11.0 cd	5.0 a-d	55 a-d	85 e-h
JACKSON - CELLO	Bejo	86.7 b-e	16.6 e	12.7 cd	5.0 a	30 d	95 bc
ENVY	Sto	85.7 cde	9.6 abc	13.8 d	7.0 a-d	45 abc	82 c-f
BRAVA	Bejo	83.3 de	14.5 cd	16.4 d	7.0 a-d	55 d	95 g-j
BRILLYANCE	Sto	77.0 ef	15.9 d	6.8 bcd	7.0 b-e	70 a-d	85 bc
EXTREMO	Vil	72.8 f	12.4 a-d	27.3 d	6.0 a-d	35 d	95 ij
Trial Average		**90.4**	**12.0**	**8.6**	**7.2**	**57**	**88**

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

** 10.0 = No Disease, 6.0 = Moderate, 1.0 = Severe (liquified)

MAIN CARROT CULTIVAR STORAGE TRIAL EVALUATION NOTES 2020-2021

Volcano: *Vilmorin sample,* Top sprouts light to moderate 1-2.5cm, Top sprout lengths uneven, Root sprouts just starting 0-1cm, Tip rot, Rot is just starting to establish, Rot is dry, Stored excellent.

Istanbul: *Bejo sample,* Top sprouts light to moderate 0-2.5cm, Root sprouts just starting 0-1cm, Majority tip rot, Odd crown rot, Rot is just starting or moderately established, Rot is dry or moist, Stored good to excellent.

New Hall: *Bejo sample,* Top sprouts just starting to light 0-2.5cm, Root sprouts just starting 0-1cm, Majority tip rot, Odd canker rot, Rot is just starting to lightly established, Rot is dry or moist, Stored good to excellent.
Cello

Belgrado: *Bejo sample,* Top sprouts just starting to light 0-2.5cm, Root sprouts are just starting 0-1cm, Majority tip rot, A few canker rot, Rot is just starting establish, Rot is dry or moist, Stored good to excellent.

Berlin: *Bejo sample,* Top sprouts just starting to light 0-2.5cm, Root sprouts just starting 0-1cm, Tip rot, Rot is just starting establish, Rot is dry, Stored excellent.

Cellobunch: *Stokes sample,* Top sprouts just starting to moderate 0-2.5, Root sprouts just starting to light 0-2.5cm, Majority tip rot, A few canker rot, Rot is just starting to moderately established, Rot is moist or dry, Stored good.

Enterprise: *Stokes sample,* Top sprouts just starting to light 0-2.5cm, Root sprouts just starting to moderate 0-2.5cm, Tip or crown rot, Rot is just starting to moderately established, Rot is moist, Rot is a slight concern, Stored good.

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MAIN CARROT CULTIVAR STORAGE TRIAL EVALUATION NOTES 2020-2021 - continued

SV 2384: *Seminis sample,* Top sprouts just starting to light 0-2.5cm, Root sprouts just starting 0-1cm, Majority tip rot, Odd canker rot, Rot is just starting to moderately established, Rot is dry or moist, Rot is a slight concern, Stored fair.

New Hall: *Bejo sample,* Top sprouts light to moderate 0-2.5cm, Root sprouts just starting 0-1cm, Tip, crown & canker rot, Rot is just starting to moderately established, Rot is dry or moist, Stored fair to excellent.
Jumbo

Bastia: *Bejo sample,* Top sprouts just starting to light 0-2.5cm, Root sprouts just starting 0-1cm, Majority tip rot, Some canker rot, Rot is just starting lightly established, Rot is dry, Stored excellent.

SV DN 5853: *Seminis sample,* Top sprouts light to moderate 1-2.5cm, Root sprouts just starting to light 0-2.5cm, Majority tip rot, Odd canker rot, Rot is just starting to lightly established, Rot is dry or moist, Stored fair to good.

Navedo: *Bejo sample,* Top sprouts just starting to moderate 0-2.5cm, Root sprouts just starting to light 0-2.5cm, Majority tip rot, Odd canker rot, Rot is just starting to slightly established, Rot is moist, Stored good.

Bentley: *Pureline sample,* Top & root sprouts heavy 2.5-5cm, Top & root sprouts lengths uneven, Top & root sprouting a concern, Majority tip rot, Some canker rot, Rot is just starting to establish, Rot is moist or dry, Stored fair to good.

Narvik: *Bejo sample,* Top sprouts light to moderate 1-2.5cm, Top sprouts lengths uneven, Root sprouts just starting to heavy 0-5cm, Root sprouts uneven, Majority tip rot, Odd canker rot, Rot is just starting to establish, Rot is dry or moist, Rot is a slight concern, Stored good.

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MAIN CARROT CULTIVAR STORAGE TRIAL EVALUATION NOTES 2020-2021 - continued

Jackson: *Bejo sample,* Top sprouts light to moderate 0-2.5cm, Root sprouts just starting to moderate 0-2.5cm, Majority tip rot, Odd canker rot, Rot is just starting to moderately established, Rot is moist, Stored good.
Jumbo

Speedo: *Vilmorin sample,* Top sprouts moderate to heavy 1-2.5cm, Top sprouts lengths uneven, Top sprouts a concern, Root sprouts just starting 0-1cm, Majority tip rot, Some canker rot, Rot is moderately established, Rot is dry or moist, Stored good.

Blanes: *Bejo sample,* Top sprouts light to moderate 1-2.5cm, Root sprouts just starting 0-1cm, Majority tip rot, Some canker rot, Rot is lightly established, Rot is moist or dry, Stored fair to good.

Baldio: *Bejo sample,* Top sprouts just to light 0-2.5, Root sprouts just starting to light 0-2.5cm, Majority tip rot, Odd canker rot, Rot is just starting or moderately established, Rot is dry, Stored good.

Orange Blaze: *Seminis sample,* Top sprouts light to heavy 1-2.5cm, Top sprouts lengths are uneven, Root sprouts just starting to moderate 0-2.5cm, Majority tip rot, Some canker rot, Rot is slightly established, Rot is moist or dry, Stored fair.

Naval: *Bejo sample,* Top sprouts light 0-2.5cm, Root sprouts just starting to light 0-2.5cm, Root sprouts slight concern, Majority tip rot, A few crown, Rot is just starting established, Rot is dry or moist, Stored good.

Jackson: *Bejo sample,* Top sprouts light to moderate 1-2.5cm, Root sprouts just starting 0-1cm, Majority tip rot, Odd canker rot, Rot is lightly to moderately established, Rot is moist, Rot is a concern, Stored a bit poor.
Cello

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MAIN CARROT CULTIVAR STORAGE TRIAL EVALUATION NOTES 2020-2021 - continued

Envy: *Stokes sample,* Top sprouts light 1-2.5cm, Root sprouts just starting 0-1cm, Majority tip rot, Odd canker rot, Rot is just starting to slightly established, Rot is moist, Rot is a slight concern, Stored good.

Brava: *Bejo sample,* Top sprouts moderate 1-2.5cm, Root sprouts just starting to heavy, Root & top sprouts lengths uneven, Root & top sprouts a concern, Majority tip rot, Odd canker rot, Rot is just starting to light established, Rot is moist or dry, Stored fair.

Brillyance: *Stokes sample,* Top sprouts light to moderate 1-2.5cm, Root sprouts just starting 0-1cm, Majority tip rot, Odd canker rot, Rot is just starting to lightly established, Rot is dry or moist, Stored fair to good.

Extremo: *Vilmorin sample,* Top sprouts heavy 2.5-5cm, Root sprouts moderate to heavy 1-2.5cm, Top & root sprouting is a concern, Majority tip rot, A few canker, Rot is light to moderately established, Rot is moist, Rot is a concern, Stored a little poor.

LONG TERM AVERAGES - CARROT CULTIVAR STORAGE TRIALS

CULTIVAR	SOURCE	# YEARS TESTED	% MARKETABLE	% WEIGHT LOSS IN STORAGE	% DECAY	DEGREE* OF DECAY
SPARTAN CLASSIC 80	Sto	4	97.6	6.8	2.4	5.5
PAK MOR	HM	6	93.5	11.5	6.5	4.2
ORANGETTE	Sto	5	92.4	16.8	7.6	6.3
VOLCANO	Vil	4	92.2	11.7	5.2	8.7
ORANGE SHERBET	Sto	6	91.9	9.0	8.1	4.5
AVENGER	Sem	7	91.3	11.5	8.7	7.0
CANADA SUPER X	Sol	14	90.8	11.9	9.2	5.5
CARO-CHIEF	Sem	5	89.0	10.1	11.0	5.0
ISTANBUL	Bejo	5	88.0	13.9	6.4	7.1
ORLANDO GOLD	Sto	6	87.9	12.7	12.1	4.2
SIX PAK II	HM	15	87.7	12.3	12.3	5.5
NEW HALL	Bejo	9	87.3	11.5	4.2	7.6
CHANCELLOR	Sem	7	86.7	11.3	13.3	4.2
CROFTON	RZ	6	84.8	11.5	3.0	7.5
2384	Sem	10	84.3	13.5	6.4	6.7
INFINITY	Bejo	5	83.4	11.4	4.9	7.8
ENTERPRISE	Sem	15	83.4	10.7	8.3	6.6
NAVAL	Bejo	10	82.7	10.5	9.4	7.6

Listed in order of % Marketable.

Storage period is approximately 9 months.

* 10.0 = No Disease, 6.0 = Moderate, 1.0 = Severe (liquified)

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LONG TERM AVERAGES - CARROT CULTIVAR STORAGE TRIALS - continued

CULTIVAR	SOURCE	# YEARS TESTED	% MARKETABLE	% WEIGHT LOSS IN STORAGE	% DECAY	DEGREE * OF DECAY
BRADFORD	Bejo	5	82.1	10.0	7.9	7.8
BELGRADO	Bejo	12	81.6	10.3	11.1	7.1
BERLIN	Bejo	9	80.8	11.9	11.6	7.2
SIX PAK	HM	20	79.8	11.5	8.6	5.8
WARMIA	RZ	5	79.1	13.6	6.9	7.1
CELLOBUNCH	Sem	29	79.1	13.1	7.0	6.8
ORANGE PAK	Nor	8	78.6	13.2	8.1	6.8
SUNRISE	Cro	15	78.6	12.8	8.2	6.8
INDIANA	Bejo	7	75.7	15.4	8.5	7.0
FONTANA	Bejo	14	75.5	11.2	13.0	6.7
DOMINION	Sem	4	74.9	13.7	11.1	5.8
BASTIA	Bejo	16	74.2	13.3	14.7	6.6
BLANES	Bejo	5	73.4	12.3	22.1	6.3
ACHIEVE	Sem	8	73.0	13.0	13.6	6.4
ENVY	Sem	16	72.2	12.7	16.6	6.6
SIX SHOOTER	HM	5	71.5	11.0	17.5	6.0
EXTREMO	Vil	4	70.1	14.4	26.6	5.9
NEVADA	Bejo	4	69.1	16.5	14.2	5.8

Listed in order of % Marketable. Storage period is approximately 9 months.

* 10.0 = No Disease, 6.0 = Moderate, 1.0 = Severe (liquified)

ONION CULTIVAR TRIAL SEASON SUMMARY – 2021

Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm.

Favourable temperatures in April allowed for the ground frost to thaw and by the end of April the soil was satisfactory for seeding. Soil moisture conditions were satisfactory, even though April was below average in precipitation. Onion seeding in the Holland Marsh began the last week of April and was pretty much completed by the 10th of May. The trial was seeded on 10 May. Day time air temperatures were in the mid teens with a mix of sun and cloud for the first 12 days of May, however nightime air temperatures were in the low single digits. Day time air temperatures increased to the low twenties to low thirties two days after seeding and remained so for the rest of the month however nightime air temperatures remained in the single digits to low teens. The month of May recorded below average rainfall and half an inch of irrigation water was applied 7 days after seeding to ensure soil moisture remained adequate for seed germination. Onion emergence was a bit slow, but vigor and plant stand were satisfactory. By 26 May the onions were in full loop to flag leaf and the herbicide Prowl was applied at the recommended rate. A half inch of irrigation water was applied to help activate the Prowl and growth of the onion seedlings. Weed pressure was light for the entire the season. Only one application of Pardner + Goal was applied and a few hand weedings were required to keep the trial free from weeds. For the first half of the growing season onion growth was slow. In July when average rainfall amounts occurred the onions had good growth. When leaf lengths were recorded on 29 July, the average leaf length was 66 cm similar to the 2020 trial average height. There were significant differences in leaf lengths among the replicates. The first replicate had the longest leaf lengths and the third replicate had the shortest leaf lengths.

On-station monitoring for onion maggot fly emergence began early with the first flies detected on 19 May. There were three peaks in onion maggot fly numbers during the monitoring period. Counts peaked at 5.1 flies/trap/day on 17 June, 2.6 flies/trap/day on 8 July and 3.3 flies/trap/day on 5 Aug. After the third peak, onion maggot fly numbers never reached over 2 flies/trap/day. The 2021 season had a low onion maggot population, and the first generation was extended over 3 weeks, however the population was below 4 flies/trap/day.

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ONION CULTIVAR TRIAL SEASON SUMMARY - 2021 – continued

Thrips were first found on 17 June and were present throughout the growing season. Onion thrips numbers in the variety trial reached a high of 3.0 thrips/leaf on 3 Aug. Several timely insecticide applications throughout the season lowered the thrips numbers below threshold. Environmental conditions were favourable for fungal diseases to develop throughout the season. Stemphylium leaf blight was found in the cultivar trial on 5 July and several fungicide applications (see Onion Management Procedures) kept severity to a minimum. Botrytis was observed in the trial on 22 July. Fungicide applications were applied to control the botrytis, and to protect from downy mildew. No downy mildew developed in the trial. A couple of random onions with bacterial rot were found in the variety trial.

Bulb development started as expected in late July. Most bulb sizing occurred in early August. Cultivars Outlander (28 July) and Highlander (6 August) were the first to lodge. It took approximately three weeks for 75% of the cultivars to reach 85% lodged. Two thirds of the cultivars reached full maturity by 26 August when at least 85% of the onions had lodged. The average days to harvest (108 days) for the 2021 season was one day longer than in 2020. There were significant differences found among the days to harvest in all three replicates. The first replicate lodged at 106, the second replicate at 107 and the third replicate at 109 days. The onion tops dried down in a satisfactory time frame. Thirty-two varieties had no seeders present and the remaining varieties had a small number of seeders. The first replicate had a significantly higher number of seeders than the third replicate. On 9 September a sample from each cultivar was pulled for judging and comparison during Grower Field Week. By this time, most cultivars had lodged but leaves were only 40-60% desiccated. The yield samples were harvested on 21 September. At harvest, a few cultivars still had some moisture in the neck. Harvest samples from each cultivar were placed in storage on 7 October and cured artificially for approximately 48 hours.

At evaluation on 8-30 November, quality was good in most of the cultivars and yields varied between a high of 1219 to a low of 643 bushels per acre. The trial yield average was 966 bu/A. This is a drop of approximately 70 bu/A from last season and is 270 bu/A less then 2019. Significant differences in yield (bu/A) were found between all three replicates. The first, second and third replicate average bu/A were 1000, 985 and 824 bu/A, respectively. Almost all cultivars had the highest number of onions in the 2½-3" size range.

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ONION CULTIVAR TRIAL SEASON SUMMARY - 2021 – continued

The trial average for the percentage of jumbos (>3" diameter) was poor at only 11%, which is down 7% from the 2020 season. Uniformity of size was a little poor and significant differences were found among cultivars and replicates. Size was the most uniform in the first replicate and the least uniform in the third replicate. The uniformity of shape rating varied among cultivars, with shapes highly variable within the individual samples. The average stand count was 6.6 plants/ft, a drop of 1 plant/ft from 2019. The third replicate was lower (6.0 plants/ft) compared to the first and second replicates (6.9 & 6.8 plants/ft). The vast majority of unmarketable onions (culls) were undersized onions (peewees). The trial average for marketable onions was 89.2% with significant variability among the replicates. Replicate one had the highest percentage of marketable onions (92.8%) and the lowest was in replicate three at (85%). Skin quality was slightly thinner than previous three years. Skins were generally average and some skin cracking was observed in most cultivars. There was very limited skin rot found in the trial. The first replicate of the trial had significantly poorer skin attachment than the third replicate. Exterior colour was good but a little uneven in most cultivars. There was only the very odd onion with mechanical damage. Greening of the outer scales and yellow or white speckling on the outer skins was present but very limited. Neck finish was good with some rough finishes in the cultivars that had taken longer to mature. The first replicate had a significantly higher neck finish rating then the other two replicates. Frimness at evaluation in November was good. Maggot damage to onion bulbs in the evaluation samples ranged from 0.6-8.2% with a trial average of 3.0%. This is a 5% decrease in average onion maggot damage for the trial compared to the 2020 season (8.7%). Cultivar Nogal had a high percentage of damage. The first replicate had significantly higher onion maggot damage (3.8%) than the third replicate which had the lowest (2.3%) damage. Multiple centers were 6.1% similar to the trial average for 2020. When the onions were cut in half for single center evaluation, it was also noted that only a few onions had greening in the interiors.

ONION CULTIVAR TRIAL – 2021

MANAGEMENT PROCEDURES

Fertilizer:

90 kg/ha Nitrogen (Calcium Ammonium Nitrate 27-0-0) + 100 kg/ha Phosphorous (MESZ 10-40-0) + 220 kg/ha Potassium (ASPIRE 0-0-58) + 120 kg/ha K–Mag (0-0-22) + 35 kg/ha Manganese + 7 kg/ha Copper (99% Cu) was worked into the soil on 26 April.

A side dressing blend of 12 kg/ha Nitrogen + 12 kg/ha Potassium + 6 kg/ha Manganese + 2.5 kg/ha Calcium + 13.6 kg/ha Sulphur was applied on 6 July.

Seeded:

All trials were seeded on 10 May. Pelletized onion seed was seeded with a Stanhay Precision Seeder. Raw onion seed was seeded with a V-Belt seeder equipped with a 5 cm wide scatter shoe. Row spacing was 43 cm. The raw seed was coated with **PRO GRO** at 60 g/2.3 kg seed plus methyl cellulose at 100 ml/2.3 kg seed. **LORSBAN 15G** was applied at 18.5 kg/ha plus **DITHANE DG** at 8.8 kg/ha in the seed furrow. The Main Trial was replicated three times.

Weed Control:

Post-emergence:
1 application **PARDNER** at 350 ml/ha on 18 May.
1 applications: **PARDNER** at 140 ml/ha and **GOAL** at 70 ml/ha and Manganese at 1.0 kg/ha on 20 May.
1 application: **PROWL H2O** 6.0 L/ha on 27 May.
1 application: **GOAL** at 175 ml/ha and Manganese at 2.0 kg/ha on 12 July
1 application: **FRONTIER** at 1.0 L/ha on 19 June

Minor Elements:

Nine foliar sprays: Calcimax on 11 June (1.0 L/ha), 24 & 30 June, 10 July and 13 August (2.0 L/ha) and 16, 22 & 30 July and 6 August (3.0 L/ha)
Eight foliar sprays: Mag Max on 24 & 30 June, 10 July (2.0 L/ha), 16, 22 and 30 July (3.0 L/ha), 13 & 20 August (4.0 L/ha)
Seven foliar sprays: Manganese Sulfate on 24 & 30 June, 10, 17 & 22 July and 13 & 20 August (2.0 kg/ha)
Seven foliar sprays: Zinc Max on 11 June and 30 July (1.0 L/ha), 4 & 30 June, 22 July and 13 August (2.0 L/ha) and 16 July (3.0 L/ha)
Seven foliar sprays: Alexin on 16, 22 & 30 July and 6 August (3.0 L/ha) and 13, 20 and 26 August (4.0 L/ha)
Six foliar sprays: Suprafeed on 16 & 22 July (2.0 kg/ha) and 30 July and 13 August (3.0 kg/ha) and 20 & 26 August (4.0 kg/ha)

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ONION CULTIVAR TRIAL - 2021 - continued

Minor Elements continued:

Four foliar sprays: 20-20-20 on 4, 11, 24 & 30 June (2.0 kg/ha)
Three foliar sprays: Nutri Bor on 6 & 20 August (1.0 L/ha) and 26 August (2.0 L/ha)
Two foliar sprays: Mancozin on 30 July and 6 August (3.0 L/ha)
Two foliar sprays: Copper Max 13 August (2.0 L/ha) and 6 August (3.0 L/ha)
One foliar spray: Truphos on 4 June (2.0 L/ha)

Insect and Disease Control:

According to IPM recommendations.

PRISTINE at 1.0 kg/ha + **DIBROM** at 500 ml/ha and Minor Elements on June 24.
MOVENTO at 365 ml/ha + **AGRAL 90** at 1.0 L/ha on 29 June.
DITHANE DG at 2.25 kg/ha + **UP-CYDE** at 280 ml/ha and Minor Elements on 30 June.
SERCADIS at 333 ml/ha + **ZAMPRO** at1.0 L/ha **+ DIBROM** at 530 ml/ha and Minor Elements on 10 July.
MIRAVIS DUO at 1.0 L/ha + **RIDOMIL MZ** 2.25 kg/ha and Minor Elements on 16 July.
ORONDIS ULTRA at 400 ml/ha + **DITHANE DG** at 3.25 kg/ha + **AGRI-MEK SC** at 200 ml/ha and Minor Elements on 22 July.
SERCADIS at 333 ml/ha + **ZAMPRO** at1.0 L/ha **+ DELEGATE** at 336 g/ha and Minor Elements on 30 July.
MIRAVIS DUO at 1.0 L/ha + **RIDOMIL MZ** 2.25 kg/ha **+ DIBROM** at 530 ml/ha and Minor Elements on 6 August.
QUADRIS ULTRA at 400 ml/ha + **SERCADIS** at 333 ml/ha and Minor Elements on 13 August.
QUADRIS TOP at 1.0 L/ha + **RIDOMIL MZ** 3.25 kg/ha + **EXIREL** 1.5 L/ha and Minor Elements on 20 August.
DITHANE DG at 3.25 kg/ha and Minor Elements on 26 August.

Harvest: The Main Trial was pulled on 13, 14 and 15 September and topped on 21 September. The trial was placed in a forced air and temperature-controlled storage on 7 October. The trial was cured for 48 hours (25^{o}C, minimum 65% RH). After curing the temperature was lowered 5^{o}C per week until 0^{o}C was attained.

.../continued

Sprout Inhibition:

Royal MH 30 XTRA at 8.63 L/ha in 550 L/ha water on:

August 13	August 19		August 26				September 3	
Highlander	Dawson	SV NY 1496	Traverse	Haeckero	Y 604	Stanley	Thunderstone	37 126
Outlander	La Salle	Elyse	Frontier	Trailblazer	Scorpion	Safrane	SV NY 7331	Milestone
	Oneida	37 120	Prelesco	Mountaineer	Fortress	Catskill	Caesar	Crockett
	Switchback	Sat 1	Mondella	Ridge Line	Patterson	Saddleback	Scout	Trident
			Haeckero Inicium	Venecia	Prefect	Braddock	Nogal	SV NY 7333
			37 120 Inicium	Powell	Overlook	37 118	E61L 10240	Lodestar
			Sumo					

EVALUATION PROCEDURES

The cultivars were evaluated 8 through 30 November after 4 weeks in storage.

 # Bulbs Harvested:

Total number of onions harvested from 4.66 m of row

Harvest Weight:

Weights from the harvested 4.66 m of row.

Average Weight/Bulb (g):

The total weight in grams of all bulbs divided by the total number of bulbs. A bulb 51 mm (2") in diameter weighs approximately 70 g. A bulb 57 mm (2¼") in diameter weighs approximately 100 g. A bulb 64 mm (2½") in diameter weighs approximately 135 g.

Marketable Yield bu/A:

Number of onions > 76 mm (> 3"), 76 mm to 64 mm (3" to 2 ½") and 64 mm to 32 mm (2 ½" to 1¼").

Majority of Culls:

D = Double PW = Pee Wee R = Rot OC = Off Colours S = Seeders SP = Sprouts

Shape:

HG = High Globe FG = Flattened Globe G = Globe Sp = Spindle TD = Tear Drop T = Top

.../continued

ONION CULTIVAR TRIAL - 2021 - continued

Skin Thickness:
10.0 = Most Desirable 7.5 = Good 6.0 = Average

Skin Attachment:
10.0 = Most Desirable, skins well attached 7.5 = Good, skins have a few small cracks 6.0 = Average, skins have cracks but still attached

Neck Finish:
10.0 = Most Desirable, small tight neck 6.0 = Average, neck closed, 4.0 = Poor, neck bit rough and open

Overall Score:
Based on quality and general appearance.

Score:
The average of eight evaluation ratings taken from Uniformity of Shape to Firmness.

Firmness:
10 = Desirable (solid and firm), 6.0 = Average (firm but some elasticity) 1.0 = Poor (spongy)

Interior Colour:
G = Green W = White C = Cream R = Red DR = Dark Red

Exterior Colour:
LG = Light Golden G = Golden DG = Dark Golden LC = Light Copper C = Copper DC = Dark Copper

Days to Harvest:
Numbers of days from seeding until 85% of the tops were down.

Percent Onion Maggot Damage:
Percentage of onions damaged by onion maggot ranging from pin hole to completely unmarketable that were found in the 4.66 m harvest sample.

Seeders:
Average number of seeders found in each cultivar of 20 m of row.

.../continued

% Single Centers:
Percentage of onions with only one heart

% Double Centers:
Percentage of onions with two hearts

% Multiple Centers:
Percentage of onions with three or more hearts

% Hollowness in Centers:
Percentage of onions with a small hollow pocket at the heart of the onion.

Top Height (cm):
The average length of 20 randomly chosen onion tops from all three replicates from the ground to the tips as taken on 29 July.
50 cm is equal to 20 inches.

Leaf Shape:
B = Leaves are bent or hanging U = Up right leaves, straight

Leaf Colour:
LG = Light Green, G = Green, BG = Blue Green, DG = Dark Green

Irrigation:
Irrigation water was applied four times for the 2021 season:

17 May in the amount of ½ inch
26 May in the amount of ½ inch
10 June in the amount of ½ inch
18 August in the amount of 1 inch

ONION CULTIVAR MAIN TRIAL - 2021

Cultivar	Source	# Bulbs Harvested	# Bulbs Jumbos > 89 mm	# Bulbs Lrg 89 - 76 mm	# Bulbs Med 76 - 64 mm	# Bulbs Small 64 - 32 mm	Stand/Foot	Average Weight/Bulb (g)
SWITCHBACK	Tak	78 lmn*	1 cd	21 ab	36 a-l	18 pqr	5.1 lmn	171.9 a-e
LODESTAR	Tak	82 j-n	1 cd	15 b-g	47 a-d	17 pqr	5.4 j-n	167.6 a-f
MILESTONE	Tak	90 h-m	3 bcd	19 abc	38 a-k	26 m-r	5.9 h-m	185.9 abc
FORTRESS	Sto	119 a-d	0 d	3 no	28 h-m	81 a	7.8 a-d	115.2 j-m
37 120	SN	114 a-g	0 d	10 f-m	47 a-d	50 c-k	7.4 a-g	128.1 g-l
La SALLE	Sto	117 a-e	0 d	9 g-n	50 a	52 b-j	7.7 a-e	131.6 g-k
OVERLOOK	Sem	110 b-h	1 cd	12 d-j	44 a-g	45 e-m	7.2 b-h	136.8 f-j
CROCKETT	Bejo	81 k-n	6 ab	11 f-m	28 h-m	31 k-r	5.3 k-n	180.7 abc
CATSKILL	Sem	119 a-d	0 d	7 h-o	47 abc	56 b-g	7.8 a-d	130.1 g-l
SV NY 7331	Sem	110 b-h	2 cd	16 b-f	46 a-e	38 g-o	7.2 a-h	151.3 c-i
TRAVERSE	Tak	93 f-m	0 d	12 d-k	38 a-j	36 i-p	6.1 f-m	142.6 e-j
STANLEY	CF	90 h-m	0 d	12 c-i	40 a-i	31 k-r	5.9 h-m	153.0 b-i

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	# Bulbs Harvested	# Bulbs Jumbos > 89 mm	# Bulbs Lrg 89 - 76 mm	# Bulbs Med 76 - 64 mm	# Bulbs Small 64 - 32 mm	Stand/Foot	Average Weight/Bulb (g)
SCOUT	Cro	78 lmn*	6 ab	24 a	28 h-m	14 r	5.1 lmn	198.9 a
VENECIA	Bejo	108 b-i	2 cd	15 b-g	49 a	33 j-r	7.1 b-i	157.0 b-h
SV NY 1496	Sem	130 ab	0 d	11 f-m	45 a-f	64 a-e	8.5 ab	123.1 h-m
37-126	Haz	65 n	3 bcd	18 a-e	23 lm	17 pqr	4.3 n	178.1 a-d
TRAILBLAZER	Tak	67 n	0 d	8 h-o	33 b-m	21 o-r	4.4 n	129.7 g-l
THUNDERSTONE	Haz	87 i-n	1 cd	12 c-i	37 a-l	29 l-r	5.7 i-n	144.0 d-j
SUMO	CF	116 a-e	1 cd	11 f-m	48 ab	46 e-l	7.6 a-f	136.6 f-j
37 120 INICIUM	SN	103 c-k	0 d	15 b-g	37 a-l	42 f-n	6.7 c-k	138.1 e-j
RIDGE LINE	Tak	78 lmn	4 abc	19 a-d	30 g-m	18 pqr	5.1 lmn	186.7 ab
HAECKERO INICIUM	SN	113 a-g	0 d	5 i-o	33 c-m	65 a-e	7.4 a-g	113.4 j-m
PREFECT	CF	109 b-i	2 cd	7 h-o	43 a-h	48 d-l	7.2 b-i	129.5 g-l
BRADDOCK	Bejo	122 a-d	0 d	4 mno	41 a-i	65 a-e	8.0 a-d	115.6 j-m

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	# Bulbs Harvested	# Bulbs Jumbos > 89 mm	# Bulbs Lrg 89 - 76 mm	# Bulbs Med 76 - 64 mm	# Bulbs Small 64 - 32 mm	Stand/Foot	Average Weight/Bulb (g)
SAT 1	SN	125 abc*	0 d	5 k-o	46 a-f	62 a-f	8.2 abc	122.7 h-m
NOGAL	EZ	101 d-k	7 a	25 a	42 a-i	17 pqr	6.6 d-k	170.7 a-f
MOUNTAINEER	Tak	77 lmn	0 d	4 l-o	31 e-m	33 j-r	5.0 lmn	119.9 i-m
SAFRANE	Bejo	115 a-f	0 d	5 j-o	41 a-i	55 b-i	7.5 a-f	118.8 i-m
SV NY 73333	Sem	109 b-i	1 cd	12 d-k	33 c-m	50 c-k	7.1 b-i	128.4 g-l
POWELL	Bejo	124 abc	0 d	1 o	38 a-j	71 ab	8.1 abc	95.7 lm
HAECKERO	Haz	91 g-m	0 d	6 h-o	37 a-l	36 h-p	6.0 g-m	131.2 g-k
PATTERSON	Bejo	107 c-i	0 d	1 o	37 a-l	56 b-i	7.0 c-i	110.0 j-m
SADDLEBACK	Sto	114 a-f	2 cd	13 c-h	41 a-i	43 f-m	7.5 a-f	131.9 g-k
MONDELLA	Bejo	115 a-f	0 d	5 j-o	39 a-j	57 b-g	7.5 a-f	110.7 j-m
PRELESCO	Haz	96 e-l	0 d	8 h-o	29 h-m	46 e-l	6.3 e-l	114.1 j-m
ELYSE	EZ	105 c-i	2 cd	16 b-f	42 a-i	31 k-r	6.9 c-i	141.8 e-j

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	# Bulbs Harvested	# Bulbs Jumbos > 89 mm	# Bulbs Lrg 89 - 76 mm	# Bulbs Med 76 - 64 mm	# Bulbs Small 64 - 32 mm	Stand/Foot	Average Weight/Bulb (g)
TRIDENT	Cro	81 k-n*	2 cd	10 f-m	27 i-m	32 k-r	5.3 k-n	132.5 g-k
SCORPION	Cro	73 mn	0 d	5 k-o	25 j-m	33 j-r	4.8 mn	121.3 i-m
FRONTIER	Tak	82 k-n	0 d	4 l-o	31 f-m	34 j-q	5.3 k-n	115.5 j-m
E61L 10240	EZ	112 a-h	3 bcd	25 a	44 a-g	23 n-r	7.3 a-h	161.0 b-g
37 118	Sem	104 c-j	0 d	5 j-o	38 a-k	45 e-m	6.8 c-j	119.5 i-m
DAWSON	Bejo	107 c-i	0 d	1 o	19 m	70 abc	7.0 c-i	93.2 m
Y 604	SN	108 b-i	4 abc	11 f-m	27 i-m	48 d-l	7.1 b-i	128.1 g-l
OUTLANDER	Sto	113 a-g	0 d	6 i-o	32 d-m	56 b-h	7.4 a-g	98.5 klm
CAESAR	CF	102 c-k	0 d	11 f-m	33 b-m	40 g-o	6.7 c-k	125.7 h-m
ONEIDA	Bejo	133 a	0 d	4 mno	36 a-l	67 a-d	8.7 a	101.6 klm
HIGHLANDER	Sto	65 n	0 d	11 e-l	23 klm	15 qr	4.3 n	169.3 a-f
Trial Average		**101**	**1**	**10**	**37**	**42**	**6.6**	**136.3**

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Total Harvest Weight (kg)	Wgt. Jumbo > 89 mm (kg)	Wgt. Large 89 - 76 mm (kg)	Wgt. Medium 76-64 mm (kg)	Wgt. Small 64-32 mm (kg)	Marketable Yield bu/A	% Marketable	Majority of Culls
SWITCHBACK	Tak	13.29 d-n*	0.32 cde	5.17 a-d	6.05 a-l	1.64 q-t	994 b-j	98.0 a	PW
LODESTAR	Tak	13.85 c-l	0.33 cde	3.82 d-g	7.94 abc	1.67 q-t	1038 a-h	97.6 ab	PW
MILESTONE	Tak	15.66 a-f	1.05 a-e	4.85 a-e	6.76 a-j	2.78 m-t	1164 a-d	96.0 abc	R
FORTRESS	Sto	13.62 d-n	0.00 e	0.67 q-t	4.59 h-m	8.08 a	1006 a-i	94.1 a-d	PW
37 120	SN	14.53 b-j	0.10 e	2.05 h-r	7.51 a-f	4.64 b-l	1079 a-g	94.0 a-e	PW
La SALLE	Sto	15.38 a-g	0.00 e	1.98 i-s	8.02 ab	5.10 b-j	1139 a-e	93.8 a-f	PW
OVERLOOK	Sem	14.99 b-i	0.46 cde	2.88 f-m	7.01 a-h	4.30 c-n	1105 a-f	93.5 a-f	PW
CROCKETT	Bejo	12.91 f-n	2.10 a	2.82 f-n	4.60 h-m	3.02 l-t	945 e-k	93.4 a-g	PW
CATSKILL	Sem	15.45 a-g	0.12 e	1.71 j-t	7.91 abc	5.44 b-g	1144 a-e	92.9 a-h	PW
SV NY 7331	Sem	16.61 abc	0.63 cde	4.06 b-g	7.88 a-d	3.59 h-p	1219 a	92.8 a-i	PW
TRAVERSE	Tak	13.21 e-n	0.11 e	2.91 f-l	6.40 a-l	3.58 i-p	980 b-k	92.8 a-i	PW
STANLEY	CF	13.74 d-m	0.00 e	3.17 e-j	6.79 a-j	3.34 j-s	1003 a-i	92.3 a-i	PW

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Total Harvest Weight (kg)	Wgt. Jumbo > 89 mm (kg)	Wgt. Large > 76 mm (kg)	Wgt. Medium 76-64 mm (kg)	Wgt. Small 64-32 mm (kg)	Marketable Yield bu/A	% Marketable	Majority of Culls
SCOUT	Cro	15.37 a-g*	2.06 ab	6.15 a	4.92 g-m	1.41 t	1096 a-f	92.3 a-i	PW
VENECIA	Bejo	16.87 ab	0.70 cde	3.90 c-g	8.30 a	3.26 k-s	1219 a	92.2 a-i	PW
SV NY 1496	Sem	16.00 a-d	0.00 e	2.50 g-p	7.29 a-g	5.76 b-f	1173 abc	92.2 a-i	PW
37-126	Haz	11.62 k-q	0.99 a-e	4.52 a-f	4.22 klm	1.57 rst	852 h-n	91.8 a-j	PW
TRAILBLAZER	Tak	9.04 q	0.00 e	1.72 j-t	5.28 f-m	1.92 p-t	672 mn	91.6 a-j	PW
THUNDERSTONE	Haz	12.53 h-o	0.31 de	2.92 f-k	6.30 a-l	2.68 n-t	921 f-l	91.6 a-j	PW
SUMO	CF	15.83 a-e	0.36 cde	2.61 g-p	7.76 a-e	4.53 b-m	1150 a-e	91.4 a-j	PW
37 120 INICIUM	SN	14.13 b-k	0.00 e	3.72 d-i	6.01 a-l	3.87 g-o	1026 a-h	91.2 a-k	PW
RIDGE LINE	Tak	14.17 b-k	1.44 abc	5.06 a-d	5.36 e-m	1.70 q-t	1023 a-i	90.9 a-l	PW
HAECKERO INICIUM	SN	12.88 f-n	0.09 e	1.30 k-t	5.18 f-m	5.85 b-e	937 e-k	90.6 a-l	PW
PREFECT	CF	14.14 b-k	0.52 cde	1.47 j-t	6.73 a-j	4.62 b-l	1005 a-i	90.3 a-l	PW
BRADDOCK	Bejo	14.06 c-k	0.00 e	0.90 p-t	6.56 a-k	6.05 bc	1020 a-i	89.6 b-m	PW

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Total Harvest Weight (kg)	Wgt. Jumbo > 89 mm (kg)	Wgt. Large > 76 mm (kg)	Wgt. Medium 76-64 mm (kg)	Wgt. Small 64-32 mm (kg)	Marketable Yield bu/A	% Marketable	Majority of Culls
SAT 1	SN	15.25 a-h*	0.00 e	1.10 n-t	7.48 a-f	6.17 b	1113 a-f	89.5 b-m	PW
NOGAL	EZ	16.91 ab	2.08 a	5.61 abc	6.57 a-k	1.53 st	1191 ab	89.0 c-m	PW
MOUNTAINEER	Tak	9.39 pq	0.12 e	1.00 o-t	5.05 g-m	2.99 l-t	690 mn	88.7 c-m	PW
SAFRANE	Bejo	13.66 d-n	0.00 e	1.23 k-t	6.89 a-i	5.05 b-k	993 b-j	88.1 c-m	PW
SV NY 73333	Sem	13.84 c-l	0.29 cde	2.77 f-n	5.47 d-m	4.73 b-l	1000 b-j	88.0 c-m	PW
POWELL	Bejo	11.99 j-p	0.00 e	0.15 t	5.39 e-m	6.00 bcd	871 g-m	87.8 d-m	PW
HAECKERO	Haz	11.96 j-p	0.00 e	1.46 j-t	6.03 a-l	3.74 g-o	846 h-n	87.4 d-n	PW
PATTERSON	Bejo	12.00 j-p	0.00 e	0.31 rst	5.82 b-l	5.40 b-h	869 g-m	87.0 d-n	PW
SADDLEBACK	Sto	15.11 a-i	0.66 cde	3.17 e-j	6.62 a-k	4.02 f-n	1092 a-f	86.9 d-n	PW
MONDELLA	Bejo	12.96 f-n	0.12 e	1.16 l-t	6.06 a-l	5.25 b-i	949 d-k	86.9 d-n	PW
PRELESCO	Haz	10.97 m-q	0.00 e	1.78 j-t	4.45 j-m	4.19 d-n	786 j-n	86.0 d-n	PW
ELYSE	EZ	14.90 b-i	0.64 cde	3.75 d-h	6.12 a-l	2.78 m-t	1002 a-j	85.9 e-n	R

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Total Harvest Weight (kg)	Wgt. Jumbo > 89 mm (kg)	Wgt. Large > 76 mm (kg)	Wgt. Medium 76-64 mm (kg)	Wgt. Small 64-32 mm (kg)	Marketable Yield bu/A	% Marketable	Majority of Culls
TRIDENT	Cro	11.04 m-q*	0.71 cde	2.43 g-q	4.54 i-m	3.01 l-t	806 i-n	85.7 f-n	PW
SCORPION	Cro	8.94 q	0.00 e	1.11 n-t	4.07 lm	3.36 j-r	643 n	85.3 g-n	PW
FRONTIER	Tak	9.34 pq	0.00 e	0.97 o-t	4.84 h-m	3.15 l-t	676 mn	85.2 h-m	PW
E61L 10240	EZ	17.80 a	0.94 b-e	5.70 ab	6.98 a-h	2.12 o-t	1187 abc	85.2 h-n	D
37 118	Sem	12.42 i-o	0.00 e	1.13 m-t	5.97 a-l	4.15 e-n	849 h-n	84.7 i-n	PW
DAWSON	Bejo	10.01 opq	0.00 e	0.24 st	3.05 m	6.13 b	710 lmn	83.8 j-o	PW
Y 604	SN	13.67 d-n	1.29 a-d	2.71 g-o	4.59 h-m	4.27 c-n	970 c-k	83.1 k-o	PW
OUTLANDER	Sto	11.10 l-q	0.00 e	1.23 k-t	4.44 j-m	4.63 b-l	777 k-n	83.0 l-o	PW
CAESAR	CF	12.80 g-o	0.00 e	2.55 g-p	5.51 c-l	3.44 i-q	868 g-m	82.0 mno	PW
ONEIDA	Bejo	13.64 d-n	0.11 e	0.97 o-t	5.63 b-l	5.95 b-e	954 d-k	79.2 no	PW
HIGHLANDER	Sto	10.92 n-q	0.00 e	2.71 g-o	4.22 klm	1.80 p-t	659 mn	76.5 o	PW
Trial Average		**13.41**	**0.40**	**2.51**	**5.98**	**3.92**	**966**	**89.2**	**PW**

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Shape	Uniformity of Shape	Uniformity of Size	Skin Thickness	Skin Attachment	Neck Finish	Overall Score	Score
SWITCHBACK	Tak	G	7.3 a-d*	7.7 a	6.7 b-e	8.3 cde	7.7 cde	7.0 b-e	7.33 a-e
LODESTAR	Tak	FG	7.0 b-e	6.7 a-d	7.3 abc	9.0 a-d	6.0 hij	7.0 b-e	7.46 abc
MILESTONE	Tak	HG	6.3 d-g	7.0 abc	7.7 ab	8.7 b-e	7.0 efg	7.0 a-d	7.38 a-d
FORTRESS	Sto	HG	7.3 a-d	7.5 ab	5.7 efg	9.7 ab	7.3 def	7.5 abc	7.75 a
37 120	SN	G	5.7 f-i	6.3 a-e	5.0 gh	8.3 cde	6.0 hij	6.0 fg	6.25 m-q
La SALLE	Sto	HG	6.7 c-f	6.7 a-d	6.0 d-g	9.3 abc	7.0 efg	6.7 c-f	7.17 b-g
OVERLOOK	Sem	G	4.3 j	6.3 a-e	5.3 fgh	8.7 b-e	6.3 ghi	6.3 efg	6.38 l-q
CROCKETT	Bejo	G	7.0 b-e	6.3 a-e	7.3 abc	10.0 a	4.3 l	6.7 c-f	7.42 a-d
CATSKILL	Sem	G	5.7 f-i	5.7 c-g	6.0 d-g	9.0 a-d	7.0 efg	7.0 b-e	6.96 c-j
SV NY 7331	Sem	G	6.3 d-g	5.0 e-h	6.0 d-g	8.0 de	7.3 def	6.3 efg	6.42 k-q
TRAVERSE	Tak	G	7.3 a-d	6.3 a-e	6.7 b-e	9.0 a-d	7.0 efg	7.3 a-d	7.38 a-d
STANLEY	CF	G	6.3 d-g	6.0 b-f	7.0 a-d	9.7 ab	6.3 ghi	7.3 a-d	7.46 abc

Listed in order of % Marketable. 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Shape	Uniformity of Shape	Uniformity of Size	Skin Thickness	Skin Attachment	Neck Finish	Overall Score	Score
SCOUT	Cro	SPG	6.0 e-h*	6.0 b-f	4.3 h	6.3 f	6.3 ghi	5.7 gh	6.04 pq
VENECIA	Bejo	TDG	7.0 b-e	6.0 b-f	7.0 a-d	9.0 a-d	8.3 abc	7.3 a-d	7.54 ab
SV NY 1496	Sem	Mix	4.7 ij	5.0 e-h	5.0 gh	5.7 f	8.7 ab	6.0 fg	6.13 opq
37-126	Haz	G	6.3 d-g	6.0 b-f	6.0 d-g	9.7 ab	5.0 kl	5.7 gh	6.67 g-n
TRAILBLAZER	Tak	FG	8.0 ab	6.0 b-f	7.3 abc	9.3 abc	7.7 cde	7.0 b-e	7.75 a
THUNDERSTONE	Haz	FG	5.3 g-j	5.3 d-g	5.3 fgh	8.7 b-e	6.7 fgh	6.7 c-f	6.63 h-o
SUMO	CF	G	6.0 e-h	6.7 a-d	5.7 efg	8.0 de	8.0 bcd	6.5 d-g	6.85 e-l
37 120 INICIUM	SN	G	6.0 e-h	5.0 e-h	5.0 gh	9.0 a-d	6.7 fgh	6.3 efg	6.46 j-p
RIDGE LINE	Tak	TD	5.3 g-j	5.7 c-g	7.3 abc	9.0 a-d	7.0 efg	6.0 fg	6.92 d-k
HAECKERO INICIUM	SN	HG	6.3 d-g	4.3 gh	6.7 b-e	8.7 b-e	7.3 def	7.0 b-e	7.13 b-h
PREFECT	CF	FG	5.7 f-i	5.3 d-g	6.0 d-g	8.3 cde	5.7 ijk	6.0 fg	6.25 m-q
BRADDOCK	Bejo	HG	5.7 f-i	6.7 a-d	5.3 fgh	9.7 ab	7.0 efg	7.7 ab	7.42 a-d

Listed in order of % Marketable. 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Shape	Uniformity of Shape	Uniformity of Size	Skin Thickness	Skin Attachment	Neck Finish	Overall Score	Score
SAT 1	SN	HG	7.0 b-e*	6.3 a-e	6.3 c-f	8.7 b-e	7.3 def	6.7 c-f	7.04 b-i
NOGAL	EZ	FG	7.7 abc	7.0 abc	7.7 ab	8.7 b-e	6.3 ghi	5.7 gh	7.38 a-d
MOUNTAINEER	Tak	G	8.3 a	5.7 c-g	6.7 b-e	8.3 cde	7.3 def	7.3 a-d	7.38 a-d
SAFRANE	Bejo	G	6.0 e-h	4.3 gh	6.7 b-e	9.3 abc	7.0 efg	7.3 a-d	7.29 a-f
SV NY 73333	Sem	G	5.0 hij	5.7 c-g	5.3 fgh	9.0 a-d	7.0 efg	7.5 abc	6.81 f-l
POWELL	Bejo	G	5.7 f-i	6.3 a-e	5.0 gh	10.0 a	6.3 ghi	6.7 c-f	7.17 b-g
HAECKERO	Haz	FG	5.7 f-i	4.7 fgh	6.3 c-f	9.0 a-d	6.7 fgh	7.0 b-e	6.83 e-l
PATTERSON	Bejo	HG	6.3 d-g	7.7 a	6.7 b-e	9.3 abc	6.7 fgh	7.3 a-d	7.54 ab
SADDLEBACK	Sto	FG	6.3 d-g	6.0 b-f	5.7 efg	8.0 de	7.7 cde	6.0 fg	6.54 i-p
MONDELLA	Bejo	G	7.3 a-d	5.7 c-g	6.3 c-f	9.3 abc	6.7 fgh	7.3 a-d	7.54 ab
PRELESCO	Haz	FG	5.3 g-j	5.7 c-g	6.0 d-g	7.7 e	6.7 fgh	5.0 h	6.17 n-q
ELYSE	EZ	Mix	4.3 j	5.0 e-h	6.0 d-g	2.7 g	8.3 abc	4.0 i	5.46 r

Listed in order of % Marketable. 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Shape	Uniformity of Shape	Uniformity of Size	Skin Thickness	Skin Attachment	Neck Finish	Overall Score	Score
TRIDENT	Cro	G	5.7 f-i*	4.7 fgh	5.0 gh	8.3 cde	6.0 hij	6.0 fg	6.04 pq
SCORPION	Cro	HG	5.7 f-i	5.3 d-g	6.0 d-g	9.7 ab	6.7 fgh	6.7 c-f	6.96 c-j
FRONTIER	Tak	G	7.0 b-e	6.3 a-e	7.7 ab	8.7 b-e	7.0 efg	6.3 efg	7.08 b-h
E61L 10240	EZ	FG	6.7 c-f	5.7 c-g	6.0 d-g	8.7 b-e	5.3 jk	6.0 fg	6.71 g-m
37 118	Sem	G	5.3 g-j	5.7 c-g	6.3 c-f	9.3 abc	6.0 hij	6.7 c-f	6.75 g-m
DAWSON	Bejo	HG	6.7 c-f	6.7 a-d	5.3 fgh	9.0 a-d	7.7 cde	8.0 a	7.54 ab
Y 604	SN	G	6.0 e-h	3.7 h	8.0 a	8.0 de	7.0 efg	6.3 efg	6.67 g-n
OUTLANDER	Sto	FG	6.7 c-f	4.3 gh	5.3 fgh	3.7 g	9.0 a	5.0 h	5.92 qr
CAESAR	CF	G	5.7 f-i	5.0 e-h	5.3 fgh	8.3 cde	7.0 efg	6.3 efg	6.63 h-o
ONEIDA	Bejo	G	7.7 abc	4.7 fgh	6.0 d-g	8.0 de	7.3 def	7.0 b-e	6.83 e-l
HIGHLANDER	Sto	G	6.3 d-g	6.0 b-f	5.0 gh	5.7 f	8.7 ab	5.7 gh	6.42 k-q
Trial Average			**6.3**	**5.8**	**6.1**	**8.4**	**6.9**	**6.5**	**6.89**

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Firmness at Harvest	Firmness at Evaluation	Interior Colour	Exterior Colour	Exterior Colour Rating	Days to Harvest	% Onion Maggot Damage	% Jumbo > 76 mm
SWITCHBACK	Tak	9.7 abc*	7.3 ghi	CW	G	6.7 b-e	105 f-j	1.8 d-i	28.1 ab
LODESTAR	Tak	10.0 a	8.7 cde	C	DG	8.0 ab	114 ab	2.1 d-i	18.5 b-f
MILESTONE	Tak	10.0 a	8.0 efg	C	DG	7.3 abc	114 ab	5.5 a-e	26.5 abc
FORTRESS	Sto	10.0 a	8.7 cde	MIX	G	8.3 a	111 b-e	1.4 e-i	2.4 m-p
37 120	SN	9.3 cde	7.3 ghi	C	G	5.3 efg	104 h-k	0.6 i	9.4 f-p
La SALLE	Sto	10.0 a	8.3 def	W	G	6.7 b-e	102 jk	1.9 d-i	7.7 h-p
OVERLOOK	Sem	9.8 ab	7.3 ghi	W	G	6.3 c-f	103 ijk	2.8 c-i	11.2 f-n
CROCKETT	Bejo	10.0 a	9.3 abc	W	DG	8.3 a	116 a	1.8 d-i	16.8 c-h
CATSKILL	Sem	9.8 ab	7.7 fgh	CW	G	7.7 abc	106 e-j	0.9 ghi	6.1 i-p
SV NY 7331	Sem	10.0 a	7.0 hij	W	G	5.3 efg	113 abc	2.4 d-i	15.4 d-i
TRAVERSE	Tak	9.7 abc	8.3 def	W	G	7.0 a-d	112 a-d	1.7 d-i	12.7 f-l
STANLEY	CF	10.0 a	8.7 cde	W	G	8.3 a	113 abc	0.7 i	13.8 e-k

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Firmness at Harvest	Firmness at Evaluation	Interior Colour	Exterior Colour	Exterior Colour Rating	Days to Harvest	% Onion Maggot Damage	% Jumbo > 76 mm
SCOUT	Cro	9.0 e*	6.7 ijk	C	LG	7.0 a-d	113 abc	3.0 c-i	31.1 a
VENECIA	Bejo	9.8 ab	8.3 def	C	G	7.3 abc	109 c-g	0.7 i	15.0 e-j
SV NY 1496	Sem	9.2 de	6.0 k	C	LG	8.0 ab	95 l	1.0 f-i	8.3 g-p
37-126	Haz	10.0 a	8.0 efg	MIX	DG	6.7 b-e	114 ab	4.9 a-h	27.9 ab
TRAILBLAZER	Tak	10.0 a	8.3 def	C	G	8.3 a	111 b-e	4.4 a-i	11.2 f-m
THUNDERSTONE	Haz	9.8 ab	7.7 fgh	C	G	7.3 abc	113 abc	2.3 d-i	14.2 e-k
SUMO	CF	9.7 abc	7.0 hij	W	G	7.0 a-d	106 e-j	5.2 a-f	9.3 f-p
37 120 INICIUM	SN	9.3 cde	7.3 ghi	C	G	6.3 c-f	106 e-j	1.5 e-i	15.4 d-i
RIDGE LINE	Tak	10.0 a	8.3 def	CW	DG	6.7 b-e	113 abc	4.5 a-i	25.1 a-d
HAECKERO INICIUM	SN	10.0 a	9.7 ab	C	G	7.0 a-d	106 e-j	0.9 ghi	4.9 j-p
PREFECT	CF	10.0 a	8.3 def	C	G	4.7 g	106 f-j	2.7 c-i	6.1 i-p
BRADDOCK	Bejo	9.8 ab	9.0 bcd	CW	G	8.3 a	103 ijk	1.1 f-i	3.0 l-p

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* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test. **.../ continued**

ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Firmness at Harvest	Firmness at Evaluation	Interior Colour	Exterior Colour	Exterior Colour Rating	Days to Harvest	% Onion Maggot Damage	% Jumbo > 76 mm
SAT 1	SN	9.5 bcd*	7.3 ghi	C	LG	6.7 b-e	99 kl	2.9 c-i	3.6 l-p
NOGAL	EZ	9.8 ab	8.3 def	C	DG	7.7 abc	114 ab	8.2 a	25.5 abc
MOUNTAINEER	Tak	10.0 a	8.0 efg	W	G	7.3 abc	110 b-f	2.3 d-i	5.4 i-p
SAFRANE	Bejo	10.0 a	10.0 a	W	G	7.7 abc	109 c-g	2.0 d-i	4.4 k-p
SV NY 73333	Sem	10.0 a	8.3 def	W	G	6.7 b-e	113 abc	1.2 f-i	11.0 f-o
POWELL	Bejo	10.0 a	9.7 ab	C	G	7.7 abc	111 b-e	0.8 hi	0.6 p
HAECKERO	Haz	10.0 a	8.7 cde	C	G	6.7 b-e	105 f-j	7.2 ab	7.2 h-p
PATTERSON	Bejo	10.0 a	9.0 bcd	C	G	7.3 abc	106 e-j	7.4 ab	1.2 nop
SADDLEBACK	Sto	9.5 bcd	7.3 ghi	C	G	5.3 efg	108 c-h	2.3 d-i	11.6 f-m
MONDELLA	Bejo	10.0 a	9.7 ab	W	G	8.0 ab	112 a-d	3.4 b-i	4.4 k-p
PRELESCO	Haz	9.7 abc	7.7 fgh	C	G	5.3 efg	104 g-j	5.7 a-d	8.3 g-p
ELYSE	EZ	8.0 f	6.0 k	W	LG	7.3 abc	99 kl	1.3 f-i	15.3 d-i

Listed in order of % Marketable. 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Firmness at Harvest	Firmness at Evaluation	Interior Colour	Exterior Colour	Exterior Colour Rating	Days to Harvest	% Onion Maggot Damage	% Jumbo > 76 mm
TRIDENT	Cro	9.7 abc*	7.7 fgh	W	DG	5.0 gh	111 b-e	7.2 ab	11.5 f-m
SCORPION	Cro	9.7 abc	8.0 efg	C	G	7.7 abc	113 abc	5.0 a-g	6.2 i-p
FRONTIER	Tak	9.8 ab	8.0 efg	C	G	5.7 d-g	111 b-e	4.4 a-i	5.6 i-p
E61L 10240	EZ	10.0 a	8.7 cde	C	G	6.7 b-e	113 abc	6.9 abc	22.8 a-e
37 118	Sem	9.8 ab	8.3 def	C	G	6.3 c-f	108 d-i	4.6 a-i	4.9 j-p
DAWSON	Bejo	9.7 abc	8.7 cde	C	DG	8.3 a	104 h-k	1.2 f-i	0.9 op
Y 604	SN	10.0 a	7.0 hij	C	G	7.3 abc	106 e-j	2.6 d-i	10.6 f-p
OUTLANDER	Sto	9.7 abc	6.0 k	W	LG	7.3 abc	90 m	1.9 d-i	5.4 i-p
CAESAR	CF	10.0 a	9.0 bcd	W	G	6.3 c-f	114 ab	4.6 a-i	10.6 f-p
ONEIDA	Bejo	9.0 e	7.7 fgh	W	DG	6.3 c-f	104 h-k	1.4 e-i	3.0 l-p
HIGHLANDER	Sto	8.3 f	6.3 jk	W	LG	7.7 abc	96 l	2.5 d-i	17.8 c-g
Trial Average		**9.7**	**8.0**			**7.0**	**108**	**3.0**	**11.4**

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Seeders	% Single Centers	% Double Centers	% Multiple Centers	% Hollowness in Centers	Top Height (cm)	Leaf Shape	Leaf Colour
SWITCHBACK	Tak	0.0 a*	0 o	73 a-e	27 ab	57 b-e	63.3 f-l	B	BG
LODESTAR	Tak	0.0 a	30 h-n	60 b-i	10 cde	10 jk	64.9 d-k	U	BG
MILESTONE	Tak	0.0 a	7 no	93 a	0 e	20 h-k	65.3 c-k	B	BG
FORTRESS	Sto	0.3 a	37 g-m	63 b-h	0 e	37 d-i	68.4 a-f	U	BG
37 120	SN	1.7 a	70 bcd	27 k-n	3 e	37 d-i	70.3 abc	B	G
La SALLE	Sto	0.3 a	47 d-j	53 d-j	0 e	37 d-i	68.7 a-e	B	G
OVERLOOK	Sem	0.0 a	50 d-i	50 e-k	0 e	17 ijk	64.6 d-k	U	BG
CROCKETT	Bejo	0.0 a	67 b-e	27 k-n	7 de	17 ijk	66.8 a-j	U	BG
CATSKILL	Sem	0.0 a	50 d-i	50 e-k	0 e	23 g-k	68.7 a-e	B	BG
SV NY 7331	Sem	0.0 a	53 c-h	47 f-l	0 e	17 ijk	68.9 a-e	U	G
TRAVERSE	Tak	0.0 a	50 d-i	50 e-k	0 e	70 abc	64.3 e-k	U	BG
STANLEY	CF	0.7 a	17 l-o	73 a-e	10 cde	30 f-k	65.7 c-k	U	BG

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Seeders	% Single Centers	% Double Centers	% Multiple Centers	% Hollowness in Centers	Top Height (cm)	Leaf Shape	Leaf Colour
SCOUT	Cro	0.7 a*	53 c-h	33 j-m	13 b-e	7 k	69.6 a-d	B	G
VENECIA	Bejo	0.0 a	20 k-o	67 b-g	13 b-e	17 ijk	70.8 ab	U	BG
SV NY 1496	Sem	0.0 a	33 g-m	63 b-h	3 e	77 ab	69.0 a-e	B	G
37-126	Haz	0.7 a	43 e-k	50 e-k	7 de	13 ijk	68.4 a-f	B	G
TRAILBLAZER	Tak	0.0 a	13 mno	83 ab	3 e	23 g-k	61.9 j-m	B	BG
THUNDERSTONE	Haz	0.0 a	50 d-i	50 e-k	0 e	23 g-k	68.8 a-e	U	G
SUMO	CF	0.3 a	40 f-l	60 b-i	0 e	30 f-k	67.4 a-i	B	BG
37 120 INICIUM	SN	1.7 a	63 b-f	37 i-m	0 e	43 d-h	68.2 a-g	U	G
RIDGE LINE	Tak	0.0 a	7 no	67 b-g	27 ab	33 e-j	62.5 h-m	B	BG
HAECKERO INICIUM	SN	0.0 a	43 e-k	53 d-j	3 e	10 jk	65.3 c-k	B	BG
PREFECT	CF	0.3 a	23 j-o	57 c-j	20 a-d	60 bcd	68.1 a-g	U	G
BRADDOCK	Bejo	0.0 a	33 g-m	63 b-h	3 e	47 c-g	67.2 a-i	B	BG

Listed in order of % Marketable. 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Seeders	% Single Centers	% Double Centers	% Multiple Centers	% Hollowness in Centers	Top Height (cm)	Leaf Shape	Leaf Colour
SAT 1	SN	0.0 a*	33 g-m	67 b-g	0 e	37 d-i	66.9 a-j	B	BG
NOGAL	EZ	11.0 c	13 mno	57 c-j	30 a	13 ijk	69.0 a-e	U	G
MOUNTAINEER	Tak	0.0 a	30 h-n	63 b-h	7 de	33 e-j	59.1 lm	B	BG
SAFRANE	Bejo	1.0 a	53 c-h	43 g-m	3 e	30 f-k	66.9 a-j	B	BG
SV NY 73333	Sem	0.3 a	57 b-g	40 h-m	3 e	10 jk	66.0 b-k	U	G
POWELL	Bejo	0.0 a	63 b-f	37 i-m	0 e	50 c-f	68.4 a-f	U	BG
HAECKERO	Haz	0.0 a	43 e-k	57 c-j	0 e	27 f-k	65.4 c-k	B	BG
PATTERSON	Bejo	0.0 a	63 b-f	37 i-m	0 e	47 c-g	65.5 c-k	B	BG
SADDLEBACK	Sto	0.0 a	37 g-m	63 b-h	3 e	27 f-k	69.1 a-e	U	G
MONDELLA	Bejo	0.7 a	77 abc	23 lmn	0 e	17 ijk	67.6 a-h	U	BG
PRELESCO	Haz	0.0 a	23 j-o	70 a-f	7 de	10 jk	63.4 f-l	B	BG
ELYSE	EZ	0.0 a	33 g-m	60 b-i	7 de	37 d-i	58.8 lm	B	G

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ONION CULTIVAR MAIN TRIAL - 2021 - continued

Cultivar	Source	Seeders	% Single Centers	% Double Centers	% Multiple Centers	% Hollowness in Centers	Top Height (cm)	Leaf Shape	Leaf Colour
TRIDENT	Cro	0.0 a*	97 a	3 n	0 e	27 f-k	68.0 a-g	B	BG
SCORPION	Cro	0.0 a	97 a	3 n	0 e	33 e-j	64.8 d-k	U	BG
FRONTIER	Tak	0.0 a	20 k-o	77 a-d	3 e	17 ijk	61.3 klm	B	BG
E61L 10240	EZ	7.7 b	30 h-n	50 e-k	20 a-d	7 k	71.7 a	U	G
37 118	Sem	0.7 a	37 g-m	57 c-j	7 de	10 jk	62.4 i-m	B	G
DAWSON	Bejo	0.0 a	80 ab	20 mn	0 e	13 ijk	65.3 c-k	B	G
Y 604	SN	0.0 a	37 g-m	57 c-j	7 de	23 g-k	66.6 a-j	B	BG
OUTLANDER	Sto	0.0 a	13 mno	80 abc	3 e	93 a	57.8 m	B	G
CAESAR	CF	0.0 a	17 l-o	73 a-e	10 cde	30 f-k	63.1 g-l	U	G
ONEIDA	Bejo	0.0 a	27 i-n	70 a-f	3 e	10 jk	68.7 a-e	B	G
HIGHLANDER	Sto	0.0 a	0 o	77 a-d	23 abc	90 a	58.9 lm	B	G
Trial Average		**0.6**	**40.0**	**53.9**	**6.1**	**30.7**	**66.0**		

Listed in order of % Marketable. 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

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ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021

Switchback: *American Takii sample*, Average appearance, Good tight neck finish, Medium sized necks, Average skin thickness, Average skin quality, A few with skin cracking, Exterior colour fairly even, Some with greening on skins, Interior color mix 40% cream 60% white, Average interior blending, Dead centers 70% white 30% green, Average to good packer, Uniformity of shape a little even, Average firmness, Firmness a little uneven, Medium run size a little uneven, Mid-term storage onion.

Lodestar: *American Takii sample*, Good appearance, Average tight neck finish, Neck finish a bit rough, Medium to large sized necks, Thicker skins, Pretty good skin quality, Odd one with skin cracking, Fairly dark exterior colour even, Odd one with yellowing on skins, Interior color cream, Average interior blending, Dead centers white or green, Average packer, Uniformity of shape a little uneven, Nice firm solid onion, Firmness even, Medium to large run size a little uneven, Longer term storage onion.

Milestone: *American Takii sample*, Good appearance, Average tight neck finish, Mixed sized necks, Thicker skins, Pretty good skin quality, Odd one with skin cracking, Odd one with skin or basal plate rot, Exterior colour a little even, Odd one with white spots on skins, Interior colour cream, Good interior blending, Dead centers 80% white 20% green, Average to good packer, Uniformity of shape a little uneven, Good firm onion, Firmness a little uneven, Medium to large run size a little uneven, Mid to longer term storage onion.

Fortress: *Stokes sample*, Good appearance, Average tight neck finish, Neck finish a bit rough, Medium sized necks, Average skin thickness, Nice skin quality, Exterior colour very even, Odd one with white spots or greening on skins, Interior colour cream or white, Good interior blending, Dead centers white, Some greening of rings, Good packer, Uniformity of shape even, Nice firm solid onion, Firmness even, Small run size a little uneven, Longer term storage onion.

37 120: *Seminova sample*, Average appearance, Average tight neck finish, Some neck finishes a bit rough, Medium sized necks, Thin to average skin thickness, Average skin quality, Exterior colour a little uneven, Odd one with greening on skins, Interior colour cream or white, Average interior blending, Dead centers 60% white 40% yellow, Average packer, Uniformity of shape even, Average firmness, Firmness uneven, Medium run size a little uneven, Early to mid-term storage onion.

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ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 - continued

La Salle: *Stokes sample*, Average to good appearance, Good tight neck finish, A few neck finishes a bit rough, Small to medium sized necks, Average skin thickness, Pretty good skin quality, Exterior colour a little uneven, Odd one with white spots on skins, Interior colour white, Good interior blending, Dead centers white or yellow, Average to good packer, Uniformity of shape a little even, Good firm onion, Firmness a little uneven, Medium run size a little uneven, Mid to longer term storage onion.

Overlook: *Seminis sample*, Good appearance, Average tight neck finish, Larger neck finishes a bit rough, Mixed sized necks uneven, Average skin thickness, Pretty good skin quality, Odd one with skin cracking, Exterior colour uneven, Interior colour white or cream, Average interior blending uneven, Dead centers colours mixed, Average packer, Uniformity of shape very uneven, Good firm onion, Firmness a little uneven, Small to medium run size uneven, Mid-term storage onion.

Crockett: *Bejo sample*, Appearance uneven, Poor to average neck finish, Neck finishes rough and ripped, Necks a bit of a concern, Large sized necks, Thicker skins, Nice skin quality, Exterior colour very even, Odd one with yellowing on skins, Interior colour white, Good interior blending, Dead centers 70% white 30% green, Average packer, Uniformity of shape even, Nice firm solid onion, Firmness even, Run size uneven, Longer term storage onion.

Catskill: *Seminis sample*, Good to nice appearance, Good tight neck finish, Small to medium sized necks, Average skin thickness, Pretty good skin quality, Odd one with skin cracking, Exterior colour even, Odd one with greening on skins, Interior colour white or cream, Average interior blending, Dead centers white or yellow, Good packer, Uniformity of shape a little uneven, Good firm onion, Firmness even, Small to medium run size uneven, Mid-term storage onion.

SV NY 7331: *Seminis sample*, Good appearance, Good tight neck finish, Small to medium sized necks, Average skin thickness, Pretty good skin quality, Odd one with skin cracking, Odd one with skin or basel plate rot, Exterior colour a little uneven, Odd one with greening on skins, Interior colour white, Good interior blending, Dead centers colours mixed, Average to good packer, Uniformity of shape uneven, Average firmness, Firmness even, Medium run size uneven, Suspicion of doubles, Early to mid-term storage onion.

…/continued

ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 - continued

Traverse: *American Takii sample*, Nice appearance, Good tight neck finish, Neck finishes a little bit rough, Medium sized necks, Average skin thickness, Nice skin quality, Odd one with skin cracking, Exterior colour fairly even, Odd one with white spots on skins, Interior colour white, Good interior blending, Dead centers white, Good packer, Uniformity of shape a little uneven, Nice firm onion, Firmness even, Small to medium run size a little uneven, Mid to longer term storage onion.

Stanley: *Clifton sample*, Nice appearance, Average tight neck finish, Odd neck finishes a bit rough, Medium sized necks, Average to thicker skins, Nice skin quality, Exterior colour even, Odd one with white spots on skins, Interior colour white, Average interior blending, Dead centers yellow, Nice packer, Uniformity of shape uneven, Nice firm solid onion, Firmness even, Medium run size uneven, Longer term storage onion.

Scout: *Crookham sample*, Fair appearance, Good tight neck finish, A few neck finishes a bit rough, Medium sized necks, Thinner skins, Fair skin quality, A few with skin cracking, Odd one with skin rot, Exterior colour a little even, Odd one with greening on skins, Interior colour cream, Good interior blending, Dead centers colours mixed, Okay packer, Uniformity of shape uneven, Average firmness a little soft, Firmness a little uneven, Medium to large run size a little uneven, Odd one with mechanical damage, Early storage onion.

Venecia: *Bejo sample*, Nice appearance, Great tight neck finish, Small to medium sized necks, Thicker skins, Nice skin quality, Odd one with skin cracking, Exterior colour even, Odd one with white spots on skins, Interior colour cream, Average interior blending, Dead centers green, Good packer, Uniformity of shape even, Good firm onion, Firmness a little uneven, Medium run size uneven, Mid-term storage onion.

SV NY 1496: *Seminis sample*, Fair appearance, Great tight neck finish, Small sized necks, Thinner skins, Poor skin quality, A lot with skin cracking a concern, Exterior colour even, Some with greening on skins, Interior colour white or cream, Average interior blending, Dead centers white or yellow, Okay packer, Uniformity of shape very uneven, Average firmness, Firmness a little uneven, Small to medium run size uneven, Odd one with mechanical damage, Early term storage onion.

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ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 - continued

37 126: *Hazera sample*, Fair appearance, Average tight neck finish, Neck finishes a bit rough, Medium to large sized necks, Thicker skins, Pretty good skin quality, Odd one with skin or basel plate rot, Exterior colour a little uneven, Odd one with yellowing or greening on skins, Interior colour white or cream, Poor to average interior blending, Dead centers colours mixed, Average packer, Uniformity of shape a little uneven, Good firm onion, Firmness even, Medium to large run size uneven, Mid to longer term storage onion.

Trailblazer: *American Takii sample*, Good appearance, Good tight neck finish, Small sized necks, Average skin thickness, Pretty good skin quality, Odd one with skin cracking, Exterior colour even, Odd one with white spots or greening on skins, Interior colour cream, Poor to average interior blending, Dead centers green, Good packer, Uniformity of shape very uneven, Good firm solid onion, Firmness even, Run size uneven, Mid to longer term storage onion.

Thunderstone: *Hazera sample*, Good appearance, Average tight neck finish, Neck finishes a bit rough, Medium sized necks, Average skin thickness, Pretty good skin quality, Odd one with skin cracking, Exterior colour a little even, Interior colour cream, Average interior blending, Dead centers 70% white 30% green, Good packer, Uniformity of shape a little uneven, Average to good firmness, Firmness a little uneven, Medium run size uneven, Mid-term storage onion.

Sumo: *Clifton sample*, Average appearance, Good tight neck finish, Small to medium sized necks, Average skin thickness, Average skin quality, Odd one with skin cracking, Some with skin rot, Exterior colour even, Some with greening on skins, Interior colour white or cream, Average interior blending, Dead centers colours mixed, Average packer, Uniformity of shape a little even, Average firmness, Firmness a little uneven, Medium run size a little uneven, Early to mid-term storage onion.

37 120: *Seminova sample*, Average appearance, Average tight neck finish, Some neck finishes a bit rough, Medium sized
INICIUM necks, Average skin thickness, Average skin quality, Odd one with skin cracking, Exterior colour slightly uneven, Interior colour cream, Average interior blending, Dead centers 60% yellow 40% green, Average packer, Uniformity of shape uneven, Average to good firmness, Firmness even, Medium run size even, Mid-term storage onion.

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ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 - continued

Ridgeline: *American Takii sample*, Average appearance, Average tight neck finish, Odd neck finishes a bit rough, Neck sizes uneven, Thicker skins, Pretty good skin quality, Odd one with skin cracking, Exterior colour a little even, Odd one with white spots or greening on skins, Interior colour cream or white, Average interior blending, Dead centers white, Average packer, Uniformity of shape uneven, Good firm onion, Firmness even, Run size very uneven, Mid-term storage onion.

Haeckero: *Seminova sample*, Good appearance, Good tight neck finish, Small to medium sized necks, Thicker skins, Nice skin quality, Odd one with skin cracking, Exterior colour even, Odd one with greening on skins, Interior colour cream, Average interior blending, Dead centers white, Greening of rings 30%, Good packer, Uniformity of shape a little even, Nice firm solid onion, Firmness even, Small to medium run size uneven, Longer term storage onion.

INICIUM

Prefect: *Clifton sample*, Average appearance, Average tight neck finish, Neck finishes a bit rough, Medium sized necks, Average skin thickness, Average skin quality, Odd one with skin cracking, Exterior colour uneven, Some with greening on skins, Interior colour cream, Average interior blending, Dead centers white, Average packer, Uniformity of shape a little even, Good firm onion, Firmness even, Small to medium run size uneven, Mid-term storage onion.

Braddock: *Bejo sample*, Nice appearance, Good tight neck finish, Odd neck finishes a bit rough, Small to medium sized necks, Average to thicker skins, Nice skin quality, Exterior colour even, Odd one with greening on skins, Interior colour cream or white, Interior blending uneven, Dead centers white, Nice packer, Uniformity of shape uneven, Nice firm solid onion, Firmness even, Small to medium run size a little uneven, Longer term storage onion.

Sat 1: *Seminova sample*, Good appearance, Average tight neck finish, Small to medium sized necks, Average skin thickness, Skin quality a bit uneven, Odd one with skin cracking, Exterior colour a little uneven, Some with greening on skins, Interior colour cream, Average interior blending, Dead centers 70% white 30% green, Good packer, Uniformity of shape a little uneven, Good firm onion, Firmness even, Medium run size even, Mid-term storage onion.

…/continued

ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 - continued

Nogal: *Enza Zaden sample*, Fair appearance, Average tight neck finish, Odd neck finishes a bit rough and ripped, Medium to large sized necks, Thicker skins, Pretty good skin quality, Odd one with skin cracking, Odd one with skin rot, Dark exterior colour even, Odd one with white spots on skins, Interior colour cream, Average interior blending, Dead centers white, Okay packer, Uniformity of shape even, Nice firm solid onion Firmness even, Medium to large run size a little uneven, Longer term storage onion.

Mountaineer: *American Takii sample*, Good appearance, Average to good tight neck finish, Small to medium sized necks, Average skin thickness, Pretty good skin quality, A few with skin cracking, Exterior colour even, Some with greening on skins, Interior colour 60% white 40% green, Poor to average interior blending, Dead centers 60% white 40% green, Good packer, Uniformity of shape even, Average firmness, Firmness a little uneven, Small to medium run size uneven, Mid-term storage onion.

Safrane: *Bejo sample*, Nice appearance, Average tight neck finish, Odd neck finish a bit rough, Medium sized necks, Thicker skins, Nice skin quality, Exterior colour even, Odd one with greening on skins, Interior colour white, Average interior blending, Dead centers green, Good packer, Uniformity of shape uneven, Nice firm solid onion, Firmness even, Small to medium run size uneven, Longer term storage onion.

SV NY 7333: *Seminis sample*, Good to nice appearance, Good tight neck finish, Small to medium sized necks, Average skin thickness, Nice skin quality, Odd one with skin cracking, Odd one with neck or basel plate rot, Exterior colour even, Interor colour white, Good interior blending, Dead centers white, Good packer, Uniformity of shape very uneven, Good firm onion, Firmness even, Run sizes very uneven, Longer term storage onion.

Powell: *Bejo sample*, Good appearance, Average to good tight neck finish, Odd neck finishes a bit rough, Medium sized necks, Average to thicker skins, Nice skin quality, Exterior colour even, Odd one with yellowing or greening on skins, Interior colour cream or green, Average interior blending, Dead centers white or green, Good packer, Uniformity of shape uneven, Nice firm solid onion, Firmness uneven, Small run size uneven, Longer term storage onion.

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ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 - continued

Haeckero: *Hazera sample*, Good appearance, Average tight neck finish, Odd larger neck finishes a bit rough, Medium sized necks, Average skin thickness, Pretty good skin quality, Odd one with skin cracking, Some with basel plate rot, Exterior colour a little even, Odd one with greening on skins, Interior colour cream, Average interior blending, Dead centers white, Good packer, Uniformity of shape uneven, Nice firm solid onion, Firmness even, Small run size uneven, Longer term storage onion.

Patterson: *Bejo sample*, Good appearance, Average to good tight neck finish, Medium sized necks uneven, Thicker skins, Nice skin quality, Exterior colour even, Odd one with greening on skins, Interior colour cream, Average interior blending, Dead centers white, Good packer, Uniformity of shape a little uneven, Good firm solid onion, Firmness even, Small to medium run size, Longer term storage onion.

Saddleback: *Stokes sample*, Fair to average appearance, Good tight neck finish, Small to medium sized necks, Average skin thickness, Average skin quality, Odd one with skin cracking, Exterior colour a little uneven, Odd one with greening on skins, Interior colour cream, Average interior blending, Dead centers colours mixed, Average packer, Uniformity of shape a little uneven, Average firmness, Firmness a little uneven, Medium run size uneven, Early to mid-term storage onion.

Mondella: *Bejo sample*, Good appearance, Average tight neck finish, Medium sized necks, Average to thicker skins, Pretty good skin quality, Odd one with skin cracking, Exterior colour even, Some with greening on skins, Interior colour white, Good interior blending, Dead centers white or green, Nice packer, Uniformity of shape a little even, Nice firm solid onion, Firmness even, Small to medium run size uneven, Longer term storage onion.

Prelesco: *Hazera sample*, Average appearance, Average tight neck finish, Odd neck finishes a bit rough, Small to medium sized necks, Average skin thickness, Average skin quality, A few with skin cracking, Exterior colour uneven, Some with greening on skins, Interior colour 60% cream 40% green, Poor to average interior blending, Dead centers white, A few with greening of rings, Okay packer, Uniformity of shape uneven, Average firmness, Firmness a little uneven, Run size uneven, Mid-term storage onion.

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ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 - continued

Elyse: *Enza Zaden sample*, Poor appearance, Great tight neck finish, Small sized necks, Thinner skins, Poor skin quality, Most with skin cracking a big concern, Skin rot a concern, Lighter exterior colour even, A lot with greening on skins, Interior colour white, Average interior blending, Dead centers yellow, Poor to okay packer, Uniformity of shape even, Poor firmness, Softer onion, Firmness uneven, Medium run size a little uneven, Suspicion of doubles, Odd one with mechanical damage, Early storage onion.

Trident: *Crookham sample*, Average appearance, Average tight neck finish, Some neck finishes a bit rough, Medium to large sized necks, Average skin thickness, Pretty good skin quality, Odd one with skin cracking, Exterior colour a little even, Odd one with greening on skins, Interior colour white, Average interior blending, Dead centers colour mixed, Average packer, Uniformity of shape uneven, Good firm onion, Firmness even, Run size very uneven, Mid-term storage onion.

Scorpion: *Crookham sample*, Good appearance, Average tight neck finish, Small to medium sized necks, Average to thicker skins, Nice skin quality, Exterior colour very even, Odd one with greening on skins, Interior colour mixed, Interior blending uneven, Dead centers colours mixed, Nice packer, Uniformity of shape uneven, Good firm onion, Firmness a little uneven, Small to medium run size uneven, Mid-term storage onion.

Frontier: *American Takii sample*, Good appearance, Good tight neck finish, Small to medium sized necks, Average to thicker skins, Pretty good skin quality, Exterior colour a little uneven, A few with greening on skins, Interior colour cream, Average interior blending, Dead centers colours mixed, Good packer, Uniformity of shape alittle even, Good firm onion, Firmness even, Small to medium run size a little uneven, Mid-term storage onion.

E61L 10240: *Enza Zaden sample*, Fair appearance, Average tight neck finish, Neck finishes rough and ripped, Medium sized necks, Average to thicker skins, Average to pretty good skin quality, A few with skin cracking, Odd one with skin or basel plate rot, Exterior colour uneven, Interior colour cream, Interior blending a little poor, Dead centers white, Average packer, Uniformity of shape even, Good firm solid onion Firmness a little uneven, Medium to large run size a little uneven, Double are an issue and concern, Longer term storage onion.

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ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 - continued

37 118: *Seminova sample*, Average appearance, Average tight neck finish, Neck finishes a bit rough, Medium sized necks, Average to thicker skins, Pretty good skin quality, Odd one with skin cracking, Odd one with basal plate or skin rot, Exterior colour even, Odd one with greening on skins, Interior colour cream a little uneven, Average interior blending, Dead centers white, Average packer, Uniformity of shape uneven, Average firmness, Firmness even, Small to medium run size a little uneven, Suspicion of doubles, Mid-term storage onion.

Dawson: *Bejo sample*, Nice appearance, Good tight neck finish, Small to medium sized necks, Average skin thickness, Nice skin quality, Slightly dark exterior colour even, Odd one with white spots on skins, Interior colour cream, Good interior blending, Dead centers white, Nice packer, Uniformity of shape a little uneven, Nice firm solid onion, Firmness even, Small run size, Longer term storage onion.

Y 604: *Seminova sample*, Fair to average appearance, Average tight neck finish, Small to medium sized necks, Average skin thickness, Pretty good skin quality, A few with skin cracking, Odd one with skin rot, Exterior colour slightly even, Some with white spots on skins, Interior colour cream, Average interior blending, Dead centers white, Average packer, Uniformity of shape a little uneven, Good firm onion, Firmness even, Run size very uneven, Mid-term storage onion.

Outlander: *Stokes sample*, Fair appearance, Great tight neck finish, Small sized necks, Thinner skins, Poor skin quality, Most with skin cracking a concern, Skin rot, Exterior colour even, Some with greening on the skins, Interior colour white, Average interior blending, Dead centers colours mixed, Okay packer, Uniformity of shape a little even, Average firmness, Firmness a little uneven, Small run size uneven, Suspicion of doubles concern, Odd one with mechanical damage, Early term storage onion.

Caesar: *Clifton sample*, Average appearance, Good tight neck finish, Small to medium sized necks, Average skin thickness, Average skin quality, Odd one with skin cracking, Basel plate rot, Exterior colour uneven, Odd one with greening on skins, Interior colour white, Average interior blending, Dead centers white or green, Average packer, Uniformity of shape uneven, Nice firm solid onion, Firmness even, Small to medium run size very uneven, Longer term storage onion.

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ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 - continued

Oneida: *Bejo sample*, Nice appearance, Good tight neck finish, Small to medium sized necks, Average skin thickness, Nice skin quality, Odd one with skin cracking, Exterior colour a little uneven, Odd one with white spots on skins, Interior colour white, Average interior blending, Dead centers green, Nice packer, Uniformity of shape a little uneven, Average to good firm onion, Firmness even, Run size very uneven, Mid-term storage onion.

Highlander: *Stokes sample*, Fair appearance, Great tight neck finish, Small sized necks, Thinner skins, Poor to fair skin quality, Most with skin cracking a concern, Odd one with skin rot, Exterior colour even, A lot with greening on skins, Interior colour white, Average interior blending, Dead centers yellow, Okay packer, Uniformity of shape uneven, Softer onion, Firmness a little uneven, Medium to large run size uneven, Suspicion of doubles a concern , Early storage onion.

ONION CULTIVAR ADAPTATION TRIAL - 2021

Cultivar	Source	# Bulbs Harvested	# Bulbs Jumbos > 89 mm	# Bulbs Lrg 89 - 76 mm	# Bulbs Med 76 - 64 mm	# Bulbs Small 64 - 32 mm	Total Harvest Weight (kg)	Wgt. Jumbo > 89 mm (kg)	Wgt. Large 89 - 76 mm (kg)	Wgt. Medium 76-64 mm (kg)	Wgt. Small 64-32 mm (kg)	Marketable Yield bu/A	% Marketable
E61D 10752	EZ	99	2	14	27	38	13.01	0.74	3.32	4.66	3.58	928	81.8

		Shape	Uniformity of Shape	Uniformity of Size	Skin Thickness	Skin Attachment	Neck Finish	Overall Score	Firmness at Evaluation	Interior Colour	Exterior Colour	Exterior Colour Rating	Score	% Jumbo > 76 mm
E61D 10752	EZ	TD	6.0	5.0	6.0	6.0	8.0	5.0	6.0	W	LG	7.0	6.13	14.1

10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

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ONION CULTIVAR ADAPTATION TRIAL - 2021 - continued

Cultivar	Source	Seeders	Majority of Culls	Stand/Foot	Average Weight/Bulb (g)	Days to Harvest	% Onion Maggot Damage	% Single Centers	% Double Centers	% Multiple Centers	% Hollowness in Centers	Top Height (cm)	Leaf Shape	Leaf Colour
E61D 10752	EZ	1.0	PW	6.5	131.4	113	0.0	10	90	0	10	47.6	B	G

ONION CULTIVAR ADAPATION TRIAL EVALUATION NOTES – 2021

E61D 10752: *Enza Zaden sample* , Poor appearance, Good tight neck finish, Small to medium sized necks, Thinner skins, Poor to fair skin quality, A lot with skin cracking a concern, Exterior colour even, A lot with greening on skins, Interior color white, Average interior blending, Dead centers green, Okay packer, Uniformity of shape a little uneven, Average firmness, Firmness a little uneven, Small to medium run size uneven, Some of the basel plates have slightly popped, Early term storage onion.

LONG TERM AVERAGES OF ONION CULTIVAR TRIALS

Cultivar	Source	# Years Evaluated	Yield bu/A	% Marketable	% Jumbos <3"	Days to Maturity	Firmness In*	Firmness out*	Neck Finish	Score	% Onion Maggot Damage	# of Seeders	Leaf Length (cm)
HIGHLANDER	Tak	17	1018	85.5	13.4	93	8.5	6.0	9.3	6.23	3.6	0.0	56
ALPINE	Tak	11	1035	89.6	14.4	95	8.5	5.9	9.6	6.24	4.9	0.0	58
TREKKER	Tak	11	1084	92.9	8.8	100	9.8	8.3	7.5	7.51	3.3	0.0	61
NORSTAR	Tak	28	1079	91.2	12.5	102	8.2	5.9	8.6	6.34	4.2	0.0	59
SADDLEBACK	Sem	6	1177	92.0	19.8	105	9.6	7.1	7.4	6.55	3.0	0.2	72
LA SALLE	Sem	12	1152	92.6	15.0	105	9.4	7.6	7.3	6.75	6.5	0.3	65
RICOCHET	Sem	9	1134	96.8	30.5	105	9.6	8.0	7.5	7.11	7.8	0.5	64
ARSENAL	Sem	13	1232	97.6	15.0	106	9.6	8.1	7.6	7.16	5.2	1.7	64
FRONTIER	Tak	28	1117	93.1	9.4	106	9.8	8.1	8.0	7.57	4.2	0.0	63
TRAILBLAZER	Tak	14	1047	91.9	15.9	106	9.8	8.3	7.9	7.43	4.3	0.0	63
RIDGELINE	Tak	6	1250	93.3	20.9	107	9.9	7.6	7.2	6.91	3.1	0.0	64
MOUNTAINEER	Tak	10	1044	96.0	19.3	107	9.5	8.2	7.9	7.62	5.6	0.0	61
TRAVERSE	Tak	6	1180	94.6	12.2	108	9.5	8.1	7.4	7.47	2.7	0.0	66
CATSKILL	Sem	7	1191	92.8	18.7	108	9.7	7.3	7.3	6.77	5.8	0.0	68
CORONA	Bejo	23	1230	86.6	20.0	108	9.5	7.1	7.1	6.26	5.8	0.0	65

Listed in order of Days to Maturity. * 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

* Firmness: A = Evaluated at time of Harvest B = Evaluated in December

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LONG TERM AVERAGES OF ONION CULTIVAR TRIALS - continued

Cultivar	Source	# Years Evaluated	Yield bu/A	% Marketable	% Jumbos <3"	Days to Maturity	Firmness In*	Firmness out*	Neck Finish	Score	% Onion Maggot Damage	# of Seeders	Leaf Length (cm)
PATTERSON	Bejo	15	1181	93.7	13.6	108	9.8	8.7	6.9	7.43	5.7	0.7	67
TAHOE	Bejo	9	1214	95.0	20.0	108	9.6	8.2	7.1	7.32	6.5	1.9	66
BRADDOCK	Bejo	14	1257	91.0	16.3	110	9.6	7.7	6.6	6.88	2.6	0.5	67
DAWSON	Bejo	6	895	84.5	11.5	111	9.8	7.8	7.4	6.93	7.5	0.0	61
CHAMP	CF	7	1167	92.4	15.6	111	9.9	8.7	7.2	7.57	10.0	0.0	68
MILESTONE	Tak	20	1340	96.0	24.2	111	9.6	7.5	6.7	7.18	4.6	0.1	65
POCONO	Sem	7	1225	92.1	20.9	111	9.7	7.7	6.9	6.65	7.1	0.0	70
STANLEY	CF	23	1193	92.4	17.5	111	9.9	8.5	6.5	7.13	4.5	0.9	66
FORTRESS	Sem	28	1078	95.4	9.2	112	9.7	7.9	6.8	7.35	3.7	1.2	65
HAMLET	Sem	23	1230	94.1	13.3	112	9.8	8.1	7.1	7.19	8.1	0.2	65
LIVINGSTON	Sol	14	1132	95.3	12.1	112	9.7	8.3	6.5	7.07	5.5	0.3	64
TALON	Bejo	7	1192	96.7	14.9	112	9.6	8.7	6.9	7.42	4.8	1.7	66
SAFRANE	Bejo	16	1253	93.3	20.1	113	9.8	8.6	6.7	7.22	3.3	2.6	66
PRINCE	Bejo	24	1233	93.6	22.2	115	9.8	8.6	6.2	7.20	5.4	0.4	66
CROCKETT	Bejo	10	1256	92.1	19.0	118	9.9	8.7	5.3	7.11	5.7	1.3	72

Listed in order of Days to Maturity. * 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

* Firmness: A = Evaluated at time of Harvest B = Evaluated in December

MAIN ONION STORAGE TRIAL 2020 - 2021

Cultivar	Source	% Marketable	% Weight Loss	% Sprouts	% Rot	% Soft	Firmness In **	Firmness Out **	% Sprouting at Base	% Sprouting at Top
HAECKARO	Haz	88.7 a*	6.6 f-j	3.3 ab	0.8 c-f	0.0 c	10.0 a	7.8 a-d	1.3 ab	1.3 ef
FRONTIER	Tak	88.0 a	6.3 c-g	3.9 bcd	1.0 c-g	0.0 c	10.0 a	7.7 a-d	2.0 bcd	4.0 ef
TREKKER	Tak	88.0 a	6.6 e-i	1.2 a	3.3 efg	0.1 c	10.0 a	7.5 a-e	0.5 a	0.3 a
SAT 1	SN	87.9 a	5.2 a	4.5 c-f	1.7 d-g	0.0 bc	10.0 a	7.3 b-e	3.7 d-g	0.7 cde
SAFRANE	Bejo	87.3 a	5.7 a-d	5.7 d-g	0.7 bcd	0.0 bc	10.0 a	8.3 a	4.3 e-h	1.0 ef
STANLEY	CF	87.1 ab	5.6 abc	5.6 c-f	1.0 d-g	0.0 bc	10.0 a	7.7 a-d	3.7 d-g	0.3 c
CARTIER	Bejo	86.9 abc	6.8 g-j	4.3 cde	1.3 d-g	0.0 c	10.0 a	8.2 ab	1.8 abc	3.0 ef
TRAILBLAZER	Tak	85.5 abc	5.8 bcd	6.2 d-g	1.8 d-g	0.0 ab	10.0 a	8.0 abc	4.0 e-h	1.0 def
MILESTONE	Tak	85.3 abc	6.4 d-h	3.7 abc	3.7 efg	0.0 c	10.0 a	6.2 ghi	2.0 bcd	1.7 ef
FORTRESS	Sto	85.0 abc	7.8 h-k	4.0 bcd	2.3 d-g	0.1 c	10.0 a	7.3 b-e	3.0 def	0.7 def
POCONO	Sto	83.3 abc	5.6 ab	9.8 e-h	0.7 b-e	0.0 bc	10.0 a	7.7 a-d	5.0 e-h	2.3 ef
PATTERSON	Bejo	79.1 a-d	6.8 f-j	10.6 f-i	2.7 d-g	0.0 bc	10.0 a	7.7 a-d	8.3 fgh	0.7 def
ARMSTRONG	CF	79.1 a-d	6.8 g-k	12.9 hi	0.4 ab	0.0 c	10.0 a	7.0 d-g	12.0 gh	0.3 cd
BRANDIT	Sto	78.4 a-d	7.4 g-k	9.9 e-i	3.2 d-g	0.4 c	10.0 a	6.0 hi	10.0 gh	3.0 ef
BRADDOCK	Bejo	77.9 a-d	6.8 f-j	12.9 hi	1.9 d-g	0.0 c	9.8 a	7.2 c-f	9.0 gh	4.0 f
CATSKILL	Sem	76.9 a-d	6.6 e-i	11.3 ghi	4.3 fg	0.2 c	9.7 ab	7.5 a-e	8.0 e-h	3.3 ef
SV NY 1496	Sem	75.4 a-d	6.0 cde	9.9 f-i	7.1 fg	0.9 c	9.3 bc	6.2 ghi	2.5 cde	4.0 f
SADDLEBACK	Sto	73.5 a-e	6.3 c-f	12.2 hi	6.2 fg	1.4 c	9.8 a	5.7 i	8.3 fgh	3.2 ef

Listed in Order of Percent Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05 Fisher's Protected LSD Test.

** 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

.../continued

MAIN ONION STORAGE TRIAL 2020 - 2021

Cultivar	Source	% Marketable	% Weight Loss	% Sprouts	% Rot	% Soft	Firmness In **	Firmness Out **	% Sprouting at Base	% Sprouting at Top
TRAVERSE	Tak	71.9 a-f*	8.0 h-k	16.6 hi	2.8 d-g	0.0 a	9.8 a	7.0 d-g	10.3 gh	0.3 b
RIDGE LINE	Tak	69.6 a-g	7.0 g-k	19.1 hi	3.6 efg	0.0 bc	10.0 a	6.3 f-i	14.0 gh	3.0 ef
Y 604	SN	67.1 b-g	6.5 e-i	20.6 hi	5.2 fg	0.0 a	9.8 a	7.0 d-g	15.0 h	6.0 f
SV NY 1141	Sem	66.8 c-g	6.7 f-j	23.5 hi	2.4 d-g	0.2 c	10.0 a	6.3 f-i	16.7 h	10.3 f
NOGAL	EZ	59.6 d-g	10.2 jk	19.4 hi	10.2 fg	0.0 c	9.2 c	7.0 d-g	13.3 gh	2.7 ef
ONEIDA	Bejo	55.0 e-h	6.4 e-i	34.4 hi	3.1 d-g	0.0 c	9.7 ab	6.7 e-h	35.7 h	21.0 f
CHAMP	CF	52.1 fgh	7.5 h-k	39.5 hi	0.3 a	0.2 c	10.0 a	7.0 d-g	39.3 h	2.3 ef
37-120	Haz	50.6 gh	9.1 jk	34.4 hi	5.4 fg	0.0 c	9.8 a	6.0 hi	35.0 h	6.7 f
CROCKETT	Bejo	50.5 gh	7.4 g-k	41.0 hi	0.6 abc	0.0 c	10.0 a	8.0 abc	23.3 h	25.7 f
31-121	Haz	50.1 gh	7.3 g-k	40.1 hi	2.1 d-g	0.0 c	10.0 a	7.3 b-e	41.7 h	8.3 f
37-118	Haz	38.7 h	8.3 ijk	48.9 hi	3.6 efg	0.0 c	10.0 a	6.2 ghi	56.7 h	30.0 f
MONDELLA	Bejo	37.9 h	8.6 ijk	51.2 hi	1.7 d-g	0.0 c	10.0 a	6.3 f-i	58.3 h	6.0 f
HIGHLANDER	Tak	15.4 i	9.6 jk	59.7 hi	13.3 g	1.6 c	9.0 c	4.3 j	78.3 h	70.0 f
OUTLANDER	Tak	12.0 i	9.3 jk	74.1 i	3.8 fg	0.5 c	9.3 bc	4.7 j	95.0 h	91.7 f
ALMAGRO	Bejo	9.7 i	10.8 k	68.5 hi	10.7 fg	0.0 c	9.3 bc	6.2 ghi	67.3 h	10.0 f
TRIAL AVERAGE		**66.7**	**7.2**	**21.9**	**3.4**	**0.2**	**9.8**	**6.9**	**20.9**	**10.0**

Listed in Order of Percent Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05 Fisher's Protected LSD Test.

** 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

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ONION CULTIVAR STORAGE TRIAL EVALUATION NOTES - 2020-2021

Haeckero: *Hazera sample,* Top sprouts just starting to light 0-2.5 cm, Root sprouts just starting 0-1 cm, Internal or skin rot, Basal plates just starting to push out 10-30%, Fairly firmness, Late storage onion, Stored nice to excellent.

Frontier: *American Takii sample,* Top sprouts just starting to light 0-2.5 cm, Root sprouts just starting 0-1 cm, Majority skin rot, Odd internal rot, Basal plates just starting to push out 10-20%, Firm onion, Late storage onion, Stored excellent.

Trekker: *American Takii sample,* Top & root sprouts just starting 0-1 cm, Majority skin rot, Odd internal rot, Basal plates just starting to push out 5-10%, Firm onion, Firmness slightly uneven, Late storage onion, Stored excellent.

Sat 1: *Seminova sample,* Top & root sprouts just starting 1-0 cm, All skin rot, Basal plates just starting to push out 5-40%, Fairly firm, Firmness slightly uneven, Mid to late storage onion, Stored nice.

Safrane: *Bejo sample,* Root sprouts just starting 0-1 cm, All skin rot, Basal plates just starting to push out 5-20%, Fairly firm onion, Late storage onion, Stored nice.

Stanley: *Clifton sample,* Root sprouts just starting 0-1 cm, Majority skin rot, Some internal rot, Basal plates just starting to push out 5-10%, Firm onion, Firmness slightly uneven, Mid to late storage onion, Stored nice.

Cartier: *Bejo sample,* Top sprouts just starting to light 0-5 cm, Root sprouts just starting 0-1 cm, Internal or skin rot, Basal plates just starting to push out 5-15%, Firm onion, Mid to late storage onion, Stored excellent.

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ONION CULTIVAR STORAGE TRIAL EVALUATION NOTES - 2020-2021 -- continued

Trailblazer: *American Takii sample,* Top sprouts just starting to moderate 0-2.5 cm, Root sprouts just starting 0-1 cm, Internal & skin rot, Basal plates just starting to push out 5-30%, Firm onion, Late storage onion, Stored excellent.

Milestone: *American Takii sample,* Top sprouts just starting to light 0-2.5 cm, Root sprouts just starting 0-1 cm, Majority skin rot, Some internal rot, Basal plates just starting to push out 30-70%, Firmness okay, Firmness uneven, Mid-term storage onion, Stored good.

Fortress: *Stokes sample,* Top & root sprouts just starting 0-1 cm, Majority skin rot, Odd internal rot, Basal plates just starting 10-20%, Fairly firm onion, Firmness slightly uneven, Mid to late storage onion, Stored nice.

Pocono: *Stokes sample,* Top & roots sprouts just starting to light 0-2.5 cm, All skin rot, Basal plates just starting & pushing out 10-45%, Fairly firm, Firmness slightly uneven, Mid to late storage onion, Stored nice.

Patterson: *Bejo sample,* Top & root sprouts just starting to light 0-2.5 cm, Majority skin rot, Some internal rot, Basal plates just starting & pushing out 25-70%, Firm onion, Firmness slightly uneven, Mid to late storage onion, Stored good.

Armstrong: *Clifton sample,* A few top sprouts light 1-2.5 cm, Root sprouts just starting to light 0-1 cm, All skin rot, Basal plates just starting & pushing out 40-60%, Fairly firm onion, Firmness uneven, Mid-term storage onion, Stored good.

Brandt: *Stokes sample,* Top sprouts just starting to moderate 0-5cm, Top sprouts uneven, Root sprouts just starting to light 0-2.5 cm, Majority skin rot, Some internal rot, Basal plates pushing out 70-85%, Firmness okay, Early to mid storage onion, Stored okay.

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ONION CULTIVAR STORAGE TRIAL EVALUATION NOTES - 2020-2021 -- continued

Braddock: *Bejo sample,* Top & root sprouts just starting 0-1 cm, Majority skin rot, Odd internal rot, Basal plates just starting to push out 20-40%, Fairly firm onion, Mid to late storage onion, Stored good to nice.

Catskill: *Seminis sample,* Top sprouts just starting to moderate 0-2.5 cm, Root sprouts just starting 0-1 cm, Majority skin rot, Odd internal rot, Basal plates just starting & pushing out 30-65%, Okay firmness, Firmness uneven, Mid storage onion, Stored good.

SV NY 1496: *Seminis sample,* Top sprouts just starting to moderate 0-2.5 cm, Root sprouts just starting 0-1 cm, Majority internal rot, Some skin rot, Basal plates just starting or pushing out 40-90%, Firmness okay, Firmness uneven, Early to mid storage onion, Stored fair to okay.

Saddleback: *Stokes sample,* Top & root sprouts just starting to light 0-2.5 cm, Majority skin rot, Odd internal rot, Basal plates just starting 25-40%, Firmness slightly soft, Firmness slightly uneven, Early to mid storage onion, Stored fair.

Traverse: *Seminova sample,* Root sprouts just starting 0- 1 cm, Majority skin rot, Odd internal rot, Basal plates just starting & pushing out 40-60%, Fairly firm, Mid-term storage onion, Stored good.

Ridgeline: *American Takii sample,* Top & root sprouts just starting 0-1 cm, All skin rot, Basal plates just starting to push out 10-40%, Firmness okay, Mid-term storage onion, Stored okay.

Y 601: *Seminova sample,* Top sprouts light 1-2.5 cm, Root sprouts just starting 0-1 cm, Majority skin rot, Odd internal rot, Basal plates just starting 20-30%, Firmness okay, Mid-term storage onion, Stored good.

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ONION CULTIVAR STORAGE TRIAL EVALUATION NOTES - 2020-2021 -- continued

SV NY 1141: *Seminis sample,* Top sprouts just starting to light 0-1 cm, Root sprouts just starting 0-1 cm, Majority skin rot, Odd internal rot, Basal plates just starting to push out 20-25%, Firmness okay, Firmness slightly uneven, Early to mid storage onion, Stored fair.

Nogal: *Enza Zaden sample,* Top & root sprouts just starting 0-1 cm, Majority skin rot, Odd internal rot, Basal plates just starting to push out 5-35%, fairly firm, Firmness slightly uneven, Mid to late storage onion, Stored a little poor, Some botrytis on surface of skins, Necks rough.

Oneida: *Bejo sample,* Top & root sprouts just starting to light 0-2.5 cm, Mostly skin rot, Odd internal rot, Basal plates just starting to push out 10-30%, Firmness okay, Mid storage onion, Stored fair to good.

Champ: *Clifton sample,* Top sprouts just starting 0-1 cm, Root sprouts just starting to moderate 0-2.5 cm, Skin or internal rot, Basal plates just starting to push out 20-50%, Firm onion, Firmness slightly uneven, Mid-term storage onion, Stored good.

37 120: *Hazera sample,* Top & root sprouts just starting to moderate 0-2.5 cm, Majority skin rot, Some internal rot, Basal plates just starting to pushing out 40-70%, Firmness okay, Firmness uneven, Early to mid storage onion, Stored okay.

Crockett: *Bejo sample,* Root sprouts just starting to light 0-2.5 cm, Majority skin rot, Some internal rot, Basal plates just starting & pushing out 40-90%, Firm onion, Late storage onion, Stored good.

.../continued

ONION CULTIVAR STORAGE TRIAL EVALUATION NOTES - 2020-2021 -- continued

37 121: *Hazera sample,* Top & root sprouts just starting 0-1 cm, Majority skin rot, Odd internal rot, Basal plates just starting to pushing out 20-60%, Firmness okay, Firmness uneven, Mid-term storage onion, Stored fair to good.

37 118: *Hazera sample,* Top sprouts light to moderate1-2.5 cm, Root sprouts just starting to moderate 0-2.5 cm, Root spouts a concern, Skin or internal rot, Basal plates pushing out 50-60%, Firmness okay, Early to mid-term storage onion, Stored a little poor.

Mondella: *Bejo sample,* Top sprouts just starting 0-1 cm, Root sprouts just starting to light 0-2.5 cm, Internal & skin rot, Basal plates pushing out 60-80%, Firmness okay, Early to mid storage onion, Stored a little poor to fair.

Highlander: *American Takii sample,* Top sprouts moderate to heavy 1-5 cm, Top sprouts uneven, Root sprouts light to moderate 1-2.5 cm, Sprouting is a concern, Majority skin rot, Odd internal rot, Basal plates pushing out 70-80%, Firmness soft, Early storage onion, Not a storage onion, Stored poor.

Outlander: *American Takii sample,* Top sprouts moderate 1-2.5 cm, Root sprouts just starting to light 0-2.5 cm, Majority skin rot, Odd internal rot, Basal plates just starting to push out 20-40%, Soft onion, Early storage onion, Stored poor.

Almagro: *Bejo sample,* Top & root sprouts just starting to light 0-2.5 cm, Root sprout a concern, Majority skin rot, A few internal rot, Basal plates just starting or pushing out 20-75%, Early to mid storage onion, Stored poor, A lot of botrytis on skins.

Check out the Muck Crops Research Station's IPM Twitter Account

The Muck Crops Research Station launched a Twitter account in 2014. The account communicates brief updates of the Station's IPM program along with other information to our growers, industry reps and academic personnel. The tweets consist of important pest alerts, reminders of up and coming events and other information that we hope will be helpful to our followers. So take some time, follow us and stay informed.

@MuckIPM

twitter

LONG TERM AVERAGES OF ONION STORAGE TRIALS

CULTIVAR	SOURCE	# YEARS TESTED	% MARKETABLE	% WT LOSS IN STORAGE	% ROT, SOFT & SPROUT	FIRMNESS * IN	FIRMNESS * OUT
INFINITY	BCSVS	9	84.6	5.9	8.3	9.68	6.68
CANADA MAPLE	Sto	9	83.3	8.3	8.3	NA	7.40
TRAILBLAZER	Tak	13	83.1	5.2	10.9	9.75	7.58
TAURUS	Sem	9	82.9	7.3	9.8	NA	5.85
MILLENNIUM	BCSVS	8	82.8	6.6	10.5	4.95	6.85
TAHOE	Bejo	9	82.8	5.0	11.9	9.70	7.68
LA SALLE	Sem	11	82.7	6.3	10.8	9.37	6.56
PATTERSON	Bejo	13	81.9	5.9	11.4	9.84	7.61
SCORPION	Cro	5	81.1	6.4	13.6	9.76	7.36
PULSAR	BCSVS	7	80.7	5.6	12.9	9.29	7.00
TRAPPS #8	E.J.	9	79.9	8.9	11.3	NA	6.35
STANLEY	Sol	22	79.2	6.8	13.4	9.85	7.23
TREKKER	Tak	11	79.1	7.0	13.2	9.88	6.64
HAMLET	Sem	25	78.1	7.4	15.2	9.60	6.46
NEBULA	Nun	8	77.2	5.8	16.3	9.60	7.40
BRADDOCK	Bejo	16	76.3	6.4	16.9	9.52	6.77
SAFRANE	Bejo	14	76.2	6.5	16.4	9.79	7.35
CHAMP	Sol	7	76.1	5.8	17.4	9.91	7.51
LIVINGSTON	Sol	13	76.1	6.9	13.8	9.70	6.90
FORTRESS	Sem	27	75.9	8.1	16.0	9.59	6.90

Listed in order of % Marketable. Storage period approximately 11 months.

* 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

LONG TERM AVERAGES OF ONION STORAGE TRIALS - continued

CULTIVAR	SOURCE	# YEARS TESTED	% MARKETABLE	% WT LOSS IN STORAGE	% ROT, SOFT & SPROUT	FIRMNESS * IN	FIRMNESS * OUT
ARSENAL	Sem	13	74.7	7.0	18.7	9.65	6.02
POCONO	Sem	7	74.7	6.4	18.0	9.66	6.66
PRINCE	Bejo	24	73.9	8.9	17.9	9.70	6.92
MOUNTAINEER	Tak	9	73.8	5.8	20.1	9.31	6.69
PARAGON	BCSVS	10	73.5	11.2	17.1	9.00	6.90
TAMARA	Bejo	9	71.9	9.9	21.8	9.85	6.75
MILESTONE	Tak	19	71.9	6.3	21.0	9.57	5.84
TARMAGON	Sto	6	70.5	10.1	19.1	8.25	5.25
BENCHMARK	Sem	5	70.5	12.8	21.3	9.45	6.91
CATSKILL	Sem	6	70.5	6.5	22.6	9.67	6.22
TRAVERSE	Tak	5	69.8	7.0	22.4	9.46	6.62
FRONTIER	Tak	26	69.2	7.6	24.0	9.83	7.11
CROCKETT	Bejo	9	68.5	7.4	23.3	9.89	7.62
SADDLEBACK	Sem	5	66.0	6.2	27.2	9.58	5.90
RIDGE LINE	Tak	5	65.8	6.4	26.9	9.82	5.84
ADVANCER	HM	11	65.5	11.0	26.6	8.30	4.00
HUSTLER	HM	11	64.1	9.9	27.8	8.00	5.30
RICOCHET	Sem	9	58.0	6.1	33.9	9.60	5.93
CORONA	Bejo	23	55.4	9.6	37.0	9.47	5.56
NORSTAR	Tak	28	51.7	9.8	40.1	8.26	4.71

Listed in order of % Marketable. Storage period approximately 11 months.

* 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

RED ONION CULTIVAR TRIAL SEASON SUMMARY – 2021

Favourable weather conditions in April allowed the ground frost to thaw and by the end of April the soil was satisfactory for transplanting onions. Onion transplanting in the Holland Marsh began mid-April and was pretty much completed by 10 May. Compared to the previous 10-year average, air temperatures in 2021 were above average for June (21.1°C) and August (22.2°C), average for September (15.8°C) and below average for May (12.6°C) and July (19.7°C). The 10-year average temperatures were: May 13.9°C, June 18.6°C, July 21.7°C, August 20.2°C and September 16.4°C. Monthly rainfall was above the 10-year average for July (105 mm) and September (173 mm) and below average for May (22 mm), June (56 mm) and August (41 mm). The 10-year rainfall averages were: May 71 mm, June 94 mm, July 75 mm, August 83 mm and September 59 mm.

The red cultivar trial was seeded, two seeds/cell, into 288-cell plug trays filled with ASB soilless mix on 24 March. The trays were placed on ebb & flow benches in the greenhouse with the daytime temperature set at 65°F and nighttime temperature set at 68°F. The onion plants were clipped regularly to a height of 8 cm to promote sturdy plants. On 7 May the transplants were placed outside on a wagon to harden off. Day time temperatures were seasonal (low teens °C) but nighttime temperatures were below seasonal near 1°C. Soil moisture conditions were satisfactory, even though April was below average in precipitation, at transplant. Air temperatures were seasonal, with a mix of sun and cloud the first 12 days of May. The month of May recorded below average rainfall and irrigation was applied to maintain adequate soil moisture. The onions were transplanted on 11 and 12 May which was 5 days later than would be standard. For onion maggot control a drench of Pyrinex 480 EC at 2.5 mL/5 L water per six meters of row was applied on 7 May.

For the first two weeks after transplanting, daytime air temperatures fluctuated from the mid-twenties to the high twenties and nighttime air temperatures were below seasonal and fluctuated from 0 - 17°C. Even with these cool night temperatures the transplants established well and plant vigor was satisfactory. By 27 May, root growth was extending outside the plug zone and the herbicide Prowl was applied at the recommended rate. There were no heavy weed flushes in May or June due to the dry conditions. One application of Goal + Pardner was applied on 12 July to clean up a small weed flush that occurred approximately one week after a significant rainfall. The trial was quickly hand-weeded several times to keep it free of weeds. For the months of May and June, onion growth was steady but slightly unsatisfactory and leaf size and density were less than expected. The onions did have a growth spurt after some significant rainfall events in early July.

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RED ONION CULTIVAR TRIAL SEASON SUMMARY - 2021 – continued

On-station monitoring for onion maggot fly emergence began early with the first flies detected on 19 May. There were three peaks in onion maggot fly numbers during the monitoring period. Counts peaked at 5.1 flies/trap/day on 17 June, 2.6 flies/trap/day on 8 July and 3.3 flies/trap/day on 5 Aug. After the third peak, onion maggot fly numbers never reached over 2 flies/trap/day. The 2021 season had a low onion maggot population, and the first generation was extended over 3 weeks however the population was below 4 flies/trap/day. Thrips were first found on 17 June and were present through August. Onion thrips numbers in the variety trial reached a high of 3.0 thrips/leaf on 3 Aug. Several timely insecticide applications throughout the season lowered the thrips numbers below threshold. Environmental conditions were favourable for fungal diseases to develop throughout the season. Stemphylium leaf blight was found in the cultivar trial on 5 July and several fungicide applications (see Onion Management Procedures) kept severity to a minimum. Botrytis was observed in the trial on 22 July. Fungicide applications were applied to control the botrytis, and to protect from downy mildew. A couple of random onions with bacterial rot were found in the variety trial.

Bulb development started in mid-July with most bulb sizing occurring in late July. Cultivars Rubillion and SV NT 1298 were the first to lodge starting on 21 July. By 11 August, two thirds of the cultivars had reached full maturity with at least 85% lodged. The average days to harvest for the 2021 season was 93 days from transplant. This was fifteen days later than in 2020, but comparable to the 2019 season. The third replicate of onions matured sooner than the first replicate but not significantly. The onion tops dried down in a satisfactory time frame. A low number of seeders were found in two varieties. A sample from each cultivar was pulled on 13 September for judging and comparison. By this time, all cultivars had lodged and were 90-100% desiccated. All cultivars matured naturally resulting in acceptable neck finishes when yield samples were harvested on 23 September. Harvest samples from each cultivar were placed in storage on 7 October and were cured artificially for approximately 48 hours.

At evaluation on 29 December and 1 and 2 January, quality was fair and yields were slightly below the desired bushel per acre. For almost all the cultivars the majority of bulbs were close to 3" diameter size range. The trial average yield of 1013 bu/A was a 200 bu/A increase from last year but less than the 2019 trial average yield of 1223 bu/A. The average percentage of jumbos (>3" diameter) was 33%. This is an increase of 13% from 2020 but still 20% less than 2019. Cultivar Tannat, Tannat with Inicium and SV 4643 had the most bulbs in the >3" category. Uniformity of shape was variable with Tannat having the best uniformity and Red Beret the poorest. Uniformity of size was variable, with Red Mountain receiving a very good rating of 8 while nine other cultivars had an average or poor rating.

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RED ONION CULTIVAR TRIAL SEASON SUMMARY - 2021 – continued

Seven of the 13 cultivars evaluated had a very respectable 97% percent marketable or greater, and the average percent marketable for all cultivars was 95.4%. The majority of culls were rot with doubles being the second most common cull. Skin quality was a little disappointing at evaluation and varied among cultivars. Half of the cultivars had good skin attachment; the other half of the cultivars had noticeable skin cracking. Exterior colour was lighter but still satisfactory on most varieties. Most cultivars had a very low incidence of skin blemishes. Interior ring colour was acceptable with only the dead center of the onions lacking ring colour. When onions were cut in half for interior colour evaluation, it was noted that all cultivars had a high percentage of double or multiple centers. Cultivar Red Stone had the highest percentage of single centers (73 %). There was limited mechanical damage found in all cultivars. Neck finishes were dry and tight, and most cultivars scored well. This confirmed that the onions had matured naturally by the harvest date. At evaluation Red Carpet and Red Wing maintained the best firmness with a rating of very good, 8.0 and 8.3, respectively. Maggot damage in the evaluation samples was very minimal and ranged from 0 – 1.7%, with a trial average of 0.6%.

RED ONION TRANSPLANT CULTIVAR TRIAL – 2021

MANAGEMENT PROCEDURES

Seeded:

On 24 March seeded in seedling trays, 288 plugs/tray, filled with ASB soilless mixture with two seeds/cell. The onion plants were clipped regularly to a height of 8 cm to promote sturdy plants.

Fertilizer:

Greenhouse – 20-20-20 at a rate of 50 ppm for the first two weeks after emergence then 100 ppm (Ebb & Flow Bench) prior to transplant.
One application of 10-52-10 at a rate of 3.1 kg/1000 L of water just prior to transplant.

Field - 90 kg/ha Nitrogen (Calcium Ammonium Nitrate 27-0-0) + 100 kg/ha Phosphorous (MESZ 10-40-0) + 220 kg/ha Potassium (ASPIRE 0-0-58) + 120 kg/ha K–Mag (0-0-22) + 35 kg/ha Manganese + 7 kg/ha Copper (99% Cu) was worked into the soil.

A side dressing blend of 12 kg/ha Nitrogen + 12 kg/ha Potassium + 6 kg/ha Manganese + 2.5 kg/ha Calcium + 13.6 kg/ha Sulphur was applied on 6 July.

Transplanted:

Three replications were planted in the field on 11 and 12 May at a spacing of 43 cm (row) and 12 cm (plant) apart.
A tray drench of Pyrinex 480 EC was applied at 1.6 ml product per 475 ml water per tray on 7 May, 4 days before transplanting.

Weed Control:

Post-emergence:
1 application **PARDNER** at 350 ml/ha on 18 May.
1 applications: **PARDNER** at 140 ml/ha and **GOAL** at 70 ml/ha and Manganese at 1.0 kg/ha on 20 May.
1 application: **PROWL H2O** 6.0 L/ha on 27 May.
1 application: **GOAL** at 175 ml/ha and Manganese at 2.0 kg/ha on 12 July.

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RED ONION TRANSPLANT CULTIVAR TRIAL - 2021 - continued

Minor Elements:

Nine foliar sprays: Calcimax on 11 June (1.0 L/ha), 24 & 30 June, 10 July and 13 August (2.0 L/ha) and 16, 22 & 30 July and 6 August (3.0 L/ha)
Eight foliar sprays: Mag Max on 24 & 30 June, 10 July (2.0 L/ha), 16, 22 and 30 July (3.0 L/ha), 13 & 20 August (4.0 L/ha)
Seven foliar sprays: Manganese Sulfate on 24 & 30 June, 10, 17 & 22 July and 13 & 20 August (2.0 kg/ha)
Seven foliar sprays: Zinc Max on 11 June and 30 July (1.0 L/ha), 4 & 30 June, 22 July and 13 August (2.0 L/ha) and 16 July (3.0 L/ha)
Six foliar sprays: Alexin on 16, 22 & 30 July and 6 August (3.0 L/ha) and 13 & 20 August (4.0 L/ha)
Five foliar sprays: Suprafeed on 16 & 22 July (2.0 kg/ha) and 30 July and 13 August (3.0 kg/ha) and 20 August (4.0 kg/ha)
Four foliar sprays: 20-20-20 on 4, 11, 24 & 30 June (2.0 kg/ha)
Two foliar sprays: Mancozin on 30 July and 6 August (3.0 L/ha)
Two foliar sprays: Copper Max 13 August (2.0 L/ha) and 6 August (3.0 L/ha)
Two foliar sprays: Nutri Bor on 6 & 20 August (1.0 L/ha)
One foliar spray: Truphos on 4 June (2.0 L/ha)

Insect and Disease Control:

According to IPM recommendations.

MOVENTO at 365 ml/ha + **AGRAL 90** at 1.0 L/ha on 17 June.
PRISTINE at 1.0 kg/ha + **DIBROM** at 500 ml/ha and Minor Elements on June 24.
MOVENTO at 365 ml/ha + **AGRAL 90** at 1.0 L/ha on 29 June.
DITHANE DG at 2.25 kg/ha + **UP-CYDE** at 280 ml/ha and Minor Elements on 30 June.
SERCADIS at 333 ml/ha + **ZAMPRO** at1.0 L/ha **+ DIBROM** at 530 ml/ha and Minor Elements on 10 July.
MIRAVIS DUO at 1.0 L/ha + **RIDOMIL MZ** 2.25 kg/ha and Minor Elements on 16 July.
ORONDIS ULTRA at 400 ml/ha + **DITHANE DG** at 3.25 kg/ha + **AGRI-MEK SC** at 200 ml/ha and Minor Elements on 22 July.
SERCADIS at 333 ml/ha + **ZAMPRO** at1.0 L/ha **+ DELEGATE** at 336 g/ha and Minor Elements on 30 July.
MIRAVIS DUO at 1.0 L/ha + **RIDOMIL MZ** 2.25 kg/ha **+ DIBROM** at 530 ml/ha and Minor Elements on 6 August.
ORONDIS ULTRA at 400 ml/ha + **SERCADIS** at 333 ml/ha and Minor Elements on 13 August.
QUADRIS TOP at 1.0 L/ha + **RIDOMIL MZ** 3.25 kg/ha + **EXIREL** 1.5 L/ha and Minor Elements on 20 August.

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Harvest:

The trial was pulled on 13 September and topped on 21 September. The trial was placed in a forced air and temperature controlled storage 7 October. The trial was cured for 48 hours (25ºC, minimum 65% RH). After curing the temperature was lowered 5ºC per week until 0ºC was attained.

Sprout Inhibition:

Royal MH 30 XTRA at 8.63 L/ha in 550 L/ha water on.

August 4	August 13		August 19	August 26
Rubillion	Red Bull	Red Beret	Tannat	Tannat Inicium
Red Stone	SV NT 4643	Red Carpet	Red Mountain	Red Wing
SV NT 1298	Ruby Ring	Red Nugent		

EVALUATION PROCEDURES

The cultivars were evaluated on 29 December and 1 & 2 January after 12 weeks in storage.

 # Bulbs Harvested:

Total number of onions harvested from 4.66 m of row.

Harvest Weight:

Weights from the harvested 4.66 m of row.

Marketable Yield bu/A:

Number of onions > 76 mm (> 3"), 76 mm to 64 mm (3" to 2½") and 64 mm to 32 mm (2½" to 1¼").

Majority of Culls:

D = Double PW = Pee Wee R = Rot OC = Off Colours S = Seeders SP = Sprouts

Shape:

HG = High Globe FG = Flatten Globe G = Globe Sp = Spindle TD = Tear Drop T = Top

Skin Thickness:

10.0 = Most Desirable 7.5 = Good 6.0 = Average

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RED ONION TRANSPLANT CULTIVAR TRIAL - 2021 - continued

Skin Attachment:
10.0 = Most Desirable, skins well attached 7.5 = Good, skins have a few small cracks 6.0 = Average, skins have cracks but still attached

Neck Finish:
10.0 = Most Desirable, small tight neck 6.0 = Average, neck closed 4.0 = Poor, neck bit rough and open

Overall Score:
Based on quality and general appearance.

Score:
The average of nine marks at evaluation from Uniformity of Shape to Firmness.

Firmness:
10 = Desirable (solid and firm) 6.0 = Average (firm but some elasticity) 1.0 = Poor (spongy)

Average Weight/Bulb (g):
The total weight in grams of all bulbs divided by the total number of bulbs. A bulb 51 mm (2") in diameter weighs approximately 70 g. A bulb 57 mm (2¼") in diameter weighs approximately 100 g. A bulb 64 mm (2½") in diameter weighs approximately 135 g.

Days to Harvest:
Numbers of days from transplant until 85% of the tops were down.

Percent Onion Maggot Damage:
Percent of onions damaged by onion maggot ranging from pin hole to completely unmarketable that were found in the 4.66 m harvest sample.

Seeders:
The average number of seeders found in all three replicates of each cultivar.

% Single Centers:
Percentage of onions with only one heart

% Double Centers:
Percentage of onions with two hearts

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% Mutiple Centers:

Percentage of onions with three or more hearts

Interior & Exterior Colour:

LR = Light Red R = Red DR = Dark Red DDR = Deep Dark Red

Top Height (cm):

The average length of 20 random onion tops from all three replicates from the ground to the tips of the leaves as taken on 14 July. 50 cm is equal to 20 inches.

Leaf Shape:

B = Leaves are bent or hanging U = Up right leaves, straight

Leaf Colour:

LG = Light Green, G = Green, BG = Blue Green, DG = Dark Green

Irrigation:

Irrigation water was applied four times for the 2021 season:

17 May in the amount of ½ inch
26 May in the amount of ½ inch
10 June in the amount of ½ inch
18 August in the amount of 1 inch

RED ONION TRANSPLANT CULTIVAR TRIAL - 2021

Cultivar	Source	# Bulbs Harvested	# Bulbs Jumbos > 100 mm	# Bulbs X-Large 89 -100 mm	# Bulbs Large 76 - 89 mm	# Bulbs Medium 64 - 76 mm	# Bulbs Small 32 - 64 mm	Stand/Foot
RED WING	Bejo	78 a*	0.0 b	2.0 bc	19.3 bc	47.3 a	8.3 cd	5.1 a
RED MOUNTAIN	Bejo	77 a	0.0 b	2.7 bc	27.3 ab	42.0 ab	4.3 d	5.1 a
RUBY RING	Tak	78 a	0.0 b	0.0 c	6.3 de	45.3 ab	25.3 b	5.1 a
RED BULL	Bejo	77 a	0.0 b	2.0 bc	28.3 ab	38.0 a-d	7.3 cd	5.0 a
RED CARPET	Bejo	76 a	0.0 b	2.3 bc	20.3 bc	39.3 abc	13.0 c	5.0 a
RED STONE	Haz	79 a	0.0 b	0.0 c	3.3 e	38.0 a-d	36.3 a	5.2 a
RED BERET	Cro	78 a	0.3 b	1.3 bc	14.7 cd	36.0 bcd	23.7 b	5.1 a
SV 4643	Sto	79 a	0.3 b	4.3 b	36.7 a	27.7 de	6.0 cd	5.1 a
RUBILLION	Tak	77 a	0.0 b	0.0 c	2.3 e	46.3 ab	24.7 b	5.1 a
TANNAT	EZ	77 a	0.0 b	3.0 bc	34.3 a	28.7 cde	5.3 cd	5.0 a
TANNAT INICIUM	SN	76 a	2.0 a	9.3 a	35.0 a	20.7 e	3.3 d	5.0 a
SV NT 1298	Sem	78 a	0.0 b	8.7 a	28.0 ab	27.3 de	8.7 cd	5.1 a
RED NUGENT	Sto	77 a	3.0 a	9.0 a	25.7 abc	20.3 e	6.3 cd	5.0 a
Trial Average		**78**	**0.4**	**3.4**	**21.7**	**35.2**	**13.3**	**5.1**

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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RED ONION TRANSPLANT CULTIVAR TRIAL - 2021 - continued

Cultivar	Source	Total Harvest Weight (kg)	Wgt. Jumbo > 89 mm (kg)	Wgt. Large 76-89 mm (kg)	Wgt. Medium 76-64 mm (kg)	Wgt. Small 64-32 mm (kg)	Marketable Yield bu/A	% Marketable	Majority of Culls
RED WING	Bejo	14.76 cd*	0.69 c	4.85 bc	8.20 a	0.89 cd	1102 ab	99.1 a	D/R
RED MOUNTAIN	Bejo	15.06 bcd	0.90 c	6.48 ab	7.13 ab	0.47 d	1129 ab	98.7 ab	PW
RUBY RING	Tak	11.11 fg	0.00 c	1.39 de	7.02 ab	2.45 b	819 de	98.3 ab	R
RED BULL	Bejo	15.10 bcd	0.67 c	6.93 ab	6.62 abc	0.71 cd	1126 ab	98.3 ab	R
RED CARPET	Bejo	13.42 de	0.76 c	4.69 bc	6.63 abc	1.31 c	1010 bc	98.3 ab	PW
RED STONE	Haz	9.97 g	0.00 c	0.72 de	5.80 bcd	3.40 a	748 de	97.9 ab	PW
RED BERET	Cro	12.21 ef	0.58 c	3.47 cd	5.67 bcd	2.16 b	896 cd	97.0 ab	R
SV 4643	Sto	15.83 abc	1.49 bc	8.47 a	4.58 de	0.51 cd	1135 ab	95.3 ab	D
RUBILLION	Tak	9.76 g	0.00 c	0.48 e	6.67 ab	2.26 b	710 e	94.8 ab	R
TANNAT	EZ	15.01 bcd	0.91 c	8.10 a	4.54 de	0.52 cd	1060 abc	93.0 ab	R
TANNAT INICIUM	SN	16.96 ab	3.81 a	8.34 a	3.37 e	0.32 d	1195 a	93.0 ab	D
SV NT 1298	Sem	16.70 abc	2.84 ab	6.78 ab	4.70 cde	0.83 cd	1142 ab	92.8 b	D
RED NUGENT	Sto	17.35 a	4.22 a	6.41 ab	3.29 e	0.59 cd	1094 ab	83.9 c	R
Trial Average		**14.10**	**1.30**	**5.16**	**5.71**	**1.26**	**1013**	**95.4**	

Listed in order of % Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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RED ONION TRANSPLANT CULTIVAR TRIAL - 2021 - continued

Cultivar	Source	Shape	Uniformity of Shape	Uniformity of Size	Skin Thickness	Skin Attachment	Neck Finish	Overall Score	Score
RED WING	Bejo	HG	7.3 a*	7.3 ab	7.3 ab	7.7 abc	7.0 bc	7.3 ab	7.30 ab
RED MOUNTAIN	Bejo	HG	6.0 a-d	8.0 a	7.3 ab	8.7 a	7.0 bc	8.0 a	7.33 a
RUBY RING	Tak	G	7.0 ab	6.7 abc	6.7 abc	5.7 de	7.7 ab	5.7 de	6.48 cd
RED BULL	Bejo	HG	5.7 b-e	7.3 ab	6.7 abc	8.0 ab	7.0 bc	7.5 ab	7.02 abc
RED CARPET	Bejo	G	5.3 cde	6.7 abc	6.3 bcd	8.7 a	7.3 abc	7.8 a	7.17 ab
RED STONE	Haz	HG	6.7 abc	6.0 bcd	7.7 a	5.3 de	7.3 abc	6.7 bcd	6.93 abc
RED BERET	Cro	SPG	4.3 e	5.0 cd	5.3 d	6.7 bcd	6.7 cd	5.7 de	5.87 ef
SV 4643	Sto	TOP	7.0 ab	6.7 abc	6.3 bcd	6.0 cde	7.0 bc	6.7 bcd	6.59 cd
RUBILLION	Tak	G	7.0 ab	7.3 ab	7.3 ab	5.7 de	8.0 a	6.0 cde	6.74 bc
TANNAT	EZ	FG	7.3 a	6.3 abc	5.3 d	8.3 ab	5.3 e	6.0 cde	6.81 abc
TANNAT INICIUM	SN	FG	7.3 a	6.3 abc	5.7 cd	9.0 a	6.0 de	7.0 abc	7.26 ab
SV NT 1298	Sem	SPG	5.0 de	6.3 abc	6.0 cd	4.3 e	8.0 a	5.3 e	6.17 de
RED NUGENT	Sto	G	4.7 de	4.3 d	5.7 cd	6.7 bcd	6.7 cd	5.0 e	5.59 f
Trial Average			**6.2**	**6.5**	**6.4**	**7.0**	**7.0**	**6.5**	**6.71**

Listed in order of % Marketable. 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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RED ONION TRANSPLANT CULTIVAR TRIAL - 2021 - continued

Cultivar	Source	Firmness at Harvest	Firmness at Evaluation	Interior Colour	Interior Colour Rating	Exterior Colour	Exterior Colour Rating	Days to Harvest	% Onion Maggot Damage	Average Weight/Bulb (g)
RED WING	Bejo	10.0 a*	8.0 ab	R	7.0 a	DR	6.7 bcd	109 a	0.0 a	190.3 cd
RED MOUNTAIN	Bejo	9.5 a-d	7.3 abc	R	7.0 a	R	6.7 bcd	98 b	0.5 a	195.0 cd
RUBY RING	Tak	10.0 a	6.3 c-f	R	7.0 a	R	5.7 de	94 b	1.7 a	141.9 fg
RED BULL	Bejo	10.0 a	7.7 ab	R	7.0 a	DR	6.3 cd	100 b	1.3 a	196.0 cd
RED CARPET	Bejo	10.0 a	8.3 a	DR	7.0 a	R	7.0 a-d	97 b	0.4 a	175.9 de
RED STONE	Haz	9.8 ab	7.3 abc	LR	8.0 a	LR	7.3 abc	74 d	0.0 a	125.6 g
RED BERET	Cro	9.5 a-d	5.8 ef	R	7.7 a	R	5.7 de	94 b	0.4 a	156.1 ef
SV 4643	Sto	9.7 abc	6.0 def	R	7.3 a	R	6.3 cd	94 b	0.9 a	200.7 bcd
RUBILLION	Tak	9.2 cd	6.0 def	LR	6.7 a	R	6.7 bcd	78 cd	1.8 a	126.2 g
TANNAT	EZ	9.0 d	7.0 bcd	DR	7.7 a	DR	8.0 ab	95 b	0.0 a	195.9 cd
TANNAT INICIUM	SN	9.5 a-d	7.0 bcd	DR	8.7 a	DR	8.3 a	100 b	0.4 a	224.2 ab
SV NT 1298	Sem	10.0 a	6.5 cde	R	7.0 a	LR	7.0 a-d	82 c	0.0 a	213.5 abc
RED NUGENT	Sto	9.3 bcd	5.3 f	DR	7.3 a	DR	4.7 e	94 b	0.4 a	226.2 a
Trial Average		**9.7**	**6.8**		**7.3**		**6.6**	**93**	**0.6**	**182.1**

Listed in order of % Marketable. 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

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RED ONION TRANSPLANT CULTIVAR TRIAL - 2021 - continued

Cultivar	Source	Seeders	Percent Single Centres	Percent Double Centers	Percent Multiple Centers	% Jumbo > 101 mm	% Jumbo > 90 - 101 mm	% Jumbo > 76 - 90 mm	Top Heights (cm)	Leaf Shape	Leaf Colour
RED WING	Bejo	0.0 a*	17 bcd	77 a	7 de	0.0 b	2.6 b	24.9 bc	74.0 abc	B	G
RED MOUNTAIN	Bejo	0.0 a	7 cd	73 ab	20 cde	0.0 b	3.4 b	35.3 ab	69.2 bc	B	G
RUBY RING	Tak	0.0 a	20 a-d	73 ab	7 de	0.0 b	0.0 b	8.1 de	66.2 c	U	BG
RED BULL	Bejo	0.0 a	10 cd	67 abc	23 bcd	0.0 b	2.6 b	36.8 ab	75.4 abc	U	G
RED CARPET	Bejo	0.0 a	17 bcd	60 abc	23 bcd	0.0 b	3.1 b	26.6 bc	73.1 abc	U	G
RED STONE	Haz	0.0 a	0 d	27 d	73 a	0.0 b	0.0 b	4.2 e	53.9 d	U	BG
RED BERET	Cro	0.0 a	33 ab	50 c	17 cde	0.4 b	1.7 b	18.7 cd	76.5 ab	B	G
SV 4643	Sto	0.3 a	27 abc	47 cd	27 bc	0.4 b	5.5 b	46.6 a	80.7 a	B	G
RUBILLION	Tak	0.0 a	37 ab	60 abc	3 e	0.0 b	0.0 b	3.0 e	67.4 bc	U	BG
TANNAT	EZ	1.0 a	40 a	50 c	10 cde	0.0 b	3.9 b	44.8 a	80.8 a	B	LG
TANNAT INICIUM	SN	2.0 a	33 ab	53 bc	13 cde	2.6 a	12.3 a	46.3 a	79.7 a	B	LG
SV NT 1298	Sem	0.0 a	7 cd	53 bc	40 b	0.0 b	11.1 a	35.7 ab	66.9 bc	B	BG
RED NUGENT	Sto	0.0 a	10 cd	67 abc	23 bcd	3.9 a	11.7 a	33.5 ab	81.6 a	B	G
Trial Average		**0.3**	**20**	**58**	**22**	**0.6**	**4.5**	**28.0**	**72.7**		

Listed in order of % Marketable. 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

RED ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021

Red Wing: *Bejo sample,* Good appearance, Good tight neck finish, Some neck finishes bit rough, Medium sized necks, Average to thick skin thickness, Pretty good skin quality, Odd one with skin cracking, Exterior colour a little even, Some with white spots on skins, Interior colour a little even, Dead centers white, Good interior blending, Nice packer, Uniformity of shape a little even, Good firm solid onion, Firmness even, Medium run size a little uneven, Long term storage onion.

Red Mountain: *Bejo sample,* Nice appearance, Good tight neck finish, Neck finishes a bit rough, Medium sized necks, Average to thick skin thickness, Pretty good skin quality, Odd one with skin cracking, Exterior colour a little even, Odd one with white spots on skins, Interior colour uneven, Dead centers yellow, Average to good interior blending, Nice packer, Uniformity of shape uneven, Good firm onion, Firmness a little uneven, Medium run size, Run size even, Mid to long term storage onion.

Ruby Ring: *American Takii sample,* Average appearance, Good tight neck finish, Small sized necks, Average skin thickness, Fair skin quality, Some skin cracking a little concern, Exterior colour a little uneven, Odd one with brown spots on skins, Dark interior colour even, Dead centers yellow, Good interior blending, Average packer, Uniformity of shape a little even, Average firmness, Firmness a little uneven, Small to medium run size, Run size a little uneven, Early to mid term storage onion.

Red Bull: *Bejo sample,* Good appearance, Average tight neck finish, Some neck finishes bit rough, Various sized necks, Average to thick skin thickness, Odd onion with skin cracking, Pretty good skin quality, Odd one with skin or basal plate rot, Darker exterior colour uneven, Odd one with white spots on skins, Interior colour slightly uneven, Dead centers white, Average interior blending, Good packer, Uniformity of shape uneven, Nice firm solid onion, Firmness a little uneven, Medium run size a little uneven, Mid to long term storage onion.

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RED ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 continued

Red Carpet: *Bejo sample,* Nice appearance, Good tight neck finish, Neck finishes a bit rough, Medium sized necks, Average skin thickness, Nice skin quality, Odd one with skin cracking, Slightly dark exterior colour even, Odd one with white or brown spots on skins, Interior colour a little uneven, Dead centers white or yellow, Average interior blending, Nice packer, Uniformity of shape very uneven, Good firm solid onion, Firmness a little uneven, Medium run size, Mid to long term storage onion.

Red Stone: *Hazera sample,* Average appearance, Good tight neck finish, Small to medium sized necks, Average skin thickness, Uneven skin quality, Some with skin cracking, Skin cracking a little concern, Exterior colour even, Some with brown spots on skins, Interior colour even, Dead centers white, Good interior blending, Average to good packer, Uniformity of shape a little even, Good firm solid onion, Firmness a little uneven, Small run size, Run size a little uneven, Mid to long term storage onion.

Red Beret: *Crookham sample,* Fair appearance, Average to good tight neck finish, Some neck finishes a bit rough, Small to medium sized necks, Average skin thickness, Average skin quality, Some with skin cracking a little concern, Odd one with skin rot, Exterior colour uneven, Some brown spots on skins, Dark interior colour even, Dead centers white or yellow 60/40, Great interior blending, Okay packer, Uniformity of shape very uneven, Average firmness, Firmness uneven, Small to medium to large run size, Run size uneven, Early to mid term storage onion.

SV NT 4643: *Stokes sample,* Good appearance, Good tight neck finish, Small & medium sized necks, Average skin thickness, Average skin quality, Some with skin cracking, Exterior colour a little uneven, Odd one with brown spots on skins, Interior colour uneven, Dead centers yellow, Good interior blending, Good packer, Uniformity of shape a little even, Average firmness, Firmness a little uneven, Medium to large run size, Run size a little uneven, Early to mid term storage onion.

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RED ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 continued

Rubillion: *American Takii sample,* Fair to average appearance, Great tight neck finish, Small sized necks, Average skin thickness, Fair skin quality, Some skin cracking a concern, Odd one with skin rot, Exterior colour even, Some onions a bit purplish in colour, Odd one with brown spots on skins, Interior colour even, Dead centers white or yellow 50/50, Good interior blending, Okay packer, Uniformity of shape a little even, Average firmness, Firmness even, Small run size, Run size even, Early to mid-term storage onion.

Tannat: *Enza Zaden sample,* Good appearance, Poor neck finish, Necks rough and ripped, Medium to large sized necks, Average skin thickness, Average skin quality, Odd one with skin cracking, Skin rot slight concern, Dark exterior colour even, Dark interior colour even, Dead centers white, Good interior blending, Good packer, Uniformity of shape a little uneven, Average firmness, Firmness a little uneven, Medium run size, Run size a little uneven, Odd onion with mechanical damage on necks, Mid term storage onion.

Tannat Inicium: *Seminova sample,* Nice appearance, Average neck finish, Necks bit rough and ripped, Medium to large sized necks, Average skin thickness, Pretty good skin quality, Odd one with skin cracking, Skin rot slight concern, Dark exterior colour even, Odd one with white spots on skins, Dark interior colour even, Dead centers white, Good interior blending, Good packer, Uniformity of shape even, Good firm onion, Firmness a little uneven, Large run size, Run size a little uneven, Odd onion with mechanical damage on necks, Mid to long term storage onion.

SV NT 1298: *Seminis sample,* Poor bit rough appearance, Good tight neck finish, Small sized necks, Thin skin thickness, Poor skin quality, A lot with skin cracking a concern, Slightly light exterior colour uneven, Some with brown spots on skins, Interior colour even, Dead centers yellow, Average interior blending, Okay packer, Uniformity of shape very uneven, Average firmness, Firmness uneven, Medium to large run size, Run size a little uneven, Suspicion of doubles some concern, Early to mid term storage onion.

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RED ONION CULTIVAR MAIN TRIAL EVALUATION NOTES – 2021 continued

Red Nugent: *Stokes sample,* Fair appearance, Good tight neck finish, Small & medium sized necks, Thin to average skin thickness, Fair to average skin quality, Some with skin cracking a little concern, Skin rot a concern, Exterior colour uneven, Some with brown spots on skins, Interior colour a little even, Dead centers white or yellow, Average interior blending uneven, Okay packer, Uniformity of shape very uneven, Softer onion, Firmness very uneven, Large run size, Run size very uneven, Suspicion of double onions, All most seems like two types of onions, Early term storage onion.

LONG TERM AVERAGES OF RED ONION CULTIVAR TRIALS

Cultivar	Source	# Years Evaluated	Yeild bu/A	% Marketable	% Jumbos <3"	Days to Maturity	Firmness In*	Firmness out*	Neck Finish	Score	% Onion Maggot Damage	# of Seeders	Leaf Length (cm)
RED SPRING	Bejo	4	706	59.6	36.4	76	8.0	6.4	8.2	5.89	1.6	0.0	65
MONASTRELL	EZ	4	726	72.9	29.8	79	8.7	7.3	8.4	5.90	2.1	0.0	62
RED SKY	Bejo	6	994	90.0	34.2	81	8.6	6.7	7.8	6.53	0.9	0.0	71
RUBILLION	Tak	5	854	93.8	23.1	83	9.0	6.8	8.0	6.82	2.6	0.0	68
BLUSH	Bejo	3	1017	92.6	30.0	85	9.7	8.3	7.1	7.32	4.0	0.0	71
SV 4643	Sem	6	1245	89.5	58.6	87	9.5	6.8	6.7	6.21	1.1	0.5	79
RED NUGENT	Sto	4	1319	89.2	60.4	91	9.3	6.5	6.7	5.90	2.4	0.0	79
MERCURY	Sto	3	1173	86.1	47.5	91	8.8	6.8	6.7	6.07	0.0	0.2	71
RED HAWK	Bejo	7	1043	83.0	49.6	92	8.7	6.6	6.3	6.77	1.4	0.8	75
RED MOUNTIAN	Bejo	3	1086	96.7	32.7	93	9.8	7.8	7.2	7.24	2.2	0.0	68
RED BULL	Bejo	7	1083	93.2	45.0	95	9.6	7.9	6.6	6.84	1.2	0.2	73
RUBY RING	Tak	8	936	94.9	24.9	96	9.7	7.4	7.0	6.72	1.6	0.0	69
RED CARPET	Bejo	5	1121	93.2	42.1	98	9.8	8.3	6.4	7.05	1.1	0.0	72
RED WING	Bejo	7	1293	97.0	56.3	107	9.6	8.2	6.6	7.23	0.3	0.0	75

All data based from 2011 season forward * Firmness: In = Evaluated at time of Harvest Out = Evaluated in December
Listed in order of Days to Maturity. * 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

MAIN RED ONION STORAGE TRIAL 2020 - 2021

Cultivar	Source	% Marketable	% Weight Loss	% Sprouts	% Rot	% Soft	Firmness In **	Firmness Out **	% Sprouting at Base	% Sprouting at Top
SV NT 1298	Sem	68.8 a*	4.6 a	17.4 a	5.0 b	3.7 a	10.0 a	6.7 bcd	8.0 a	3.3 a
BLUSH	Bejo	66.5 a	5.3 a	25.5 abc	2.3 b	0.0 a	9.2 bc	7.7 ab	23.3 bcd	2.0 a
BAROLO INICIUM	SN	66.3 a	4.8 a	23.7 ab	4.2 b	0.0 a	9.5 ab	7.3 abc	16.7 abc	7.7 bc
E61L 10657	EZ	63.9 a	4.7 a	28.1 abc	2.6 b	0.0 a	9.5 ab	7.2 abc	16.7 bcd	28.0 c
RUBY RING	Tak	57.1 ab	6.0 a	34.6 bcd	1.4 b	0.0 a	10.0 a	6.3 bcd	40.7 def	4.3 bc
RED MOUNTAIN	Bejo	55.3 abc	5.4 a	35.3 cd	3.3 b	0.5 a	9.8 a	7.2 abc	45.0 def	8.0 bc
BUBILLION	Tak	54.9 abc	5.5 a	38.7 cde	0.5 a	0.0 a	10.0 a	6.2 cd	36.7 cde	16.7 c
BAROLO	EZ	53.4 a-d	5.1 a	37.1 cde	4.0 b	0.0 a	9.5 ab	7.2 abc	37.3 c-f	15.0 c
SV 4643 NT	Sto	51.5 a-d	5.3 a	25.3 abc	12.7 b	0.0 a	9.7 ab	5.7 d	16.7 ab	5.0 bc
RED STONE	Haz	48.2 a-d	5.2 a	45.6 cde	0.4 a	0.0 a	10.0 a	8.2 a	48.3 def	8.3 bc
RED HAWK	Bejo	41.9 bcd	5.2 a	51.6 de	1.2 a	0.0 a	9.7 ab	6.5 bcd	61.7 ef	10.0 bc
RED CARPET	Bejo	40.3 bcd	5.1 a	53.1 de	1.4 a	4.4 a	10.0 a	7.2 abc	58.3 ef	10.3 c
RED NUGENT	Sto	34.7 cd	5.5 a	39.7 cde	15.2 b	0.4 a	9.5 ab	5.7 d	36.7 cde	3.3 b
RED BULL	Bejo	33.2 d	6.4 a	55.9 de	3.9 b	0.0 a	9.8 a	6.8 a-d	71.7 ef	4.7 bc
MONASTRELL	EZ	6.1 e	12.4 c	64.7 de	17.0 b	0.0 a	8.7 cd	6.3 bcd	90.0 ef	85.0 c
RED SPRING	Bejo	1.3 e	10.4 b	68.9 e	19.4 b	0.0 a	8.3 d	3.0 e	95.7 f	93.3 c
Trial Average		**46.5**	**6.1**	**40.3**	**5.9**	**0.6**	**9.6**	**6.6**	**44.0**	**19.1**

Listed in Order of Percent Marketable.

* Numbers in a column followed by the same letter are not significantly different at P = 0.05 Fisher's Protected LSD Test.

** 10.0 = Most Desirable, 7.5 = Good, 6.0 = Average

RED ONION CULTIVAR STORAGE TRIAL EVALUATION NOTES - 2020-2021

SV NT 1298: *Seminis sample,* Top sprouts just starting to light 0-2.5 cm, Root sprouts just starting 0-1 cm, Majority skin rot, A few internal rot, Basal plates just starting to push out 10-20%, Firmness okay, Firmness slightly uneven, Early to mid storage onion, Stored a little poor, Every thing is just a bit uneven.

Blush: *Bejo sample,* Top & root sprouts just starting to light 0-1 cm, Skin or internal rot, Basal plates just starting to pushing out 10-30%, Firm onion, Firmness even, Late storage onion, Stored nice.

Barolo: *Seminova sample,* Top & root sprouts just starting 0-1 cm, Majority skin rot, Odd internal rot, Basal plates just starting to push out 10%, Firm onion, Firmness slightly uneven, Mid to late storage onion, Stored good.
Inicium

E61L 10657: *Enza Zaden sample,* Top sprouts just starting 0-1 cm, Root sprouts just starting to light 0-2.5 cm, Skin or internal rot, Basal plates just starting to push out 5-10%, Firm onion, Firmness even, Late storage onion, Stored nice.

Ruby Ring: *American Takii sample,* Top & root sprouts just starting 0-1 cm, Root sprouts slight concern, Majority internal rot, Some skin rot, Basal plates just starting to push out 10%, Firmness uneven, Mid-term storage onion, Stored okay.

Red Mountain: *Bejo sample,* Top & root sprouts just starting to light 0-1 cm, Majority internal rot, Some skin rot, Basal plates just starting to pushing out 20-40%, Fairly firm, Firmness even, Late storage onion, Stored good to nice.

Rubillion: *American Takii sample,* Top & root sprouts just starting to light 0-2.5 cm, Root sprouts are a slight concern, Majority internal rot, Odd skin rot, Basal plates just starting to push out 10-20%, Firmness okay, Firmness slightly even, Mid-term storage onion, Stored okay to good.

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RED ONION CULTIVAR STORAGE TRIAL EVALUATION NOTES - 2020-2021 - continued

Barolo: *Enza Zaden sample,* Top sprouts just starting 0-1 cm, Root sprouts just starting to light 0-2.5 cm, Majority skin rot, Some internal rot, Basal plates just starting to push out 10-15%, Fairly firm, Firmness slightly uneven, Mid to late storage onion, Stored good.

SV 4643: *Stokes sample,* Top & root sprouts just starting to moderate,0-2.5 cm, Top sprouts slightly uneven, Majority skin rot, Odd internal rot, Basal plates just starting to push out 10-20%, Firmness uneven, Early to mid-term storage onion, Stored a little poor.

Red Stone: *Hazera sample,* Top & root sprouts just starting 0-1 cm, Root sprouts a concern, All internal rot, Basal plates just starting to push out 2-10%, Firm onion, Late storage onion, Stored nice to excellent.

Red Hawk: *Bejo sample,* Top sprouts just starting 0-1 cm, Root sprouts just starting to moderate 0-2.5 cm, Majority internal rot, Some skin rot, Basal plates just starting to pushing out 10-20%, Firmness okay, Firmness slightly uneven, Mid-term storage onion, Stored okay.

Red Carpet: *Bejo sample,* Top & root sprouts just starting 0-1 cm, Skin or internal rot, Basal plates just starting to pushing out 25-30%, Fairly firm, Firmness even, Late storage onion, Stored okay to nice.

Red Nugent: *Stokes sample,* Top sprouts just starting 0-1 cm, Root sprouts just starting to moderate 0-2.5 cm, Majority skin rot, Odd internal rot, Basal plates just starting to push out 10-20%, Soft onion, Firmness uneven, Early to mid storage onion, Stored a little poor to good.

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RED ONION CULTIVAR STORAGE TRIAL EVALUATION NOTES - 2020-2021 - continued

Red Bull: *Bejo sample,* Top sprouts just starting 0-1 cm, Root sprouts just starting to heavy 0-2.5 cm, Root sprouts a concern, Majority internal rot, Some skin rot, Basal plates just starting to push out 10-30%, Fairly firm, Mid-term storage onion, Stored okay to good.

Monastrell: *Enza Zaden sample,* Top sprouts just starting to heavy 0-5 cm, Top sprouts uneven, Root sprouts just starting to moderate 0-2.5 cm, Top & root sprouts a concern, Majority skin rot, Odd internal rot, Rot is a concern, Basal plates just starting to push out 10-20%, Firmness okay, Early to mid-term storage onion, Stored poor.

Red Spring: *Bejo sample,* Top sprouts heavy 2.5-5 cm, Root sprouts light to heavy 1-2.5 cm, Top sprouts uneven, Sprouting is a big concern, Majority skin rot, A few internal rot, Basal plates just starting to push out 10-15%, Soft onion, Early storage onion, Stored poor, Not a storage onion.

LONG TERM AVERAGES OF RED ONION STORAGE TRIALS

CULTIVAR	SOURCE	# YEARS TESTED	% MARKETABLE	% WT LOSS IN STORAGE	% ROT, SOFT & SPROUT	FIRMNESS * IN	FIRMNESS * OUT
RED MOUNTAIN	Bejo	4	65.3	4.9	29.2	9.67	7.07
BLUSH	Bejo	3	62.4	5.2	31.8	9.73	7.80
RED BULL	Bejo	5	55.8	6.0	38.8	9.56	7.08
RUBY RING	Tak	6	55.5	6.3	34.3	9.48	6.52
SV 4643	Sto	3	49.8	5.5	42.5	9.70	6.23
RED HAWK	Bejo	5	49.7	6.5	45.0	8.58	6.10
RED WING	Bejo	4	49.3	5.5	35.5	9.43	6.83
RED CARPET	Bejo	4	47.3	6.0	47.5	9.50	7.20
RUBILLION	Tak	4	38.8	5.9	54.8	8.75	6.30
RED SKY	Bejo	4	30.7	5.4	64.1	8.58	6.28
RED SPRING	Bejo	4	1.0	13.7	85.1	7.75	3.10

Listed in order of % Marketable. Storage period approximately 11 months.

* 10.0 = Most Desirable, 8.0 = Good, 6.0 = Average

Check out the Muck Crops Research Station's

Web Page

https://bradford-crops.uoguelph.ca/

Grower Field Day & Muck Conference Information

Integrated Pest Management Information

- IPM Report Updates
- Weather Data
- Insect & Disease Forecasting Data

Publications

- Cultivar Trial Results (1971-2020)
- Research Reports
- Research Documents

Check out the Muck Crops Research Station's You Tube Account

The Muck Crops Research Station launched a YouTube channel in 2021. The account communicates brief videos of the Station's IPM program, variety trial results, past Muck Conferences and other information to our growers, industry reps and academic personnel. We hope the information will be helpful to our followers. So take some time, check out our channel and stay informed.

Simply type in:

"Muck Crops IPM" on YouTube to find us we're the first result.

or follow this link https://www.youtube.com/channel/UCT0B5570_1h7DVWwTDJylUA