

FARMER-RESEARCHERS

Angie Koch

Fertile Ground Farm

Ann Slater

Ann Slater Organics

Hilary Moore

Maplelane Farm

Martina Schaefer

Spiral Farm

Romina Bortoluzzi & Roger

Thiessen

Our Fields Farm

Roger Rivest

Nature Lane Farms

Sarah Judd

Meadow Lynn Market Garden

RESEARCH REPORT 2021

Summer green head lettuce variety trial

IN A NUTSHELL

The growers' objective was to document the best green head lettuce for summer production across different farms throughout southern Ontario during the 2021 season.

- Nevada was the top variety with respect to vigor, flavour, longest harvest, disease hardiness, and germination in this trial.

- Muir was a runner-up to Nevada, but did have some germination issues and did not size up as well.
- Concept and Encino were the growers' least favorite varieties this year.
- Overall, these results are consistent with the 2020 lettuce variety trial (1).



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MOTIVATION

The hot summer weather in Ontario can make it hard to germinate and grow head lettuce of marketable quality. This year, 7 growers from across Ontario — many of whom participated in the 2019 and 2020 lettuce variety trials — assessed six varieties of green head lettuce in a randomized and replicated trial over two planting dates. The goal of the trial was to identify the best summer head lettuce across different farms in Ontario during the 2021 season.

METHODS

In 2021, growers from southern Ontario compared six varieties of green head lettuce (**Table 1**) in a randomized and replicated trial over two planting dates. The growers included three varieties (Muir, Nevada, and Encino) from 2020 summer and fall head lettuce variety trials (1), and one variety (Starfighter) from the 2019 fall head lettuce variety trial (2). Crop management records for seeding dates, transplant

dates, and data collection can be found in **Table 2**. Growers used either drip or overhead sprinkler irrigation and organic fertilizers as required.

Plot Location

- Growers avoided the edge of the field and the end of the bed when planting the trial.
- Growers planted the trial in a homogenous area of the field and avoided areas with known soil, shade, or irrigation differences which may have affected plots.
- When possible, they planted the trial in a spot which had the same crop on either side.

Trial Arrangement

- For each planting, growers created two replicated blocks with a plot for each of the six varieties, each variety plot containing 6+ heads of lettuce within.

- Growers distributed the plots randomly either in multiple side-by-side beds or across one bed.
- Suggested spacing for growers in-row: 12" and between-row: 12-14"
- Growers used stakes to label plots and drew field maps showing the order and location of varieties.



Photo 1. Collecting leaf samples for taste tests at Fertile Ground CSA.

Table 1. Complete list of summer head lettuce varieties that the growers selected to trial in 2021.

BLIND CODE	VARIETY	TYPE	COLOUR	DTM	SOURCE	ANY INTELLECTUAL RESTRICTIONS GRANTED	ORGANIC CERT.	BREEDER*
LS1	Bergam's Green	Green Leaf	Green	45 days	Johnny's	No	OG	Vitalis Organic Seeds (Enza Zaden)
LS2	Concept	Summer Crisp/ Batavia	Green	51 days	High Mowing	No	OG	Orsetti Seed Co.
LS3	Encino	Oakleaf	Green	50 days	High Mowing	No	OG	Vitalis Organic Seeds (Enza Zaden)
LS4	Muir	Summer Crisp/ Batavia	Green	50 days	Johnny's	Yes (PVP**)	OG	Vitalis Organic Seeds (Enza Zaden)
LS5	Nevada	Summer Crisp/ Batavia	Green	48 days	Johnny's	No	OG	Vilmorin
LS6	Starfighter	Green Leaf	Green	52 days	Johnny's	No	OG	Rijk Zwaan

*The breeder column represents varieties that come from the same breeder and thus are likely to have similar genetics.

**A Plant Variety Protection (PVP) is granted by the United States Department of Agriculture. It protects a unique seed by prohibiting unauthorized commercialization and as such growers cannot sell farm-saved seeds from this lettuce. The PVP remains in effect for 20 years. Many PVP varieties are granted Plant Breeders Rights (PBR) in Canada.

DATA ANALYSIS

To evaluate the effect of variety on germination, harvest window, disease pressure, flavour and overall rating, we used a statistical model called analysis of variance (ANOVA) with a 90% confidence level to calculate the least significant difference (LSD) needed to call the treatments "statistically different".

Using a 90% confidence level means that if we measure a difference between any two treatments that is greater than the calculated LSD, we expect this difference would occur 9 times out of 10 under the same conditions. In this case, we consider the difference reliable and refer to the results as statistically significant. On the other hand, if we measure a difference between any two treatments that is less than the calculated LSD, we consider these treatments unreliably different or statistically similar. We could make these statistical calculations because the growers' experimental designs involved replication of the treatments and farm sites.

FINDINGS

Germination

Growers recorded germination rates for both plantings and found there was a significant difference between the two plantings ($P=0.05$). As such, data from each planting was analyzed separately.

Growers found a significant difference among varieties in planting 1 ($P=0.01$). Using an LSD of

18% seen in **Table 3**, they found that Concept, Nevada, Starfighter, and Muir had the highest germination rates, followed by Encino and than Bergam's Green. Growers also found a significant difference among varieties in planting 2 ($P=0.001$), using an LSD of 13%. They found that Concept, Nevada, and Starfighter had the highest germination rates, followed by Encino, Bergam's Green, and than Muir (**Table 3**).

Table 2. Crop management records for both plantings of the head lettuce trial.

FARMER	SEEDING DATE	TRANSPLANT DATE	DATA COLLECTION & NOTES
Angie Koch*	May 19 & June 8	June 23 & July 7	Left in field for bolting X 2
Ann Slater	May 27 & June 8	June 16 & June 30	Harvest for market
Hilary Moore	May 16 & June 11	June 18 & August 10	Harvest for market
Martina Schaefer	May 23 & June 1	June 21 & July 16	Harvest for market
Roger Thiessen and Romina Bortoluzzi	May 17 & June 1	June 16 & June 25	Harvest for market
Roger Rivest	May 25 & June 7	June 23 & July 6	Left in field for bolting
Sarah Judd	May 28 & June 15	July 2 & July 15	Left in field for bolting

*Angie Koch planted four replicate blocks to increase the statistical power of data collected from growers who left lettuce in the field to bolt.

Table 3. Mean germination rate for each variety in each planting across farms.

VARIETY	GERMINATION	
	PLANTING 1	PLANTING 2
Bergam's Green	55% c	55% bc
Concept	86% ab	78% a
Encino	66% bc	60% bc
Muir	82% ab	47% c
Nevada	83% ab	69% ab
Starfighter	91% a	76% a
LSD	18%	13%

Lower case letters denote significant differences between varieties, based on the LSD.

Table 4. Mean harvest window (in weeks) for each variety in each planting across farms who measured bolting.

VARIETY	HARVEST WINDOW	
	PLANTING 1	PLANTING 2
Bergam's Green	1.0	1.0
Concept	2.0	1.5
Encino	1.3	0.75
Muir	1.2	0.75
Nevada	1.5	1.0
Starfighter	1.3	1.3
LSD	NS	NS

NS = Not significant.

Harvest Window

Growers determined the harvest window by counting the number of weeks a variety had 50% or more harvestable heads with fewer than 50% of heads bolted. This was done in the hopes of determining which variety held the longest in the field, between being ready for harvest and before bolting. Due to limited data available, we analyzed Angie's (4 replications) and Sarah's data (2 replications) for planting 1 and Angie's (4 replications) for planting 2. With this dataset, growers found no significant difference in harvest window among any of the varieties in planting 1 (P=0.49) or in planting 2 (P=0.90) (**Table 4**).

Harvest Information

Harvest information was taken from grower observation records. All farms contributed to first harvest and first bolt dates, while only those growers who harvested head lettuce for markets contributed to the last harvest day dates.

As seen in **Table 5**, growers found there was no significant difference in the days to first harvest (P=0.23), which had a LSD of 5 days. Growers did find a significant difference in the days to first bolt (P=0.01). Using an LSD of 4 days, they found that Encino was the first variety to bolt, and Nevada was the last variety to bolt. They also found a significant

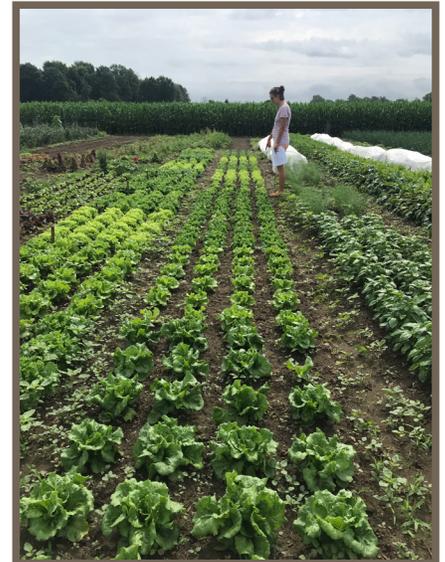


Photo 2. Evaluating lettuce trials at Our Fields Farm.

Table 5. Mean days since transplant until first harvest, first bolt, and last harvest for each variety averaged over farms.

VARIETY	FIRST HARVEST (DAYS)	FIRST BOLT (DAYS)	LAST HARVEST (DAYS)
Bergam's Green	34	46 abc	37 b
Concept	36	46 abc	40 ab
Encino	34	42 c	37 b
Muir	37	48 ab	41 ab
Nevada	37	49 a	42 a
Starfighter	36	43 bc	41 ab
LSD	NS	4	4

Lower case letters denote significant differences between varieties, based on the LSD. NS = Not significant



Photo 3. Lettuce bolting at Fertile Ground CSA, showing presence of disease.

Table 6. Mean flavour averaged over both plantings across all farms for the trial.

VARIETY	FLAVOUR
Bergam's Green	2.9 b
Concept	3.3 ab
Encino	3.6 ab
Muir	3.6 ab
Nevada	4.3 a
Starfighter	4.1 ab
LSD	1.2

Lower case letters denote significant differences between varieties, based on the LSD.

Table 7. Mean overall rating for each planting and averaged over both plantings across all farms for the trial.

VARIETY	PLANTING 1 OVERALL RATING	PLANTING 2 OVERALL RATING	AVERAGE OVERALL RATING
Bergam's Green	3.7 ab	3.6 a	3.7 ab
Concept	2.7 b	2.2 b	2.5 c
Encino	3.2 b	2.8 ab	3.0 bc
Muir	3.3 ab	4.0 a	3.7 ab
Nevada	4.4 a	4.0 a	4.2 a
Starfighter	3.0 b	3.4 ab	3.2 abc
LSD	1.2	1.1	1.1

Lower case letters denote significant differences between varieties, based on the LSD.

difference in the days to the last harvest ($P=0.02$). Using an LSD of 4 days, growers found that Nevada was harvested by market growers over the longest number of days, while Encino and Bergam's Green were harvested over the shortest number of days.

Flavour Rating and Overall Rating

Once per planting, growers rated each variety for flavour and overall rating. For flavour, growers tasted each variety of lettuce and ranked them on a scale for general taste and bitterness as follows: poor taste and bitter (1), okay (3), and excellent taste and sweet (5). They ranked overall ratings on a scale for overall performance as follows: poor (1), okay (3), and excellent (5).

Growers found a significant difference in flavour among varieties ($P=0.07$). Using an LSD of 1.2, they found that Nevada had the best flavour, followed by Starfighter, Muir, Encino, Concept, and than Bergam's Green (**Table 6**).

Growers found a significant difference in overall rating among varieties across farms in both plantings (planting 1, $P=0.07$; planting 2, $P=0.06$). The means and

LSD for overall rating for planting 1 and 2 are in **Table 7**. They also found a significant difference in overall rating among varieties when averaged over the two plantings ($P=0.002$). Using an LSD of 1.1, they found that Nevada rated best overall, followed by Muir, Bergam's Green, and Starfighter, than Encino and Concept (**Table 7**).

Table 8 shows the growers' notes on overall ranking and flavour for each variety in the trial. **Table 9** shows growers' answer to the question "Would you grow this green head lettuce variety again?". The flavour, overall ratings, and answers to the question corroborate other findings that Nevada and Muir were the top varieties in the summer head lettuce variety trial in 2021.

Disease Pressure

There was higher than normal disease pressure (both fungal and viral) in the growers' head lettuce crops this year due to the high heat and humidity. Using growers' observations on disease, they consistently noted that Muir, Concept, Encino, and Starfighter were more disease prone than Nevada and Bergam's Green (**Table 8**).

NEXT STEPS

Farmer-researchers from this multi-farm trial will use this data set to help inform green summer head lettuce selection moving forward. Growers will also use what they learned this year to help inform the types of data to collect and the ways in which to record them. For example, could rating disease hardness (or resistance) during head development up until head maturity and harvest help with variety selection in our unpredictable climate?



Photo 4. First Planting of Muir and Nevada lettuce heads at Maplelane Farm.

Table 8. Grower notes on flavour and overall rankings of each variety in the trial.

VARIETY	AK	AS	HM	MS	RT & RB	RR
Bergam's Green	Poor germination in heat, but heads were nice, good size, colour and flavour	Slightly bitter	Very crunchy, performed well but enjoyed its appearance and flavour most	Overall nice heads	Sweet at first, but bitter finish	Large heads
Concept	Great size and sturdiness, gorgeous heads and good flavour	Blah texture and flavour, but not bitter	Not bitter, not generally into romain type but liked this one	Tougher leaf than others, disease prone	Good taste, worst harvestability	Large leaves
Encino	Very soft, spine more bitter than leaf, juicy, bolted more quickly and leaves seemed damage prone with pale colour	Panisse has a similar oakleaf shape had better flavour and more tender leaf	Very tender, not what I look for in a summer lettuce, wouldn't grow as a summer lettuce- would try for fall	10/10, beautiful, tender, crispy, and sweet	Spongy texture, least pleasant mouth feel	Small heads has virus
Muir	Late to mature, very dense heads, did not size up very nicely this year, and second most disease prone	Holds well but flavour so-so	Crunchy and sweet, favourite - resistant to rot, good flavour, germination, and appearance	Crisp, good flavour, some disease	A bit chewy	Best of varieties, best flavour
Nevada	Nice texture, bolt resistant, sweet, long lasting, excellent	Crisp texture, sweet flavour	Flavour was fine, variety was okay, not my fave, not frilly or crunchy just leafy	Crunchy, fresh taste, and good quality heads		Large heads and leaves
Starfighter	Medium to large heads, frilly and attractive, tastes more bitter	Sweet if harvested right on time, bolts quickly	Good Flavour, variety was okay, not my fave, not frilly or crunchy just leafy	Nice heads, tender leaves, but disease prone	Best taste, worst harvestability	Smallest heads and leaves

* AK- Angie Koch; AS- Ann Slater; HM- Hillary Moore; MS- Martina Schaefer; RT & RB- Roger Thiessen and Romina Bortoluzzi; and RR- Roger Rivest.

Table 9. Growers were asked “Would you grow this green head lettuce variety again?”

VARIETY	AK	AS	HM	MS	RT & RB	RR
Bergam’s Green	Yes	Maybe	Yes	Yes	No	Yes
Concept	Yes	No	Yes	No	Maybe	No
Encino	No	No	Yes	Yes	No	No
Muir	Yes	Maybe	Yes	Yes	Maybe	Yes
Nevada	Yes	Yes	Maybe	Yes	Yes	Yes
Starfighter	Yes	No	Maybe	Maybe	No	No

AK- Angie Koch; AS- Ann Slater; HM- Hillary Moore; MS- Martina Schaefer; RT & RB- Roger Thiessen and Romina Bortoluzzi; and RR- Roger Rivest.

TAKE HOME MESSAGE

Although hot and wet summers can pose challenges for head lettuce growers, this trial offers insight into the most viable head lettuce varieties for production on ecological farms in Ontario.

Nevada was the standout summer head lettuce variety in this trial. It scored high in germination, days to first bolt, days to last harvest, disease hardiness, flavour and overall rating from growers.

Muir was a runner-up after Nevada, but had some issues with germination in the second planting along with stunted growth from disease and summer heat.

Concept and Encino were the growers’ least favorite varieties overall.

This dataset adds a second year of robust data for summer head lettuce varieties in southern Ontario. While 2020 was a relatively dry year and 2021 had high humidity and rainfall, in both years Muir and Nevada came out as the top varieties. Seeing the same varieties take top spot in two years with different weather patterns is interesting to note in light of climate change as we look to select more climate resilient varieties.

ACKNOWLEDGEMENTS

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1. Koch et al. 2020. Summer and fall head lettuce variety trials, https://efao.ca/wp-content/uploads/EFAO-LettuceTrial_2020.pdf.
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