

RESEARCH REPORT

Summer and Fall Head Lettuce Variety Trials

Farmer-Researchers

Angie Koch
Fertile Ground Farm (West)

Ann Slater
Ann Slater Organics (West)

Lise-Anne Léveillé
BeetBox Coop. Farm (East)

Jon Gagnon
Earth to Table Farm (West)

Laurie & Corey Ahrens
Edible Acres (West)

Martina Schaefer
Spiral Farm (West)

Hilary Moore
Maplelane Farm (East)

Harold Saunders
Saunders Family Farm (West)

Sarah Judd
Meadow Lynn Market Garden (West)

IN A NUTSHELL

The growers' objective was to document the best summer and fall head lettuce across different farms throughout southern and eastern Ontario during the 2020 season.

- Magenta, Muir, and Nevada were the top varieties with respect to overall vigor, flavour, and germination in the summer.
- Green Star was the growers' least favourite variety overall in the summer.
- Magenta, Ruby Sky, and Red Mist (from Vitalis Organic Seed) were the top varieties with respect to overall vigor in the fall.
- Encino was the growers' least favourite variety overall in the fall.
- Red Mist (from another seedhouse) had poor germination rates, demonstrating that seed source - and not just variety - matters.

MOTIVATION

Hot summer weather in Ontario can make it hard to germinate and grow summer head lettuce of marketable quality. At the same time, the fall slot for head lettuce is also challenging, as the lettuce has to handle both the moisture and temperature variability characteristic of the season. The goal of this trial was to identify the most reliable summer and fall head lettuce varieties across different farms in southern Ontario.

DESIGN

In 2020, growers from southern and eastern Ontario compared six varieties of summer head lettuce (**Table 1**) and five varieties of fall head lettuce (**Table 3**) in a randomized and replicated trial over two planting dates for each season.

The growers included one variety from 2019 in the fall trial (1). Growers chose to either harvest heads or leave them in the field to bolt. Crop management records for seeding dates, transplant dates, and data collection can be found in **Table 2** and **Table 4**, for summer and fall planted head lettuce respectively.

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 and each block contained sections with 8+ heads of each variety.
- Growers distributed the plots randomly either in multiple side-by-side beds or across one bed.
- Suggested spacing for growers was 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.



Table 1. Complete list of summer head lettuce varieties that the growers selected to trial in 2020.

Blind Code	Variety	Type	Colour	DTM	Source	Utility Patent Granted ^b	Certification	Breeder ^a
LS1	Green Star	Leaf	Green	52 Days	High Mowing	No	OG	Unknown
LS2	Magenta	Summer Crisp/ Batavia	Red	48 Days	Johnny's	No	OG	Graines Gautier
LS3	Muir	Summer Crisp/ Batavia	Green	50 days	Johnny's	Yes	OG	Vitalis Organic Seeds
LS4	Nevada	Summer Crisp/ Batavia	Green	48 Days	Johnny's	No	OG	Vilmorin
LS5	New Red Fire	Leaf	Red	55 days	High Mowing	No	OG	Takii Seeds
LS6	Tropicana	Leaf	Green	52 days	Vitalis Organic Seeds	Yes	OG	Vitalis Organic Seeds

^a - The breeder column represents varieties that come from the same breeder and thus are likely to have similar genetics

^b - (regular size italic) Utility Patents Granted means that this variety has intellectual property rights and can not be used by farmers to start a breeding project.

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

Farmer	Seeding Date	Transplant Date	Data Collection & Notes
Angie Koch	May 19 & June 4	June 18 & July 2	Left in field for bolting
Ann Slater	May 19 & June 4	June 12 & June 25	Harvest for market
Lise-Anne Léveillé	May 21 & June 5	June 17 & July 4	Left in field for bolting
Harold Sanunders	May 27 & June 10	June 23 & July 7	Left in field for bolting
Jon Gagnon	May 21 & June 4	June 25 & July 9	Left in field for bolting
Laurie and Corey Ahrens	May 20 & June 4	June 16 & June 30	Left in field for bolting
Martina Schaefer	May 19 & July 6	June 14 & August 16	Harvest for market
Sarah Judd	May 25 & June 10	June 18 & July 3	Left in field for bolting
Hillary Moore	May 22 & June 8	June 24 & July 20	Harvest for market



Table 3. Complete list of fall head lettuce varieties that the growers selected to trial in 2020.

Blind Code	Variety	Type	Colour	DTM	Source	Utility Patent Granted ^c	Certification	Breeder ^a
LF1	Encino	Leaf (Oak)	Green	50 Days	High Mowing	No	OG	Vitalis Organic Seeds
LF2	Red Mist	Leaf	Red	40 days ^b	Saanich Organics	No	OG	Vitalis Organic Seeds
LF3	Grazion	Leaf	Green	52 Days	Johnny's	No	OG	Rijk Zwaan
LF4	Magenta	Summer Crisp/ Batavia	Red	48 days	Johnny's	No	OG	Graines Gautier
LF5	Ruby Sky	Leaf	Red	58 Days	Johnny's	Yes	OG	Rijk Zwaan
LF6	Red Mist	Leaf	Red	40 days ^b	Vitalis Organic Seed	No	OG	Vitalis Organic Seeds

^a - The breeder column represents varieties that come from the same breeder and thus are likely to have similar genetics

^b - Note that the DTM for Red Mist is listed as 40 days at High Mowing, 50 at William Dam, and 60 days to maturity at Osborne Seeds.

^c - Utility Patents Granted means that this variety has intellectual property rights and can not be used by farmers to start a breeding project.

Table 4. Crop management records for both plantings of the fall trial.

Farmer	Seeding Date	Transplant Date	Data Collection & Notes
Angie Koch	July 10 & July 24	August 12 & August 26	Left in field for bolting
Ann Slater	July 29 & August 12	August 24 & September 6	Harvest for market
Lise-Anne Léveillé	July 19 & August 3	August 20 & September 2	Left in field for bolting
Harold Sanunders	July 10 & July 28	August 7 & August 21	Left in field for bolting
Jon Gagnon	July 27 & August 18	August 27 & September 14	Left in field for bolting Second planting did not survive
Sarah Judd	July 21	September 4 only	Left in field for bolting No Second Planting
Hillary Moore	July 24 & August 14	September 3 only	Harvest for market

^a - Only seven of nine growers participated in the fall trial.



FINDINGS - SUMMER

Germination

Growers recorded germination rates for both plantings. Germination rates were similar in the two plantings ($P=0.22$). Combining data from both plantings and using an LSD of 13%, we found that Magenta, Nevada and New Red Fire had the highest germination rates, followed by Muir and then Green Star and Tropicana (**Table 5**).

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% heads bolted. There was a difference in harvest window for planting 1 ($P<0.05$) but no detectable difference in the harvest window for planting 2 ($P>0.30$). This was true when the data was analyzed using data from all growers and only data from growers who did not harvest but kept the lettuce in the field to bolt. The mean harvest window in weeks for each variety in each planting and the LSD can be seen in **Table 6**.

Heat Tolerance

Growers scored all varieties from best (1) to worst (5) based on the week in which each variety started to bolt. We assessed the scores for planting 1 and planting 2 separately, and needed to see an LSD of 0.7 for planting 1 and 0.6 for planting 2. For plantings 1 and 2, Nevada, Magenta, Muir and New Red Fire bolted last, and Green Star and Tropical bolted first, as shown in **Table 7**.

Figure 1 and **Figure 2** show the mean percent of bolted heads by measurement week for the six varieties tested in the summer trial at planting 1 and 2 respectively.

Table 5. Mean combined germination rates for both plantings across farms for the summer trial.

Variety	Germination
Green Star	63% b
Magenta	82% a
Muir	74% ab
Nevada	79% a
New Red Fire	77% a
Tropicana	61% b
LSD	13%

^a - Lower case letters denote significant differences between varieties, based on the LSD. See more on statistics in the info on statistics box at the end of the report.

Table 6. Mean harvest window (in weeks) for each planting for the summer trial.

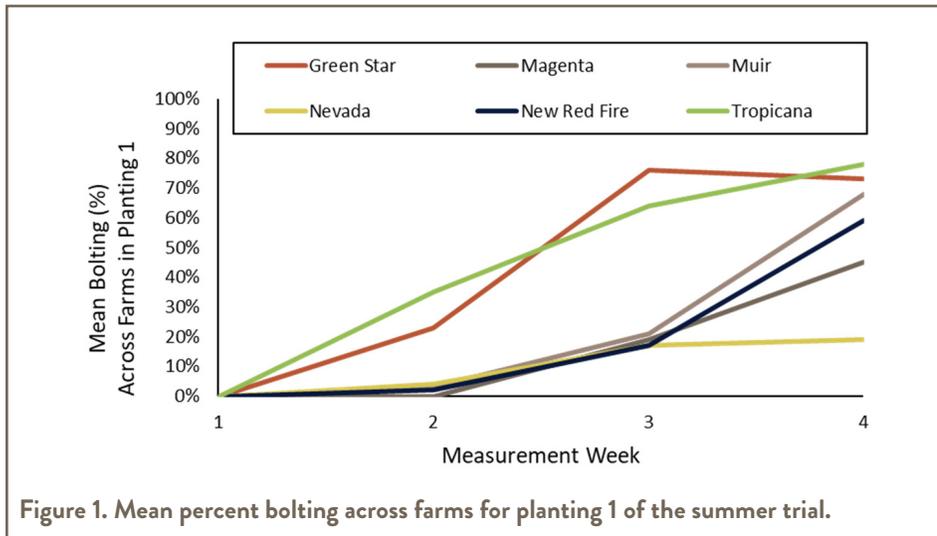
Variety	Planting 1	Planting 2
Green Star	1.1 b	1.7
Magenta	2.6 a	2.1
Muir	1.8 ab	2.1
Nevada	2.7 a	1.8
New Red Fire	2.4 a	1.6
Tropicana	1.3 b	1.6
LSD	0.91	NS

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

Table 7. Mean bolting score (1, bolted last; 5 bolted first) for each planting across farms for the summer trial.

Variety	Planting 1	Planting 2
Green Star	3.7 c	3.5 b
Magenta	1.7 ab	1.6 a
Muir	2.0 ab	1.3 a
Nevada	1.6 a	1.3 a
New Red Fire	2.4 ab	2.0 a
Tropicana	3.7 c	3.0 b
LSD	0.7	0.6

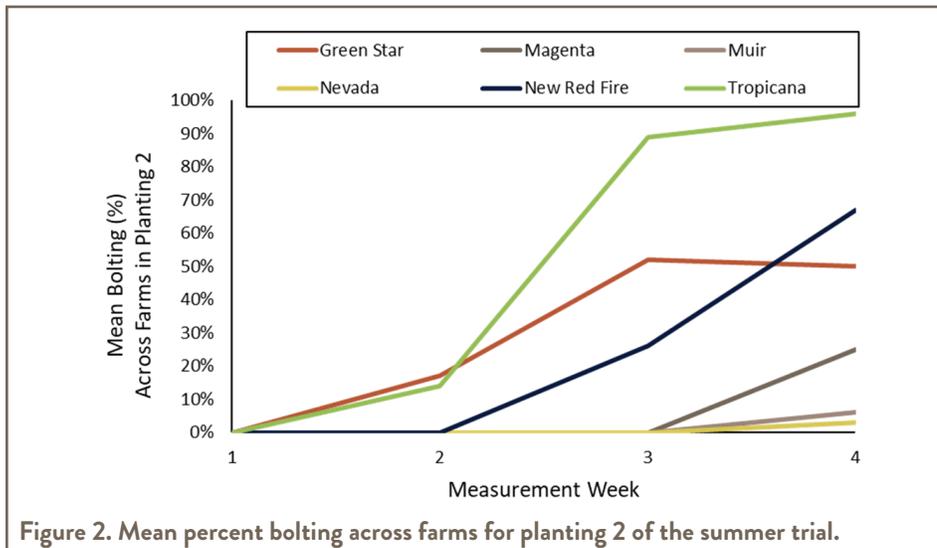
^a - Lower case letters denote significant differences between varieties, based on the LSD.



Tip Burn

Growers recorded the number of heads of each variety that showed tip burn, and coded each variety for presence (1 irrespective of # of heads affected) or absence (0) of tip burn in each planting. We then added up scores from all farmers for a score for each planting, and across plantings for a cumulative score.

Overall, tip burn was minimal for all varieties tested. Farmers did, however, observe tip burn in other varieties on growers' farms. For this reason, we concluded that the varieties tested were generally not prone to tip burn vs. weather not being favourable for tip burn.



As shown in **Table 8**, we found that New Red Fire, Magenta and Muir scored best, while Nevada, Green Star and Tropicana scored worst. Since tip burn was minimal such that the relatively poor tip burn rating for Nevada did not affect its overall rating by the growers.

Flavour and Overall Rating

Once per planting growers rated each variety for flavour and overall rating. For flavour, growers tasted each variety of lettuce and rated them on a scale for general taste and bitterness. For overall rating, growers rated overall performance. Ratings for both followed poor (1) to excellent (5). Flavour and overall performance ratings can be found in **Table 9**.

Table 10 shows the growers notes on overall ratings and flavour for each variety in the trial. The flavour and overall ratings corroborate other findings that Magenta, Muir and Nevada were the top varieties in the summer head lettuce variety trial in 2020.

Table 8. Mean bolting score (1, bolted last; 5 bolted first) for each planting across farms for the summer trial.

Variety	Planting 1	Planting 2	Planting 3
Green Star	2	2	3
Magenta	1	2	2
Muir	2	1	2
Nevada	3	2	4
New Red Fire	1	1	1
Tropicana	2	2	3

^a - We did not perform statistical analysis on this data.



Table 9. Mean flavour averaged over both plantings and the mean overall rating for each planting and averaged over both plantings across all farms for the summer trial.

Variety	Flavour	Overall Rating - Planting 1	Overall Rating - Planting 2	Average Overall Rating
Green Star	2.8 b	2.6 b	2.8	2.7 b
Magenta	3.6 ab	3.8 a	3.2	3.5 a
Muir	4.2 a	3.5 ab	3.9	3.7 a
Nevada	3.9 a	3.7 ab	3.8	3.8 a
New Red Fire	3.1 b	3.0 ab	3.2	3.1 a
Tropicana	2.6 b	2.8 b	3.1	3.0 a
LSD	0.7	0.8	1.1	0.8

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

Table 10. Grower notes on flavour and overall ratings of each variety in the summer trial.

	AK	AS	LA	HS	MS	SJ	LC
Green Star	Small harvest window	Bolted and lost flavour		Worst	Bolted and not good heads but were vigorous		Poor flavour, bolting
Magenta	Long harvest window, dense heads	uniform, flavour		Hardy	Consistent and held up, not bitter	Look, upright heads, flavour	
Muir			Taste and compact head	colour			Good flavour and slower bolting
Nevada	Long harvest window, dense heads	Good flavour		Uniform	Consistent and held up, not bitter	Not as great taste	Good flavour and slower bolting
New Red Fire							Good flavour and slower bolting
Tropicana	Small harvest window	Bolting	Bolting and germination		Bolted and not good heads but were vigorous	Easily wilts and bad taste	Poor flavour, bolting

^a - AK- Angie Koch; AS- Ann Slater; LA- Lise-Anne Léveillé; HS- Harold Saunders; JG- Jon Gagnon; MS- Martina Schaefer; SJ- Sarah Judd; HM- Hillary Moore and; LC- Laurie and Corey Ahrens.



FINDINGS - FALL

Germination

Growers recorded germination rates for both plantings. Germination rates were similar in the two plantings ($P=0.81$). Using an LSD of 11%, we found that Grazion, Encino and Magenta had the highest germination rates and Red Mist from Saanich Organics was the lowest in the trial (**Table 11**).

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% heads bolted. There was no detectable difference between varieties for planting 1 ($P=0.076$) or planting 2 ($P=0.99$). The mean harvest window for each variety in each planting can be seen in **Table 12**.

Tip Burn

Tip Burn

Tip burn was not assessed as planned because the growers had a hard time telling the difference between tip burn and frost damage.

Frost Tolerance

For the first fall planting, growers reported minimal frost damage to all head lettuce varieties, and frost damage in most incidents did not lead to loss of marketable heads of fall head lettuce. Frost damage was highest in Encino with over 18% damage reported for three out of the four weeks of observation. All other varieties had under 6% damage in all four observation weeks.

Frost damage for the second planting was reported in all varieties, but overall varieties tested showed moderate to good tolerance to frost damage. Encino again had the highest damage reported at over 50% in week 4. All other varieties were under 50% damage in week four.

Heat Tolerance

Growers who left lettuce in the field to bolt recorded the number of bolting heads in each variety over the planting. In the first planting bolting occurred first in Red Mist - SO and Red Mist - VOS in week one, followed by Encino and Ruby Sky in week two, then Grazion in week three, and Magenta in week four (**Figure 3**). Bolting in the second planting was not of concern and minimal across all growers.

Flavour & Overall Rating

Growers rated flavour and overall rating using the same method as for summer lettuce. The means and LSD can be found in Table 14 for the

average flavour ratings across the two plantings ($P=0.59$) and overall ratings for planting 1 ($P=0.01$) and planting 2 ($P=0.14$) separately, as well as the average for the overall rating across the two plantings ($P=0.08$) for each variety.

Table 15 shows the growers notes on overall rating and flavour for each variety in the trial. The overall ratings corroborate other findings that Red Mist- VOS, Ruby Sky, and Magenta were the top varieties in the fall head lettuce variety trial in 2020.

Table 11. Mean combined germination rates for both plantings across farms for the fall trial.

Variety	Germination
Encino	84% ab
Red Mist-SO	39% c
Grazion	95% a
Magenta	84% ab
Ruby Sky	81% b
Red Mist - VOS	75% b
LSD	11%

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

Table 12. Mean harvest window (in weeks) for each planting across farmers for the fall trial.

Variety	Planting 1	Planting 2
Encino	1.5	3.0
Red Mist-SO	1.2	4.3
Grazion	2.1	2.7
Magenta	2.3	2.9
Ruby Sky	2.5	3.1
Red Mist - VOS	1.8	3.9
LSD	NS	NS

^a - Data was dropped from growers whose second planting did not survive.

^b - NS stands for not significant.

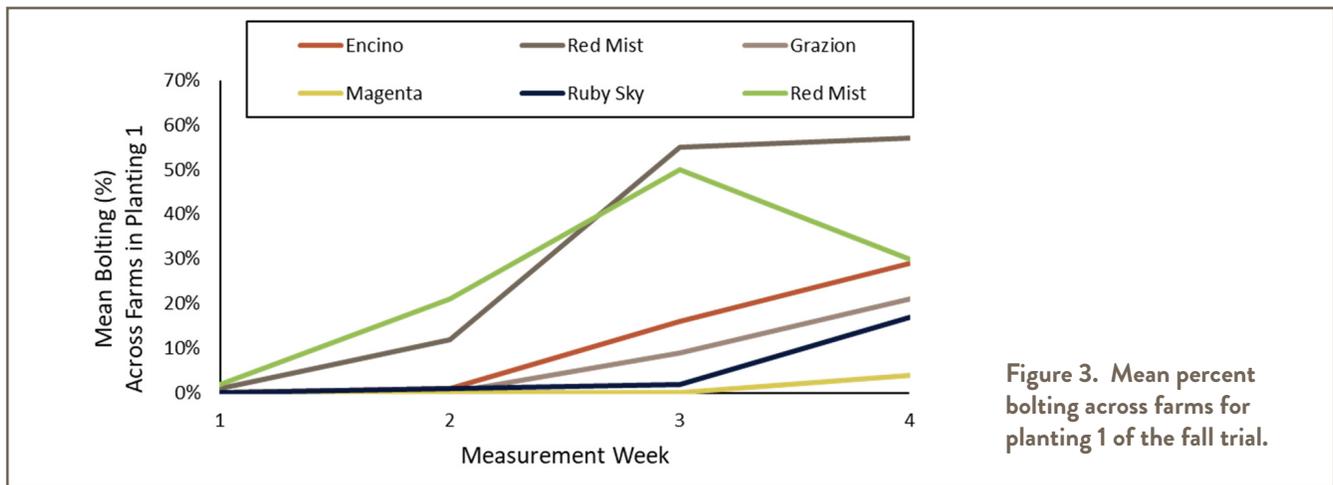


Figure 3. Mean percent bolting across farms for planting 1 of the fall trial.

Table 14. Mean flavour averaged over both plantings and the mean overall rating for each planting and averaged over both plantings across all farms for the fall trial.

Variety	Flavour	Overall Rating - Planting 1	Overall Rating - Planting 2	Average Overall Rating
Encino	3.3	2.9 ab	3.0	2.9 b
Red Mist-SO	3.6	2.5 b	4.0	3.3 ab
Grazion	3.5	3.4 ab	2.8	3.1 ab
Magenta	3.7	3.6 ab	3.4	3.5 ab
Ruby Sky	3.6	4.0 a	3.5	3.8 a
Red Mist - VOS	3.6	4.0 a	3.6	3.8 a
LSD	NS	1.0	NS	0.8

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

^b - NS stands for not significant.

Table 15. Grower Grower notes on flavour and overall rating of each variety in the fall trial.

	AK	AS	LA	HS	SJ
Encino	Really dense, soft leaves	Small when mature, not a great look, soft texture	Fun shape		
Red Mist-SO	Big heads, nice colour and shape	Beautiful colour, not consistent growth plant to plant			Very small plants
Grazion	Small heads	Size is so-so not impressed with this variety	Sweet		
Magenta	Nice heads, but small	Quality fine, size a bit small	Beautiful head but small, sweet		
Ruby Sky	Small overall nice shape, colour, and density	Stando out for both planting, beautiful colour, good flavour, and consistent size	Open shape, less compact heads, almost bitter		Large Beautiful heads
Red Mist - VOS	Very nice size! As big as summer	Beautiful colour, not consistent growing plant to plant	A bit small, still sweet	Fast growing	

^a - AK- Angie Koch; AS- Ann Slater; LA- Lise-Anne Léveillé; HS- Harold Saunders; JG- Jon Gagnon and; SJ- Sarah Judd.



CONCLUSIONS

Although hot summer weather and variable temperature and moisture in the fall 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.

Magenta, Muir, and Nevada were standout summer head lettuce varieties in this trial. All varieties scored high in germination rate, flavour, and overall ratings from growers. Magenta, Ruby Sky, and Red Mist-VOS were the top standout varieties of fall head lettuce. These varieties performed well in germination, frost tolerance, and overall ratings from growers.

“For both summer and fall lettuces we have found some winners. Whatever happens with the stats, I think it’s been worth it for me!”
- Angie Koch of Fertile Ground Farm

NEXT STEPS

Farmer researchers from this multi-farm trial used this dataset to help inform selections for their 2021 summer lettuce variety trial, including the types of data to collect and how to take measurements in 2021.



Photo 1. Summer lettuce varieties from first planting at Spiral Farm



Photo 2. Summer lettuce varieties from first planting at Meadow Lynn Market Garden



Photo 3. Fall lettuce varieties at Fertile Ground Farm



Photo 4. Fall lettuce varieties at BeetBox Coop Farm

ACKNOWLEDGEMENTS

We thank Johnny's Selected Seeds, High Mowing Organic Seeds and Vitalis Organic Seed for generously providing seed for the trial.

REFERENCES

1. Koch et al. 2019. What are the best fall lettuce varieties for southern Ontario?, <https://efao.ca/wp-content/uploads/EFAO-Lettuce-2019.pdf>

FUNDING

This project was funded by the Robert and Moira Sansom Community Foundation, a fund within the London Community Foundation, and the Brian and Joanna Lawson Family Foundation.

INFO ON STATISTICS BOX

To evaluate germination, harvest window, heat tolerance, 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 see among treatments in order to call them “statistically different”.

Using a 90% confidence level means:

When we measure a difference between any two treatments that is greater than the calculated least significant difference (LSD), we expect this difference would occur 9 times out of 10 and, therefore, consider it a reliable difference.

When we measure a difference between any two treatments that is less than the calculated LSD, we consider these treatments unreliably different and not statistically different.

We used lower case letters in tables and graphs to denote differences among varieties according to the LSD, such that varieties that share a letter are not different from each other.

Examples

Varieties coded with a are the same as other varieties coded a and ab and different from varieties coded b or c;

Varieties coded with b are different from varieties coded a and c but the same as varieties coded b and ab or bc, etc.