



## Organic Seed Alliance

*Advancing ethical seed solutions to meet food and farming needs in a changing world*

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# Vegetable Crops for Season Extension in the Pacific Northwest: 2014-2016 Trial Results



In partnership with  
Washington State University



With support from Washington State Department of Agriculture's  
Specialty Crop Block Grant Program

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## Introduction

Washington agriculture excels in production of high value specialty vegetable crops during the prime growing seasons, but the organic produce industry remains dependent on imported crops during the winter and early spring months. Farmers are eager to expand production of overwintering and storage crops to retain customers through the winter or “off-season”. Chefs, produce retailers and the general public (through CSAs and farmers markets) increasingly demand locally grown vegetables of exceptional flavor and culinary qualities throughout the entire year representing a significant market opportunity. Winter vegetables often have superior flavor as the cool growing conditions tend to concentrate plant sugars. Four key crops were identified by stakeholders through focus groups, farmer gatherings and roundtable discussions as prime opportunities for expanding year-round production in Washington: overwintering chicories, overwintering sprouting broccoli, storage cabbage, and storage onions. The goal of this project was to identify optimum varieties of these four priority crops through evaluations of organic variety trials focused on agronomic, storage, and culinary qualities.

The four crops were identified by stakeholders as crops of interest based on several factors including: the potential for introducing new, or lesser known crops to the market to expand seasonal crop diversity; interest in the culinary quality of the crop; and need for identifying varieties with good production qualities and winter holding or storage capacity. Stakeholders also expressed interest in identifying organically available seed sources, including hybrid varieties and identifying desirable open-pollinated varieties to expand regional and local seed production.

Winter cabbage was prioritized as regional kraut businesses are growing, and retailers and distributors in the Pacific Northwest (PNW) are increasingly looking for producers due to the fact that the California cabbage industry has experienced impacts of a new pest known as the Bagrada bug.

Purple sprouting broccoli is ideally suited to the Pacific Northwest (PNW) climate and is growing in popularity as a crop of high culinary and nutritional value to fill the late winter and early spring market slot when diversity in local foods is at its lowest.

Washington is a major producer of onions, but growers and chefs have expressed frustration in accessing high quality and good tasting storage varieties for the PNW region.

Chicories are in high demand by NW chefs and gaining popularity among the gourmet food buyers offering an alternative option for off-season salad when local lettuce is seldom available.

Organic Seed Alliance (OSA) conducted variety trials on organic farms from 2014 to 2016 in multiple locations on the northern Olympic Peninsula, including Sequim, Port Townsend, Nordland, and Chimacum. Nearly 90 varieties of storage cabbage, storage onions, chicory, and purple sprouting broccoli were evaluated across these locations in two production cycles over the three-year period. Breeding populations of all crops except cabbage were included in the trials in order to provide feedback to breeders for future releases and to inform the selection and evolution of the populations. Data was mainly collected in fall and late winter and focused primarily on winter hardiness, storage, product quality, and flavor. This project was made possible through support from the Washington State Department of Agriculture Specialty Crops Block Grant Program.



## Methods and Materials

### CABBAGE

Year	Trial Location	Farm Name	Seeding Date	Transplant Date	Trial Design	Number of Reps	In-row Spacing	Between Row Spacing	Harvest Evaluation
2014-2015	Sequim	Nash's Organic Produce	NA	July 14 <sup>th</sup>	Randomized Block	3	15"	18"	October 29 <sup>th</sup>
2015-2016	Chimacum	OSA Research Farm	June 17 <sup>th</sup>	July 23 <sup>rd</sup>	Randomized Block	3	18"	24"	October 27 <sup>th</sup> -30 <sup>th</sup>

Variety	Source	Certified Organic Seed	OP/F1	2014-2015	2015-2016
Bartolo	Fedco Seeds	No	F1	x	x
Charmant	Sakata Seeds	No	F1	x	
Dottenfelder Dauer	Sativa/Bingenheimer Saatgut	Yes	OP		x
Dowinda	Sativa/Bingenheimer Saatgut	Yes	OP		x
Granite	Nash's Organic Produce	Yes	OP	x	x
Impala	High Mowing Organic Seeds	Yes	F1		x
Integro	High Mowing Organic Seeds	Yes	F1		x
Kaitlin	Johnny's Selected Seeds	No	F1	x	
Mammoth Red Rock	Fedco Seeds	No	OP		x
Marner	Nash's Organic Produce	Yes	OP	x	x
Reaction	Bejo Seeds	Yes	F1	x	
Red Drum Head	Nash's Organic Produce	Yes	OP		x
Rodynda	Sativa	Yes	OP		x
Ruby Perfection	Osborne Seed Co.	No	F1		x
Storage #4	Sakata Seeds	No	F1	x	
Superstar	Osborne Seed Co.	No	F1	x	
Turkis	Nash's Organic Produce	Yes	OP	x	x

## Results

2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Variety		Avg Head Weight (lb)		Avg Height (in)		Avg Width (in)		Taste (1=worst, 5=best)		Marketability (1=worst, 5=best)		Plot Uniformity (1=worst, 5=best)		Cabbage Looper Damage (1=most, 5=least)		Aphid Damage (1=most, 5=least)			
Charmant		4.1		6.1		6.6		NA		NA		NA		4.3		NA			
Kaitlin		5.2		6.7		7.4		NA		NA		NA		3.3		NA			
Reaction		2.3		5.9		5.2		NA		NA		NA		4		NA			
Storage #4		3.3		6.3		5.6		NA		NA		NA		3.7		NA			
Superstar		3.7		6.5		6.5		NA		NA		NA		2.7		NA			
Bartolo		2.9	3.9	7	6.8	5.6	6.5	NA	3.9	NA	4.2	NA	4.3	3.8	2.8	NA	4		
Marner		2.5	4.1	5.9	6.5	5.8	6.7	NA	3.2	NA	4	NA	3.3	4.2	4.3	NA	4.3		
Turkis		2.5	3.6	6	5.7	5.6	6.9	NA	3.8	NA	3.4	NA	3.6	3.8	3.8	NA	4.8		
	Dottenfelder Dauer		4.7		7.4		6.7		2.5		3.8		3.2		3.8		4.3		
	Dowinda		4.7		8.2		6.4		4.1		3.8		3.3		3		3		
	Granite		3.1		6.2		5.6		1.7		3.2		2.6		4.4		2.9		
	Impala		4.2		7.1		6.7		3		4.8		4.8		3.3		4.4		
	Integro		4.9		6.9		6.5		4.3		4.5		4.7		4.6		1.4		
	Mammoth Red		4		6.8		6.4		2.4		2.3		3.1		3.8		2.2		
	Red Drum Head		1.8		5.6		4.9		2.4		2.3		2.7		3.3		3.1		
	Rodynda		3.5		6.7		5.5		2		4.8		3.8		4.75		3		
	Ruby Perfection		2.5		5.7		5.4		1.8		4.3		3.5		3.75		1.25		

## 2014

Charmant and Kaitlin produced the biggest and heaviest heads. Charmant heads had a lot of cracking at harvest and it was surmised that it might be more appropriate as a summer variety rather than for fall production and storage. Kaitlin, Bartolo, and Reaction stood out for producing exceptionally dense heads. Marner and Superstar had the most balanced and preferable flavor according to taste evaluations. Superstar, Storage #4 and Reaction were found to be mildly spicy (defined as a “hot sulfur” flavor). Evaluators noted Turkis and Kaitlin as having the most mild flavor. Charmant and Marner had the least damage from cabbage looper and Superstar had the most according to ranked evaluations.

## 2015

Integro, Dottenfelder Dauer, and Dowidna were the best performing varieties for head weight. Impala also performed well when considering both head weight and head size (height and width). In taste evaluations, Bartolo, Dowinda, and Integro stood out as having the best flavor and texture. Participating farmers indicated that texture and flavor are equally important in a good cabbage, with an ideal cabbage being crisp and sweet with a balance of moderate sulfur flavor. Farmers also found thick leaves desirable because they had previously observed a correlation between thick leaves and increased storability. Bartolo and Integro ranked highly for uniformity, as did Impala. The highest scores for marketability were Impala for the green cabbages and Rodynda for the red cabbages.

## Discussion

Bartolo, Charmant, Impala, and Reaction were the best overall performing varieties of the green F1 hybrids considering all of the traits evaluated at the two trial locations. Farmers involved in the trials also reported that Bartolo held well in the field and did not continue to grow and increase in size once it was fully mature. Integro was the standout among the purple F1 hybrids as it had exceptionally uniform, attractive heads and excellent texture and flavor. However, it seemed to readily succumb to head rot both in the field and in storage. Reaction, Integro, and Impala are all available as organic seed. Ruby Perfection also performed well but rated low for flavor. Marner and Dowinda were standout open-pollinated varieties among the greens and Rodynda stood out among the purples. Due to its somewhat unique, football-like shape Dowinda does not fit the current market for a commercial shipping cabbage, but was noted to have strong potential for fresh market sales. Dowinda also scored high in taste tests in 2015 and was of notable interest to local growers. In both years it was observed that in general green cabbages appeared to be more susceptible to cabbage looper damage, while red cabbage varieties had greater aphid damage.

## ONIONS

Year	Trial Location	Farm Name	Seeding Date	Transplant Date	Trial Design	Number of Reps	In-row Spacing	Between Row Spacing	Harvest Evaluation
2014-2015	Port Townsend	Midori Farm	February 18 <sup>th</sup>	April 18 <sup>th</sup>	Augmented Incomplete Block	NA	NA	NA	August 19 <sup>th</sup>
2015-2016	Chimacum	OSA Research Farm	February 18 <sup>th</sup>	April 17 <sup>th</sup> and 21 <sup>st</sup>	Randomized Block	2	4”	12”	August 19 <sup>th</sup>

Variety	Source	Certified Organic Seed	OP/F1	2014-2015	2015-2016
Australian Brown	Organic Seed Alliance	Yes	OP	x	
Bajosta	Sativa	Yes	OP	x	x
Borettana	Uprising Seeds	Yes	OP	x	
Cabernet	Johnny's Selected Seeds	No	F1	x	x
Calibra	Bejo Seeds	Yes	F1	x	
Cipolla di Rovato	Osborne Seeds	No	OP	x	
Clear Dawn	Turtle Tree Seeds	Yes	OP	x	
Copra	Bejo Seeds	No	F1	x	x
Cortland	Bejo Seeds	Yes	F1	x	
Dakota Tears	Prairie Road Organics	Yes	OP	x	
Dorata di Parma	Gourmet Seeds	No	OP	x	
Front Range Yellow	Abbo Regional	Yes	OP	x	
Gold Coin	Johnny's Selected Seeds	No	OP	x	
Legend	Bejo Seeds	No	F1	x	
New York Early	Wolf Gulch Farm	Yes	OP	x	
Newburg	Siskiyou Seeds	Yes	OP	x	x
Ramata di Milano	Gourmet Seeds	No	OP	x	
Red Cipollini	Beth Rasgorshek - Canyon Bounty Farm	Yes	OP	x	
Red Marble	Bejo Seeds	No	F1	x	x
Rossa di Milano	Uprising Seeds	Yes	OP	x	x
Rouge de Geneve	Sativa	Yes	OP	x	
Sturon	Sativa	Yes	OP	x	
Stuttgarter	Sativa	Yes	OP	x	x
W.E.O.S. 1	University of Wisconsin	No	OP	x	
W.E.O.S. 2	University of Wisconsin	No	OP	x	
W.E.O.S. 3	University of Wisconsin	No	OP	x	
W.E.O.S. 4	University of Wisconsin	No	OP	x	x
W.E.O.S. 5	University of Wisconsin	No	OP	x	
Yankee	Bejo Seeds	Yes	F1	x	
Yellow Valencia	Abbo Regional	Yes	OP	x	
Talon	Bejo Seeds	No	F1		x
T5987	Vitalis Seed	No	F1		x
Kauri	Vitalis Seed	No	F1		x
Plutonius	Vitalis Seed	No	F1		x
Frontier	Osborne Seed Company	No	F1		x
OSA Red	Organic Seed Alliance	No	OP		x

## Results

Year	2014-2015	2015-2016	2014-2015	2015-2016	2014-2015	2015-2016	2014-2015	2015-2016	2014-2015	2015-2016
Variety	% Marketable at Harvest		Marketable Weight (lb)		Firmness (1=soft, 3=firm)		% Remaining after January Cull		% Remaining after February Cull	
Australian Brown	93.5		0.2		3.0		41.9		11.6	
Boretana	60.0		0.2		3.0		18.5		3.7	
Calibra	18.0		0.3		1.3		54.8		17.8	
Cipolla di Rovato	21.3		0.2		3.0		30.0		20.0	
Clear Dawn	27.1		0.2		NA		76.9		53.8	
Cortland	26.1		0.2		2.3		60.0		40.0	
Dakota Tears	33.3		0.2		NA		69.2		38.5	
Dorata di Parma	30.2		0.2		2.0		25.0		16.7	
Front Range Yellow	16.7		0.2		2.0		42.9		0.0	
Gold Coin	31.8		0.2		2.0		28.6		28.6	
Legend	27.7		0.2		2.3		76.1		57.3	
New York Early	38.6		0.2		NA		61.1		44.4	
Red Cipollini	51.1		0.1		NA		26.1		17.4	
Rouge de Geneve	97.9		0.1		3.0		76.6		70.2	
W.E.O.S. 1	76.6		0.2		3.0		63.9		50.0	
W.E.O.S. 2	88.9		0.2		NA		93.0		0.0	
W.E.O.S. 3	74.5		0.3		3.0		37.1		25.7	
W.E.O.S. 5	87.5		0.3		2.0		47.1		8.8	
Yellow Valencia	13.6		0.2		2.0		16.7		0.0	
Bajosta	55.0		0.2		3.0		86.4		59.1	
Cabernet	100.0	36.8	0.2	0.3	1.7	2.0	45.5	21.4	20.9	0.0
Copa	26.1	76.9	0.2	0.3	3.0	2.8	70.2	84.0	65.6	36.0
Newburg	55.6	28.6	0.2	0.4	2.0	3.0	72.0	81.3	56.0	25.0
Red Marble	93.2	62.0	0.2	0.2	3.0	2.5	70.0	87.5	35.0	87.5
Rossa di Milano	9.8	59.1	0.3	0.3	2.0	2.5	50.0	67.3	0.0	28.2
Stuttgart	97.6	79.0	0.2	0.3	NA	2.8	100.0	95.3	95.0	90.5
W.E.O.S. 4	66.7	76.4	0.2	0.3	3.0	2.0	67.7	65.8	38.7	37.9
Yankee	14.9	25.6	0.4	0.3	3.0	2.0	100.0	100.0	100.0	72.7



## Results (continued)

Frontier		45.7		0.4		3.0		70.8		21.1
Kauri		54.5		0.3		2.5		69.3		69.3
Plutonius		57.7		0.3		3.0		76.7		76.7
Talon		81.7		0.4		3.0		51.9		51.9
TS987		40.1		0.4		NA		0.0		0.0

Onions were initially evaluated and put into storage on 9/26/14 for the 2014-15 season and on 9/23/15 for the 2015-16 season. January and February evaluations and culls occurred four and five months, respectively, after initial storage.

## **2014**

This trial was hit extremely hard by downy mildew in June and all varieties suffered damage. There was also a significant amount of bolting in the trial. These two factors along with size were the primary reasons for reductions in marketable yield at harvest. Yankee tolerated the downy mildew infection best, followed by Legend. Cabernet and the W.E.O.S varieties incurred the worst damage from the infection. Cabernet, Rouge de Geneve, Stuttgarter, Australian Brown, and Red Marble all produced greater than 90% marketable bulbs at harvest (based on bulb size, lack of bolting, lack of disease, and overall appearance). Rossa di Milano, Yellow Valencia, Yankee, Front Range Yellow, and Calibra all performed poorly at harvest with less than 20% marketable bulbs. Across the trial all varieties produced relatively small marketable bulbs, Yankee produced the largest and Red Cipollini and Rouge de Geneve produced the smallest.

Harvested bulbs were stored and evaluated for quality in January and February. Bulbs were culled for root growth, neck elongation, rot, and/or disease. At the January evaluation 100% of the stored bulbs of Yankee and Stuttgarter and more than 90% of W.E.O.S remained marketable. The worst performers in terms of storage quality in the January evaluation were Borettana and Yellow Valencia. After the final storage evaluation in February, 100% of Yankee and 95% of Stuttgarter still remained in marketable condition. No marketable bulbs remained after the February evaluation of Borettana, Front Range Yellow, W.E.O.S. 2., Yellow Valencia, or Rossa di Milano.

## **2015**

This trial experienced no major pest or disease issues. At harvest only Talon had greater than 80% marketable bulbs, and Stuttgarter, Copra, and W.E.O.S. 4 produced between 76-79% marketable bulbs. The poorest performers for percentage of marketable bulbs were Newburg and Yankee. The average marketable bulb weights were larger than in 2014 and no varieties stood out as smaller or larger than the rest. Again Yankee and Stuttgarter had the highest percentage of bulbs remaining marketable after the January storage evaluation, and Cabernet and Talon had the least. Stuttgarter and Red Marble had the highest percentages of remaining marketable bulbs after the February storage evaluation. Only Cabernet had no marketable bulbs left after the February evaluation. Notably, Talon, Plutonius, Kauri, and Red Marble all had no loss of marketable bulbs between the January and February storage evaluations.

## **Discussion**

Overall several organically available open-pollinated (OP) varieties performed well and several of the best performing F1's are also available as organic seed. The percentage of marketable bulbs at harvest was high in some varieties that did not hold well in storage such as Australian Brown and Cabernet; indicating these varieties may be best for immediate and early winter sales. Unfortunately the varieties with the longest storage quality tended to be ones such as Yankee and Newburg that had lower marketable yields at harvest, making them less desirable for production. Yankee also had a higher average bulb weight and bulb firmness than most, but may need a longer season than we have on the Olympic Peninsula for optimal maturity and sizing up. Among the OP varieties Rouge de Geneve and Stuttgarter produced high marketable yields, firm bulbs, and good retention in storage.

# CHICORY

Year	Trial Location	Farm Name	Seeding Date	Transplant Date	Trial Design	Number of Reps	In-row Spacing	Between Row Spacing	Harvest Evaluation
2014-2015	Nordland	WSU Twin Vista Ranch	NA	August 27 <sup>th</sup>	Randomized Block	3	12"	12"	February 24 <sup>th</sup> -April 2 <sup>nd</sup>
2015-2016	Chimacum	OSA Research Farm	July 24 <sup>th</sup>	September 3 <sup>rd</sup>	Randomized Block	3	12"	12"	February 26 <sup>th</sup> -March 30 <sup>th</sup>

Variety	Type	Source	Certified Organic Seed	OP/F1	2014-2015	2015-2016
Castelfranco	Castelfranco	Wild Garden Seed	Yes	OP	x	
Variegata Di Castelfranco (VDC)	Castelfranco	Adaptive Seeds	Yes	OP	x	x
Variegata Di Castelfranco (VDC)	Castelfranco	Seeds from Italy (SFI)	No	OP	x	x
Variegata Di Castelfranco (VDC)	Castelfranco	Uprising Seeds	Yes	OP	x	x
Midori Castelfranco M1	Castelfranco	Midori Farm	Yes	OP	x	
Midori Castelfranco M2	Castelfranco	Midori Farm	Yes	OP	x	x
Bel Fiore	Bocciolo ('Rose Bud')	Johnny's Selected Seeds	No	F1	x	x
Variegata Di Lusita Tardiva	Castelfranco	Seeds from Italy (SFI)	No	OP	x	x
Rossa Di Verona Sel. Arca	Bocciolo ('Rose Bud')	Seeds from Italy (SFI)	No	OP	x	x
Rossa Verona Tardiva	Bocciolo ('Rose Bud')	Uprising Seeds	Yes	OP	x	x
Grumolo Rossa	Bocciolo ('Rose Bud')	Seeds from Italy (SFI)	No	OP	x	x
Bocciolo di Rosa M1	Bocciolo ('Rose Bud')	Midori Farm	Yes	OP	x	x
Bocciolo Rosa M2	Bocciolo ('Rose Bud')	Midori Farm	Yes	OP	x	x
Orchidea Radicchio	Bocciolo ('Rose Bud')	Adaptive Seeds	Yes	OP	x	x

## Results

Year	2014-2015	2015-2016	2014-2015	2015-2016	2014-2015	2015-2016	2014-2015	2015-2016	2014-2015	2015-2016	2014-2015	2015-2016	2014-2015	2015-2016
Variety	Ave. % Plants Overwintered		Plant Habit (1=prostrate, 5=upright)		Plot Uniformity (1=worst, 5=best)		Appearance (1=worst, 5=best)		Flavor (1=worst, 5=best)		Ave. Plant Height (in)		Ave. Plant Width (in)	
Castelfranco	75.4	NA	3	NA	4.1	NA	3.3	NA	3.5	NA	NA	NA	NA	NA
Variegata Di Lusita Tardiva	58	76.2	3.3	3.2	3.2	2.9	4.3	NA	4.5	NA	NA	8.2	NA	12.8
Grunmolo Rosa	78.3	83.1	4.7	3.7	3.4	4.2	NA	NA	NA	NA	NA	8.4	NA	11.7
Midori Castelfranco M1	75.4	NA	3.8	NA	2.6	NA	3.3	NA	2	NA	NA	NA	NA	NA
Midori Castelfranco M2	85.5	64.3	1.5	2.0	3.3	3.6	3.1	NA	3.7	NA	NA	10.4	NA	14.5
Orchidea	65.2	65.7	2.8	3.2	2.5	2.7	3.9	NA	3.6	NA	NA	8.3	NA	11.7
Red Rossa M1	91.3	95.2	3.8	4.0	4.2	4.9	3.3	NA	3.1	NA	NA	11.6	NA	13.9
Red Rossa M2	89.9	32.9	4.3	3.8	4.4	4.6	3	NA	3.1	NA	NA	9.2	NA	14
Rossa di Grunmolo	NA	67.9	NA	3.5	NA	4.1	NA	NA	NA	NA	NA	7.6	NA	10.9
Rossa di Verona Tardiva	87	75.6	4.2	3.8	3.8	4.4	4	NA	3.1	NA	NA	8.1	NA	11.2
Rossa di Verona Sel. Arca	32.6	NA	3.5	NA	3.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
VDC (Adaptive)	88.4	85.6	2.8	3.0	3.2	3.6	4.9	NA	4.3	NA	NA	10.2	NA	14.9
VDC (SF1)	87	80.4	2.3	2.0	3.3	2.6	3.5	NA	3.1	NA	NA	9.7	NA	15.8
VDC (Upripping)	78.3	81	2.7	2.3	3.6	3.8	2.9	NA	2.5	NA	NA	8.8	NA	13.4

## **2014-2015**

Winter low temperatures for this trial were in the mid-teens with a recorded low of 14F (-10C). For the Castelfranco types, the strain from Adaptive Seeds and the Midori Farm M2 strain had the highest percentages of plants that successfully overwintered, whereas the Variegata Di Lusia Tardiva had the most loss over the winter. The Wild Garden Seed Castelfranco was the most uniform across the plot and Variegata Di Lusia Tardiva and the Adaptive Seeds strain had the least uniformity. Midori M2 strain was the most prostrate of the Castelfrancos and Variegata Di Lusia Tardiva was the most upright. Of the Castelfranco's Variegata Di Lusia Tardiva had the most preferable flavor and the Midori M1 strain had the least preferable. For the Bocciolo types the Red Rossa M1 and M2 strains overwintered the most successfully and Rossa di Verona Sel Arca had the most loss. Red Rossa M2 was the most uniform across the plot for the Bocciolo types and Orchidea was the least. Grumolo Rosa was the most upright of the Bocciolo's and Orchidea was the most prostrate. For the Bocciolo's Orchidea had the most preferable flavor and all the others were rated the same.

## **2015-2016**

Winter low temperatures were similar to the 2014-2015 season and reached the high-teens with a recorded low of 19F (-7C). The Adaptive Seeds strain had the highest percentage of overwintering plants that survived among the Castelfranco types, and the Midori M2 strain had the lowest. The differences in percent of overwintered plants was minimal between all varieties, and the Midori M2 strain ranked higher in overwintering survival in the previous years trial. The Uprising Seeds strain was the most uniform across the plot and the Seeds From Italy strain was the least uniform. Again the Midori M2 strain, along with the Seeds From Italy strain, were the most prostrate of the Castelfrancos and the Midori M1 strain was the most upright. Differences in overwintering survival was more extreme among the Bocciolo types. Red Rossa M1 had the best overwintering survivorship with 95% survival, and Red Rossa M2 had the worst with 32% survival. Red Rossa M1 was the most uniform across the plot and again Orchidea was the least uniform. Red Rossa M1 was the most upright and again Orchidea was the most prostrate. No flavor evaluation data was available for this trial.

## **Discussion**

This trial included two main types or classes of chicory varieties, Castelfranco and Bocciolo. The two types are best compared within their respective classes rather than across as they differ in appearance, growth habit, and culinary qualities. Several different seed sources of similar types within these classes were included. The Castelfranco type is characteristically light green, sometimes mottled with red speckles or variegated splashes of red color, and forms a rosette similar to a head of lettuce. It tends to be milder in flavor than the Bocciolo varieties. Bocciolo is a newer term that means "rose bud" in Italian. It is characteristically between a "Treviso" type and a radicchio with an upright in stature like Treviso, but with more open and rounded leaves like a radicchio, presenting a looser, floral-like arrangement in the head shape. This type has a stronger, more bitter flavor than Castelfranco types.

Chicory varieties are primarily open-pollinated and generally much less uniform in appearance than other crops. They often exhibit diversity in colors, leaf texture, stature, and size between individual plants within a variety. This creates a prime opportunity to select plants out of a variety or even across varieties and create new populations. This is indeed how the multiple varieties from Midori Farm in the trial were originally created. The lack of uniformity within and between varieties also leaves room for personal preferences, as there is no "one" distinct prototype, and an opportunity for chef's to creatively integrate the colors, textures, and flavor differences into various culinary applications. The ability to overwinter, produce a good head size, hold in the field and not bolt prematurely are all important agronomic qualities for production in the Northwest region. An upright habit and tighter heads are also desirable to avoid dirt splashing on leaves and heads retaining a good shape at market. Differences in these agronomic traits can be seen in the trial data with some clear stand outs and some qualities that were more consistent across varieties.



## PURPLE SPROUTING BROCCOLI

Year	Trial Location	Farm Name	Seeding Date	Transplant Date	Trial Design	Number of Reps	In-row Spacing	Between Row Spacing	Harvest Evaluation
2014-2015	Nordland	WSU Twin Vista Ranch	NA	September 8 <sup>th</sup>	Randomized Block	3	18"	30"	March 10 <sup>th</sup> -31 <sup>st</sup>
2015-2016	Chimacum	OSA Research Farm	August 3 <sup>rd</sup>	September 4 <sup>th</sup>	Randomized Block	3	18"	30"	March 11 <sup>th</sup> -April 12 <sup>th</sup>

Variety	Source	Certified Organic Seed	OP/F1	2014-2015	2015-2016
Bonarda	Bejo Seeds	No	F1		x
Mendocino	Bejo Seeds	No	F1		x
Red Matador	Osborne Seed Company	No	F1	x	
Red Fire	Osborne Seed Company	No	F1	x	x
Red Admiral	Osborne Seed Company	No	F1	x	x
PSB-Thoreau	Chris Thoreau	No	OP	x	
PSB-Territorial	Territorial Seed Company	No	OP	x	x
Cardinal	Tozer Seeds	No	OP	x	x
Rudolph	Osborne Seed Company	No	OP	x	x
Red Head	Tozer Seeds	No	OP	x	
OSA 239	Blue Fox Farm	Yes	OP	x	
OSA 206	Blue Fox Farm	Yes	OP	x	
OSA - Chris Jager Population	Blue Fox Farm	Yes	OP		x
OSA Midori 212	Midori Farm	Yes	OP		x
TVR PSB	Organic Seed Alliance	Yes	OP		x
Red Arrow	Tozer Seeds	No	OP		x
Red Spear	West Coast Seeds	No	OP		x
Rioja	Bejo Seeds	No	F1		x
Santee	High Mowing Organic Seeds	Yes	F1		x

## Results

Year	2014- 2015	2015- 2016	2014- 2015	2015- 2016	2014- 2015	2015- 2016	2014- 2015	2015- 2016	2014- 2015	2015- 2016	2014- 2015	2015- 2016	2014- 2015	2015- 2016	2014- 2015	2015- 2016	2014- 2015	2015- 2016
Variety	Ave. Total Harvest Weight/Plant (lb)		Ave. Sprouts/Plant		Ave. Central Head Diameter (in)		Ave. Bud Diameter (in)		Ave. Bud Color (1=lightest, 5=darkest)		Plot Uniformity (1=worst, 5=best)		Flavor (1=worst, 5=best)					
OSA 239	0.3		11.5		3.7		1.6		4.4		2.3		2.5					
PSB - Thoreau	0.3		10.9		4.3		1.5		3.0		3.5		NA					
Red Head	0.3		8.1		4.6		1.6		4.7		4.2		2.8					
Red Matador	0.3		7.4		4.5		1.6		4.0		NA		NA					
Cardinal	0.5	0.4	14.2	6.0	4.3	3.8	1.2	1.4	5.0	4.0	4.0	3.7	NA	4.1				
OSA 206	0.4	0.4	11.4	9.1	4.5	3.9	1.3	1.4	4.6	2.7	3.0	2.7	3.7	2.8				
Red Admiral	0.5	0.2	18.5	10.7	4.7	3.3	1.1	1.1	3.0	1.8	NA	4.0	NA	3.0				
Red Fire	0.3	0.3	18.5	10.2	4.1	2.8	1.4	1.1	5.0	3.6	4.5	3.5	4.1	3.5				
Rudolf	0.4	0.3	5.5	4.8	5.9	3.8	1.5	1.6	4.0	3.5	NA	2.8	2.4	2.8				
PSB- Territorial	0.3	0.4	17.2	8.2	4.0	4.1	1.2	1.3	3.5	3.5	2.3	4.0	2.3	3.4				
Bonarda		0.4		6.4		4.2		1.3		4.2		4.8		3.1				
Jager '15		0.3		6.9		4.2		1.3		3.5		2.5		2.6				
Mendocino		0.5		6.9		3.7		1.7		3.8		4.3		3.6				
OSA 212		0.4		7.4		3.5		1.3		3.9		3.2		3.6				
Red Arrow		0.4		10.6		3.2		1.2		3.3		2.8		4.2				
Red Spear		0.4		11.8		2.8		1.8		2.3		1.0		2.7				
Rioja		0.5		8.5		4.3		1.8		4.2		4.7		3.2				
Santee		0.3		8.8		2.9		1.2		3.9		3.7		3.9				
Summer		0.3		7.6		4.0		1.5		3.3		1.7		2.3				
TVR PSB		0.5		8.9		4.2		1.6		3.5		3.8		3.4				

## **2014-2015**

Winter low temperatures for this trial were in the mid-teens with a recorded low of 14F (-10C). Included in these trials were varieties of three distinct maturity classes: early, mid, and late. The varieties in each of these categories were:

Early Maturity Varieties (first to be ready for harvest): Red Matador, Red Admiral, Rudolph

Mid-Maturity Varieties (second to be ready for harvest): Red Fire, PSB-Territorial

Late Maturity Varieties (third to be ready for harvest): Cardinal, Red Head, PSB-Thoreau, OSA 239, OSA 206.

Cardinal and Red Admiral produced the heaviest average harvest weight (combination of both sprouts and central heads). Red Admiral and Red Fire produced substantially more sprouts per plant and Red Matador and Rudolph produced the least number of sprouts per plant. Rudolph also produced the largest diameter central heads whereas OSA 239 had the smallest. Red Head produced some of the largest and darkest sprouts and Red Admiral produced the smallest and lightest colored sprouts. Red Fire plots were the most uniform and plots of PSB-Territorial and OSA 239 were the least uniform. Red Fire was found to have the most preferable flavor and PSB-Territorial had the least preferable flavor.

## **2015-2016**

Several varieties were dropped from the 2014-2015 trial based on seed availability and results, and several more were included. Some of the repeated varieties fell into different maturity classes in 2015-2016 than in 2014-2015. The varieties in each of the maturity categories were:

Early Maturity Varieties: Red Admiral, Rudolph, Red Fire, Rioja, Santee, Summer, PSB 212

Mid-Maturity Varieties: Mendocino, Jager '15, OSA 206, TVR PSB, Red Arrow

Late Maturity Varieties: Cardinal, Bonarda, Red Spear, Territorial.

Winter low temperatures were similar to the 2014-2015 season and reached the mid-teens with a recorded low of 19F (-7C). Rioja and Mendocino produced the heaviest average harvest weight. Red Spear, Red Admiral, Red Arrow, and Red Fire all produced the most sprouts per plant, and Rudolf produced the least. Rioja, Bonarda, and Jager '15 produced the largest diameter central heads and Red Spear and Santee produced the smallest. Rioja produced the biggest and darkest sprouts and again Red Admiral produced the smallest and lighted colored sprouts. Rioja and Bonarda produced the most uniform plots and Summer and Red Spear produced the least uniform plots. Sprouts of Rioja and Bonarda were notably cleaner (little to no leaves) and fatter than the rest of the varieties in the trial. Red Arrow and Cardinal were the most preferable for flavor and Summer and Jager '15 were the least preferable.

## **Discussion**

All varieties included in both years of the trials performed fairly consistently across the two trial locations (Nordland and Chimacum), although all varieties produced more sprouts/plant in the 2014-2015 than in the 2015-2016 trial. Santee is the only one of the 14 commercially available varieties of PSB that is available as organic seed. However, all of the varieties performed well and produced quality, marketable sprouts.

Producers and retailers are still developing methods for harvesting and presenting purple sprouting broccoli as a crop. Many producers bunch side shoots with a twist tie for marketing, while other producers sell shoots in a loose bin and price by weight. Some varieties seemed to have more brittle heads that could be damaged if not carefully handled in bunches or loose bins. Producer feedback indicated a preference for more purple color in the stems, as it looks better and less messy when presented in a bulk or loose form. Also, breakage or damage of individual flower buds is not as apparent as it is when the stems are highly contrasted green.

Although this trial did not include cutting the central heads in the early maturity stage this is a common commercial practice. Producers who participated in the evaluation hypothesized that cutting the central head early may increase side shoot formation and bud size, but this was not confirmed by our trial. Producers and retailers also proposed that the central head might also be of market value if cut and marketed differently than the side shoots.

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Photos courtesy of Organic Seed Alliance

**Reference as:**

**McKenzie, L., Davis, K., Colley, M. 2016. Vegetable Crops for Season Extension in the Pacific Northwest: 2014-2016 Trial Results. Organic Seed Alliance, Port Townsend, WA.**

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**Educational Materials**

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