

2019-2020 Michigan Regional Trial Potatoes USA / SNAC International Storage Chip Quality

Michigan State University Montcalm Research Center MPIC Demonstration Storage

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Objective: To assess the storability of eight chipping varieties by evaluating sugar concentrations, chip color, and visual defects during storage.

Materials and Methods:

The MSU Potato Outreach Program planted seed at Sandyland Farms, LLC, in Howard City, MI on May 19, 2019 at 10" within row spacing and 34" between row spacing. Vine kill occurred on August 29, 2019. We harvested the potatoes on October 17, 2019 (2861 GDD₄₀ from planting to vine kill) and collected storage samples.

Commercial Storage and Processing

Two, 40-pound samples of each variety were stored at Sandyland Farms, LCC commercial storage and evaluated at Herr Foods, Nottingham, PA on January 20 and April 6, 2020. The pile temperature before processing was 50.0°F in both January and April. CIPC was applied to control sprouting in October 2019 and March 2020.

Demonstration Storage and Monthly Evaluations

Eighteen samples of 30 tubers per variety were stored at the Michigan Potato Industry Commission's (MPIC) Cargill Potato Demonstrations Storage Facility in two separate bulk bin storages. One sample bag from each of the twelve varieties was stored at approximately 48°F and 54°F for monthly evaluations from October 2019 through June 2020. Techmark, Inc. processed these MPIC samples for sucrose and glucose values (percent of fresh weight), SNAC color score, and undesirable chip color rating. Undesirable chip color rating is rated as a percentage by weight, of the total chips evaluated.

Results:

Commercial Storage and Processing

Herr Foods, Inc. evaluated varieties on January 20th and April 6th, 2020 (Table 1 and 2). On the first processing date, the top three varieties for chip quality were Petoskey (MSV030-4), Lamoka, and Snowden. The next highest ranked, non-check varieties were MSW075-2 and ND7519-1 (Table 1). On the second processing date, the top three varieties were Lamoka, Snowden, and MSW075-2 (Table 2). Petoskey had the highest specific gravity in January at 1.087 and MSZ219-14 had the highest gravity in April at 1.087. Lamoka had the fewest chip defects in January while MSW075-2 had the fewest defects in April (Table 1 and 2).

Table 1. 2019 SNAC Variety Trial January 20, 2020¹

Merit ²	Variety	Agtron Color ³	SNAC Color ⁴	Specific Gravity	Percent Chip Defects ⁵			Comments
					Internal	External	Total	
1	Petoskey (MSV030-4)		2	1.087	12.8%	8.9%	21.7%	Minor scab and bruise. 2 to 3 ½ inches in size
2	Lamoka		2	1.081	4.4%	5.6%	10.0%	Minor greening. Oblong shape. 2 ½ to 4 inches in size
3	Snowden		2	1.075	0.7%	17.4%	18.1%	Some scab. 2 to 3 ½ inches in size
4	MSW075-2		3	1.070	7.7%	9.9%	17.6%	Minor scab and bruise. 1 ½ to 3 ½ inches in size.
5	ND7519-1		2	1.081	4.8%	8.3%	13.1%	Minor green. 1 ¾ to 3 ½ inches in size
6	Mackinaw		2	1.081	6.8%	7.9%	14.7%	Minor green and scab. 2 to 3 ½ inches in size.
7	MSZ219-14		3	1.078	13.2%	27.8%	41.0%	Some internal color. Minor green. 1 ½ to 3 inches in size.
8	AOR09034-3		3/4	1.077	34.2%	30.4%	64.6%	Minor internal color. Fair amount of scab. 2 ½ to 4 ½ inches in size.

¹Samples collected on January 13, 2020 and processed by Herr Foods, Inc., Nottingham, PA on January 20, 2020.

²Merit: ranked by Herr Foods, Inc. 1 = highest chip quality, 8= lowest chip quality

³Agtron Color: not available

⁴SNAC Color: 1=lightest, 5=darkest

⁵Percent Chip Defects: percentage based on weight of the total sample; comprised of undesirable color, greening, internal and external defects

Table 2. 2019 SNAC Variety Trial April 6, 2020¹

Merit ²	Variety	Agtron Color ³	SNAC Color ⁴	Specific Gravity	Percent Chip Defects ⁵			Comments
					Internal	External	Total	
1	Lamoka		3	1.070	6.3%	5.7%	34.0%	Minor bruise. 1 7/8 to 4 3/4 in size. Oblong shape.
2	Snowden		2	1.072	0.7%	6.3%	28.7%	Scab and minor green. 2 to 3 1/2 inches in size.
3	MSW075-2		3	1.065	10.4%	9.4%	20.4%	Minor color in vascular ring. Gravity too low. 1 3/4 to 3 inches in size.
4	Mackinaw		2	1.075	3.6%	17.8%	32.8%	Minor green, bruise and scab. 2 to 4 inches in size.
5	Petoskey (MSV030-4)		2	1.080	6.6%	11.9%	24.8%	Some internal color. 1 1/2 to 3 3/4 inches in size.
6	MSZ219-14		3	1.087	18.5%	23.5%	32.7%	Some internal color. Minor green. 1 3/4 to 3 1/2 inches in size. Really nice raw grade and gravity.
7	ND7519-1		4	1.075	55.2%	4.1%	44.6%	Too much internal color. Minor scab. 1 1/2 to 3 3/4 inches in size.
8	AOR09034-3		4	1.072	36.6%	22.1%	51.1%	Too much internal color. Scab. 1 1/2 to 3 3/4 inches in size.

¹Samples collected at harvest on April 6, 2020 and processed by Herr Foods, Inc., Nottingham, PA on April 6, 2020.

²Merit: ranked by Herr Foods, Inc. 1 = highest chip quality, 8 = lowest chip quality

³Agtron Color: not available

⁴SNAC Color: 1 = lightest, 5 = darkest

⁵Percent Chip Defects: percentage based on weight of the total sample; comprised of undesirable color, greening, internal and external defects

Demonstration Storage and Monthly Evaluations

Below, Lamoka and Snowden are compared in the Techmark Inc. assessments of each variety. These samples were stored at 48°F and 54°F in the MPIC Demonstration Storage facility and evaluated monthly from October 2019 to June 2020. The varieties are listed alphabetically with the check varieties last. For yield and raw tuber quality data at harvest, please see the 2019 field trial results.








Conclusions:

Based on the processing results from both commercial and demonstration storage, Mackinaw, Petoskey (MSV030-4), and MSW075-2 appear to be the most promising lines for commercialization and full season storage. Mackinaw has long term storage potential at both 48°F and 54°F. This variety was ranked 6th by Herr's in January and 4th in April, noting greening and scab in both samples (Tables 1 and 2). This variety displays a similar trend in sucrose and glucose concentrations as the check varieties and had similar but slightly higher chip defect incidence during storage (Figures 5,6, and 7). Petoskey (MSV030-4) was ranked 1st by Herr's in January, but 5th in April with some internal color observed (Tables 1 and 2). This was not observed at the demonstration storage, and all chips were rated a 1.0 on the SNAC scale (Figure 12). This variety had glucose and sucrose concentrations very similar to those of Lamoka during the storage season (Figures 9 and 10). Chip samples processed in June had good chip quality, especially at 48°F (Table 5). While MSW075-2 exhibited a decline in mid-season chip quality between February and March, it generally improved through the June sample (Table 6). Herr's ranked this variety 3rd in April but noted a low gravity (Table 1). Sucrose concentrations were higher than those of Lamoka and Snowden but did not lead to higher glucose concentrations toward the end of storage or cold-induced sweetening (Figures 13 and 14).

The other varieties have good chip quality during part of the storage season but did not demonstrate full season storage potential in 2019-2020. These varieties are listed with the last acceptable chip sample date in parenthesis after the variety name. MSZ219-14 (April), ND7519-1 (March), and AOR09034-1 (January). AOR09034-1 exhibited signs of both chemical immaturity and senescence sweetening at both temperatures (Table 3, Figures 21 and 22). ND7519-1 appeared acutely susceptible to senescence sweetening at both temperatures (Tables 8, Figures 21 and 22).

AOR09034-3: At 48°F, AOR09034-3 had higher glucose levels than Lamoka and Snowden beginning at the January sample and ending at 0.018%. It displayed a similar trend at 54°F, with the final glucose concentration at 0.046% (Figure 1). AOR09034-3 had sucrose levels consistent with the check varieties at 48°F, and followed the trend of initially decreasing, stabilizing though the winter and increasing gradually beginning in March. At 54°F, glucose levels were like those of the checks until an increase in May (Figure 2). This variety had a higher percentage of defects than the checks for most months, with the fewest defects observed in January at both temperatures. The June sample stored at 48°F also had few defects and an improved chip color compared to previous samples (Figure 3 and 4). This variety had higher chip color scores than the checks in all but the January sample (Figure 4).

Table 3. AOR09034-3 monthly chip quality pictures from Techmark Inc.

Month	48°F	54°F
October		
November		
December		
January		

February		
March		
April		
May		
June		

Figure 1. AOR09034-3 glucose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

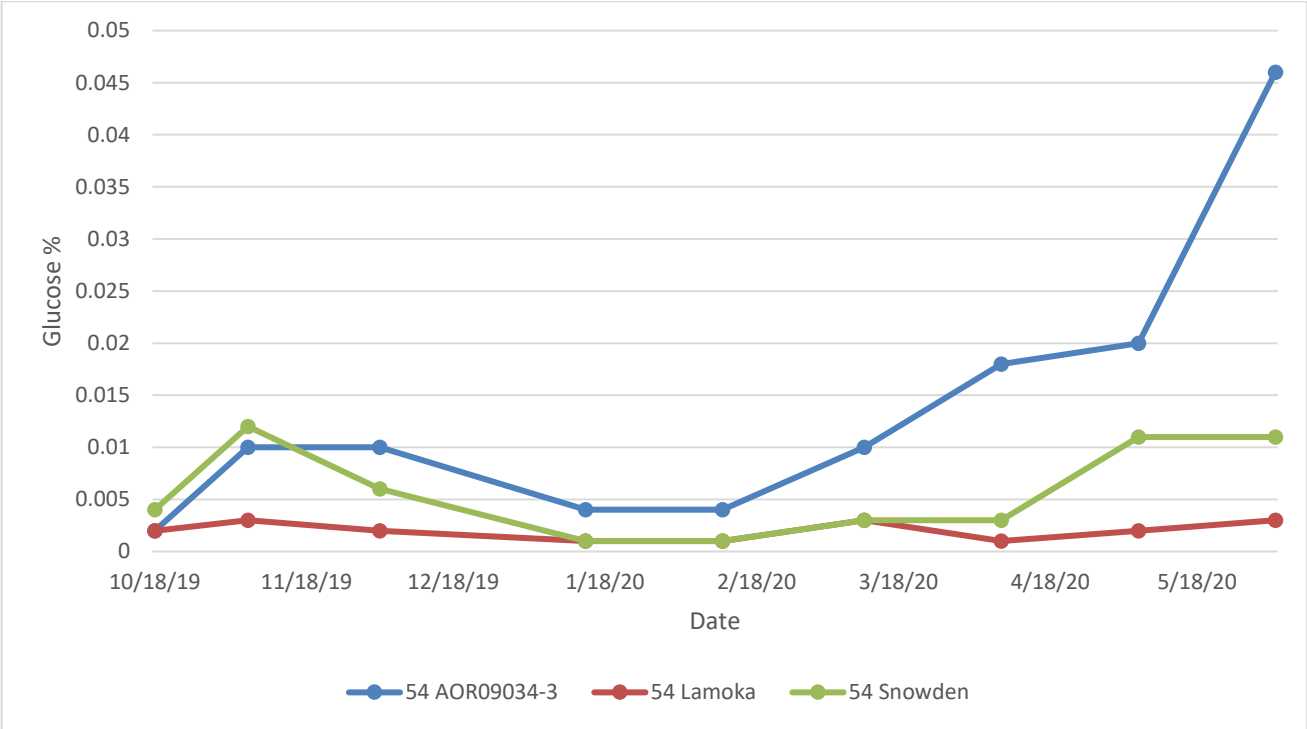
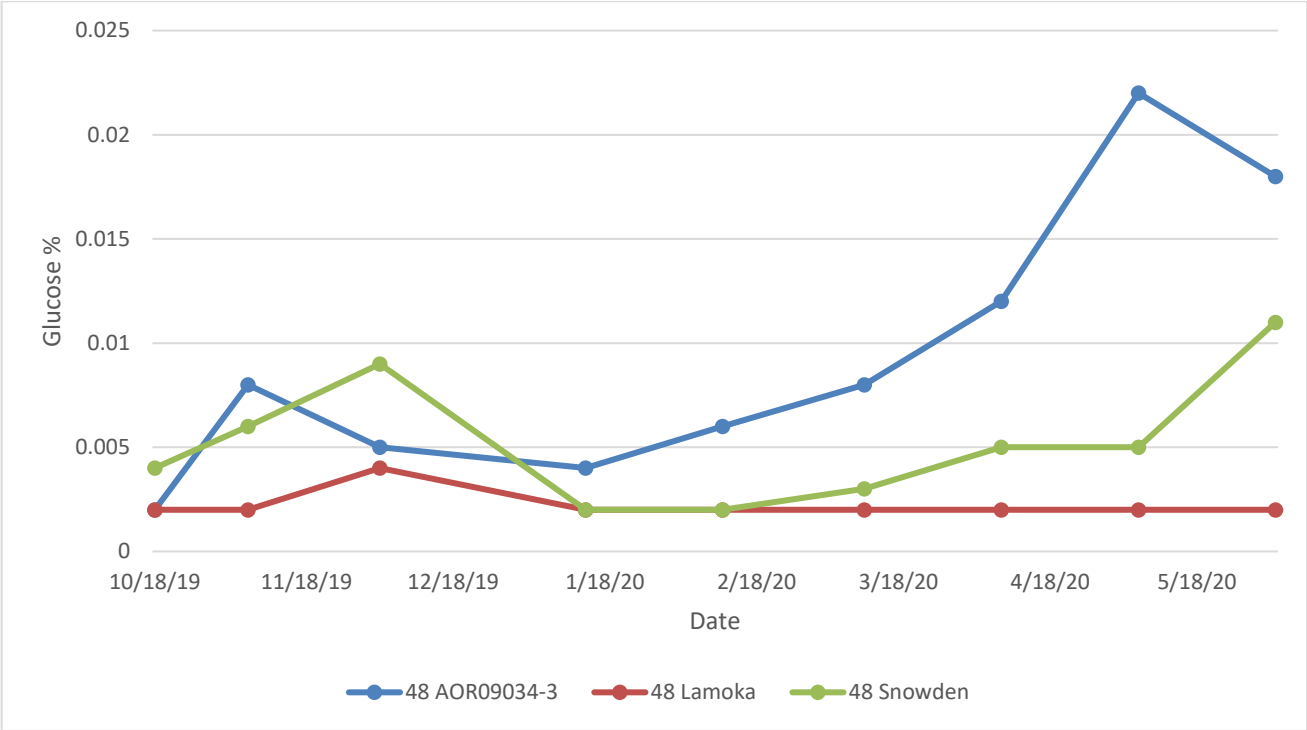


Figure 2. AOR09034-3 sucrose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

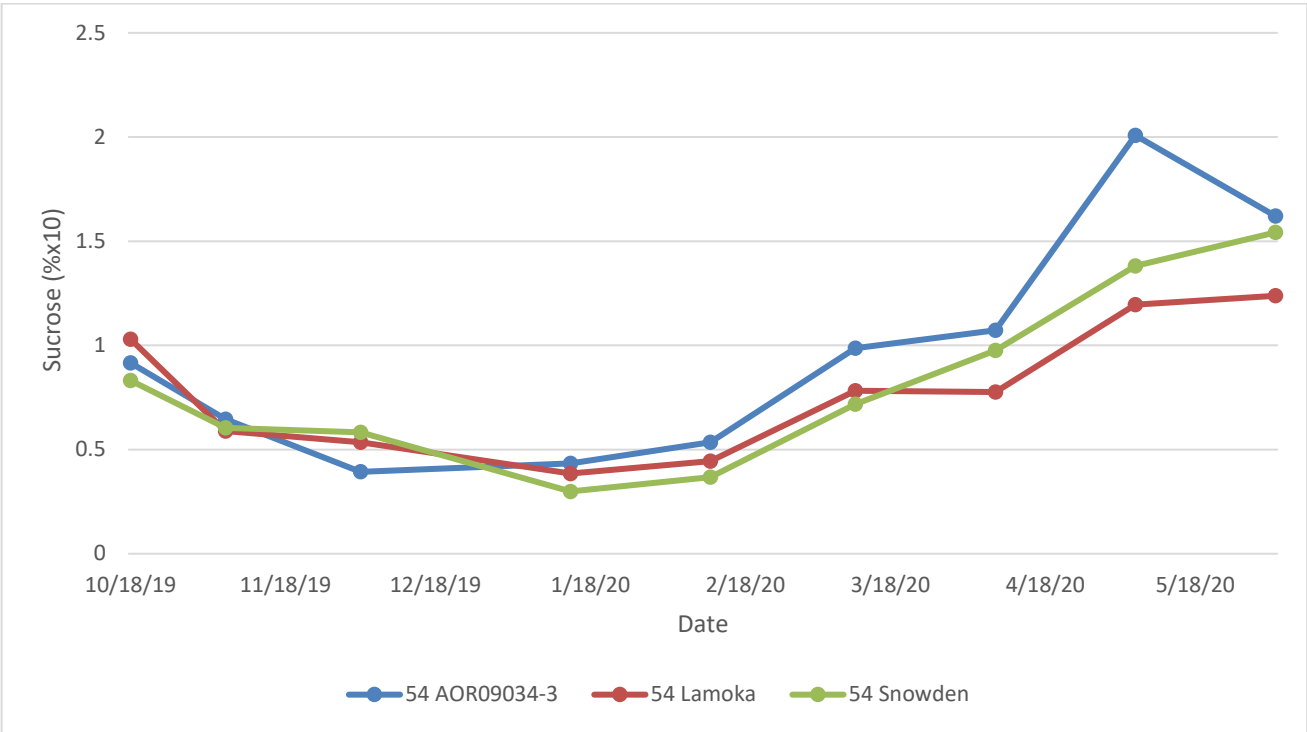
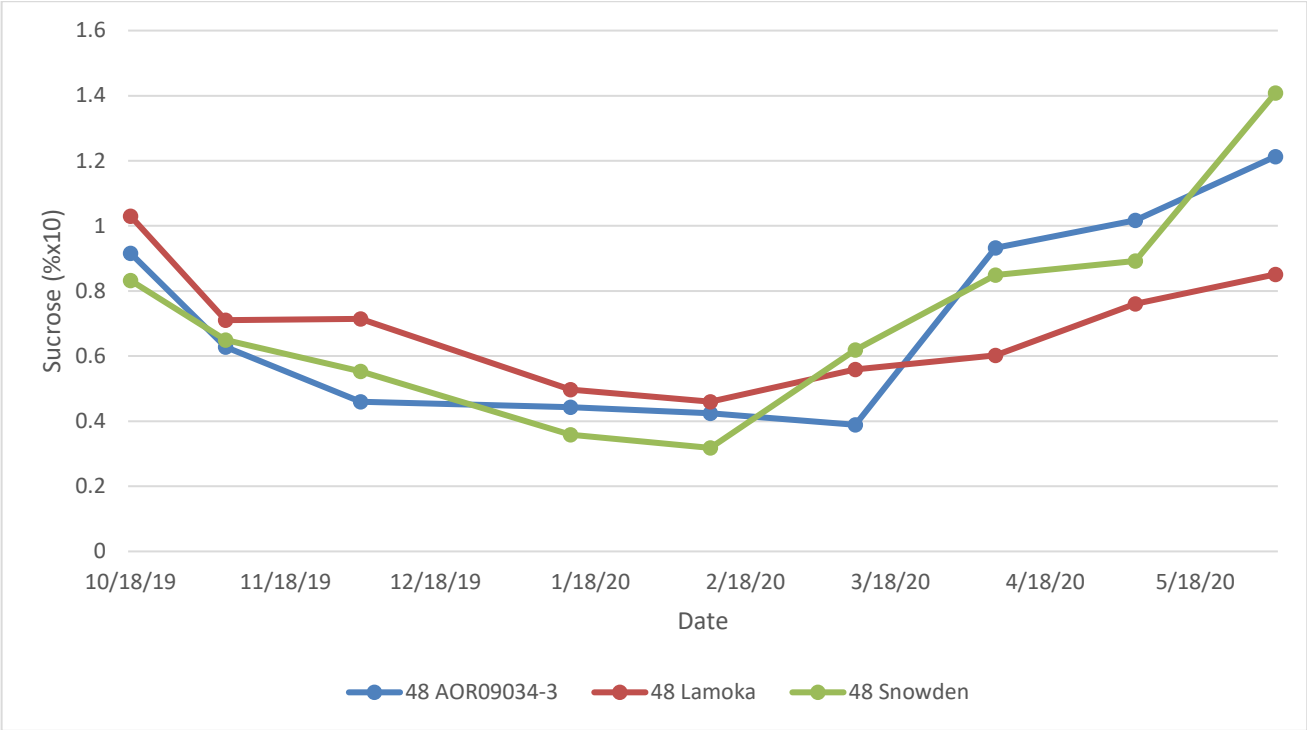


Figure 3. AOR09034-3 percent defects for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

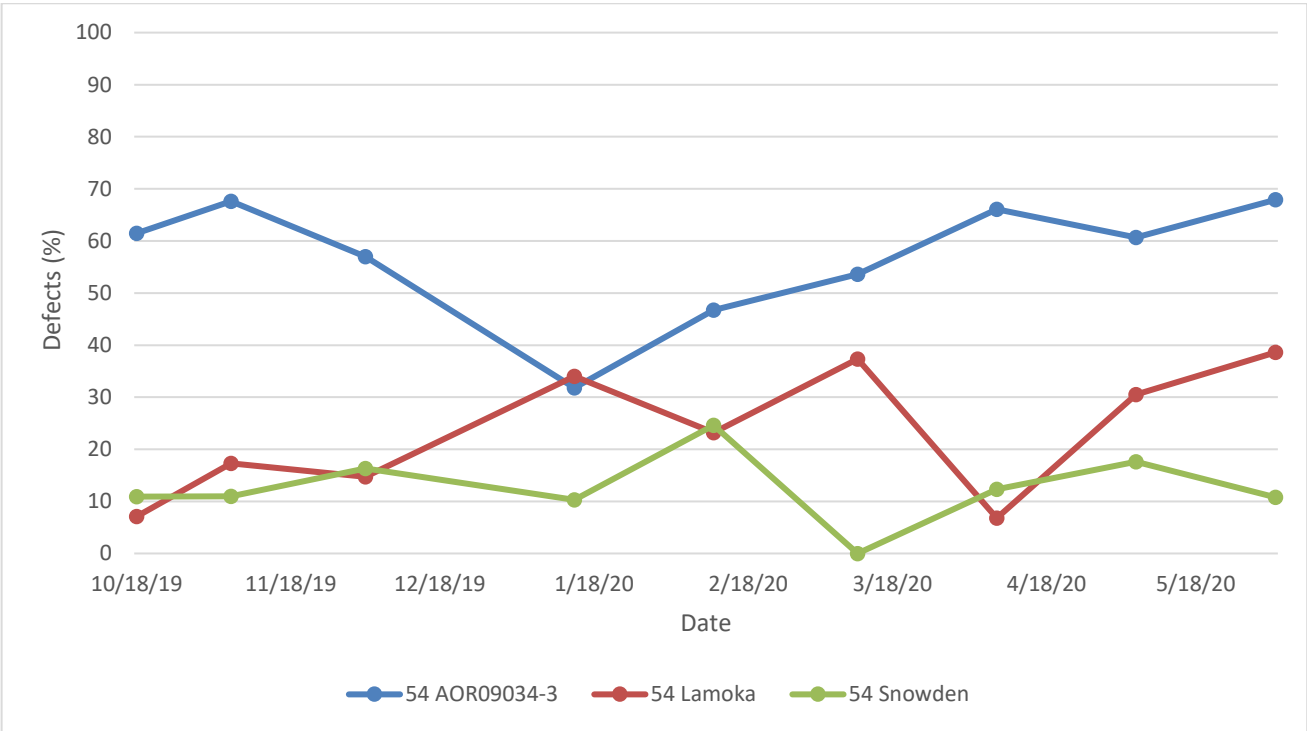
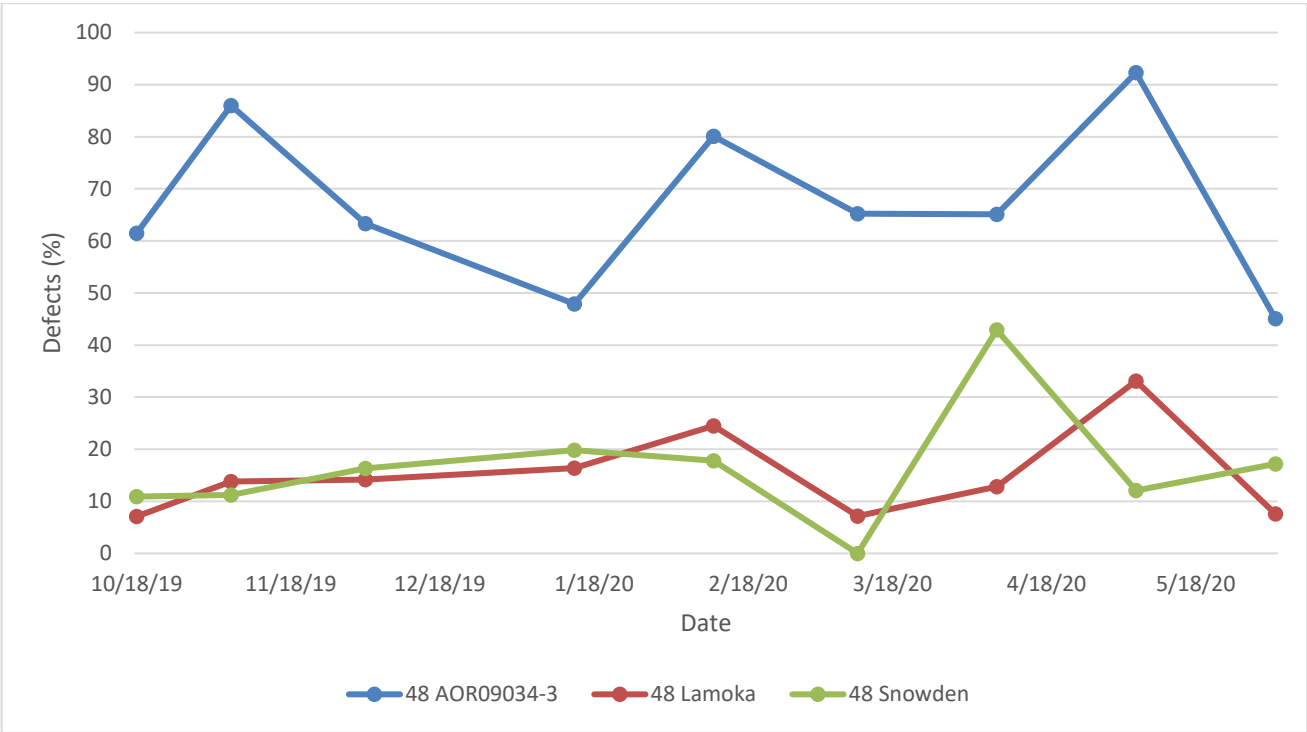
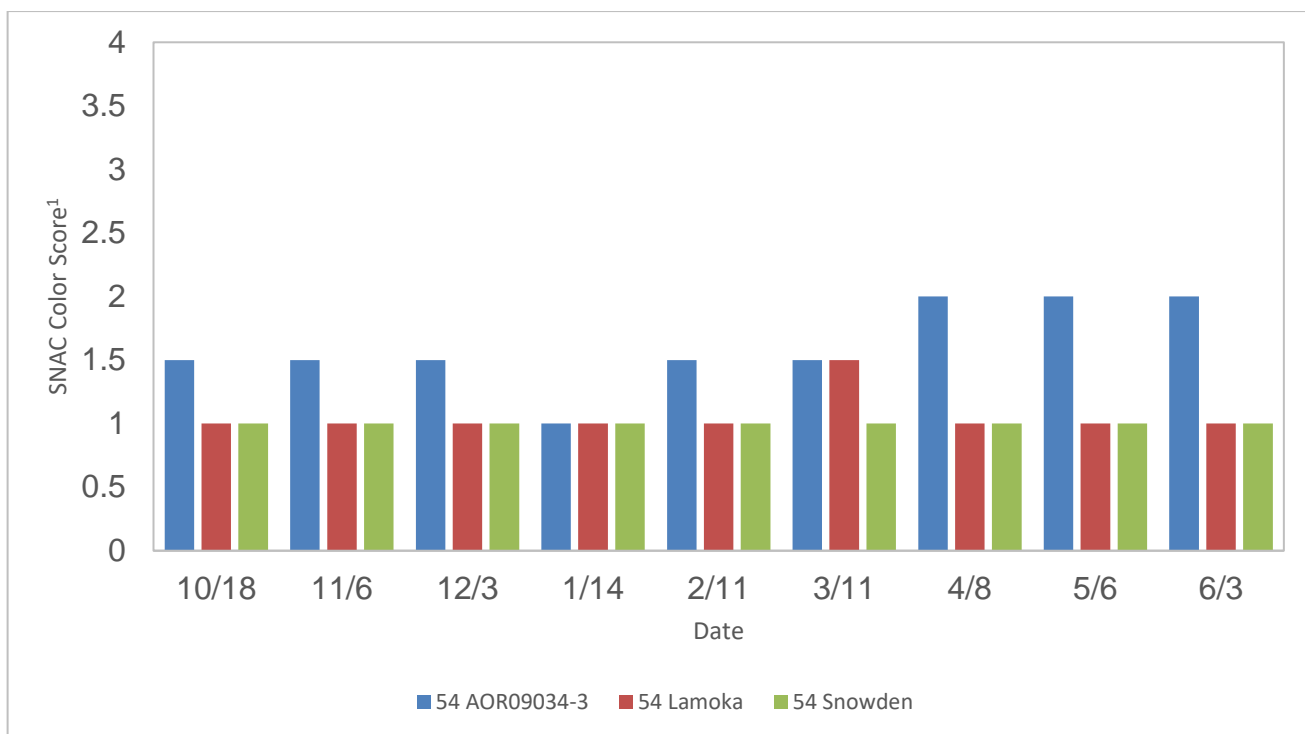
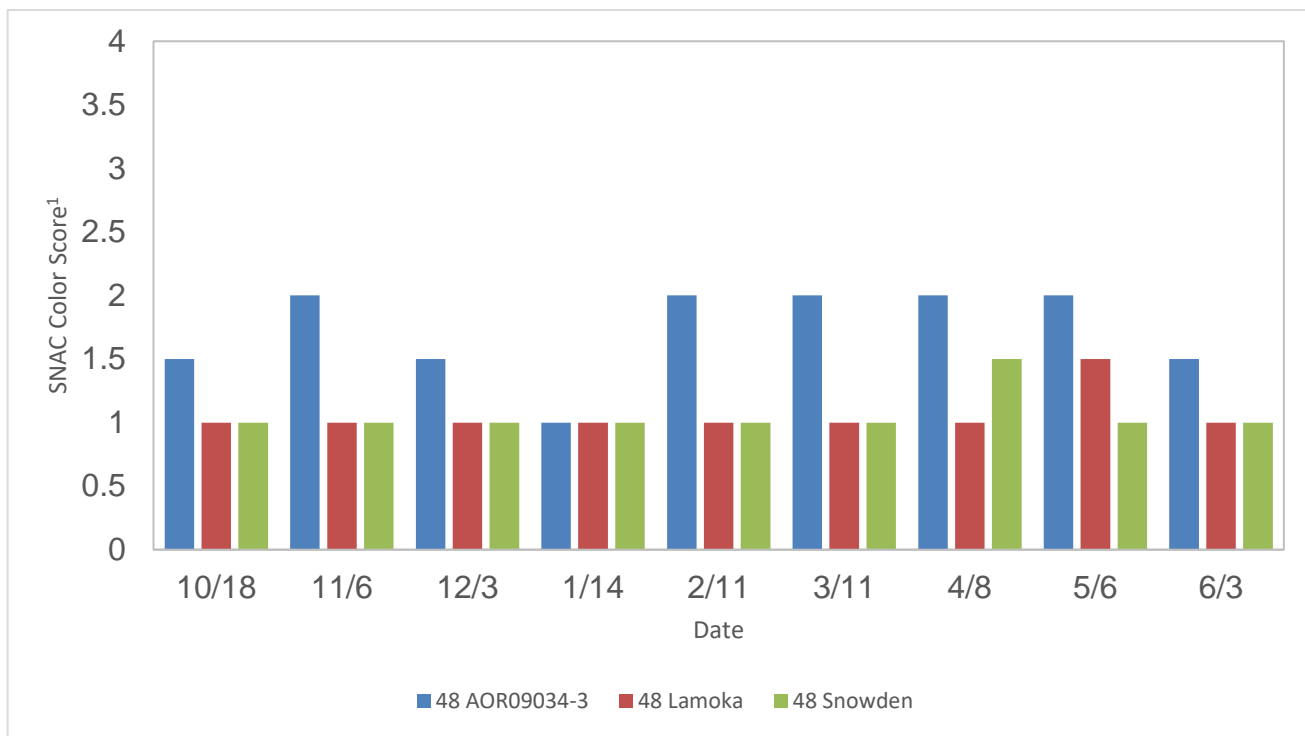









Figure 4. AOR09034-3 SNAC Color Score (1 = lightest, 5 = darkest) the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.



Mackinaw: At 48°F, this Michigan State University variety had glucose levels between those of the check varieties for all but the February sample. At 54°F it also had glucose levels like the check varieties, but the March sample had higher glucose (Figure 5). The sucrose concentrations followed the same trend of those in Lamoka and Snowden but were consistently higher at almost all samples at both temperatures (Figure 6). At 48°F, this variety had consistently higher defects, especially after the March sample. Conversely, the sample stored at 54°F initially had a higher percent of defects until January, but they later decreased to levels like the check varieties (Figure 7). At both temperatures, the SNAC score did not exceed 1.5, indicating good chip color for the entire storage season (Figure 8).

Table 4. Mackinaw monthly chip quality pictures from Techmark Inc.

Month	48°F	54°F
October		
November		
December		
January		











February		
March		
April		
May		
June		

Figure 5. Mackinaw glucose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

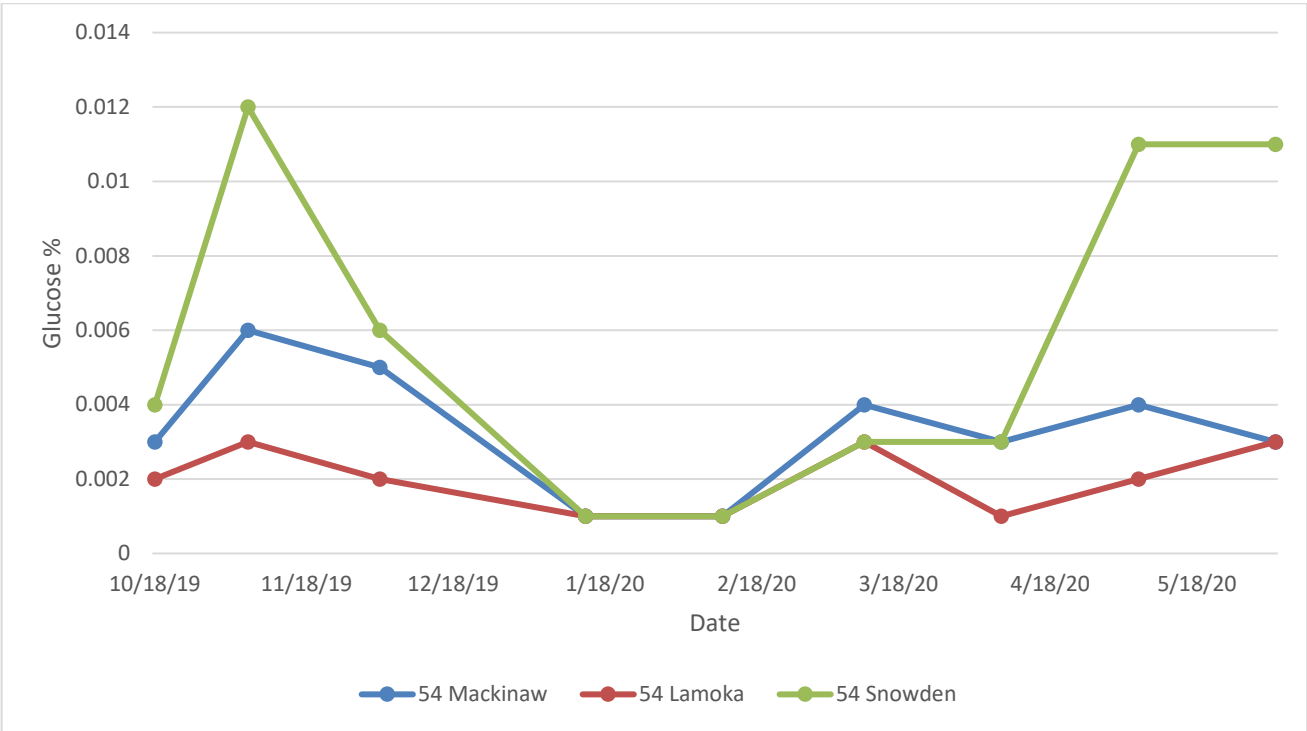
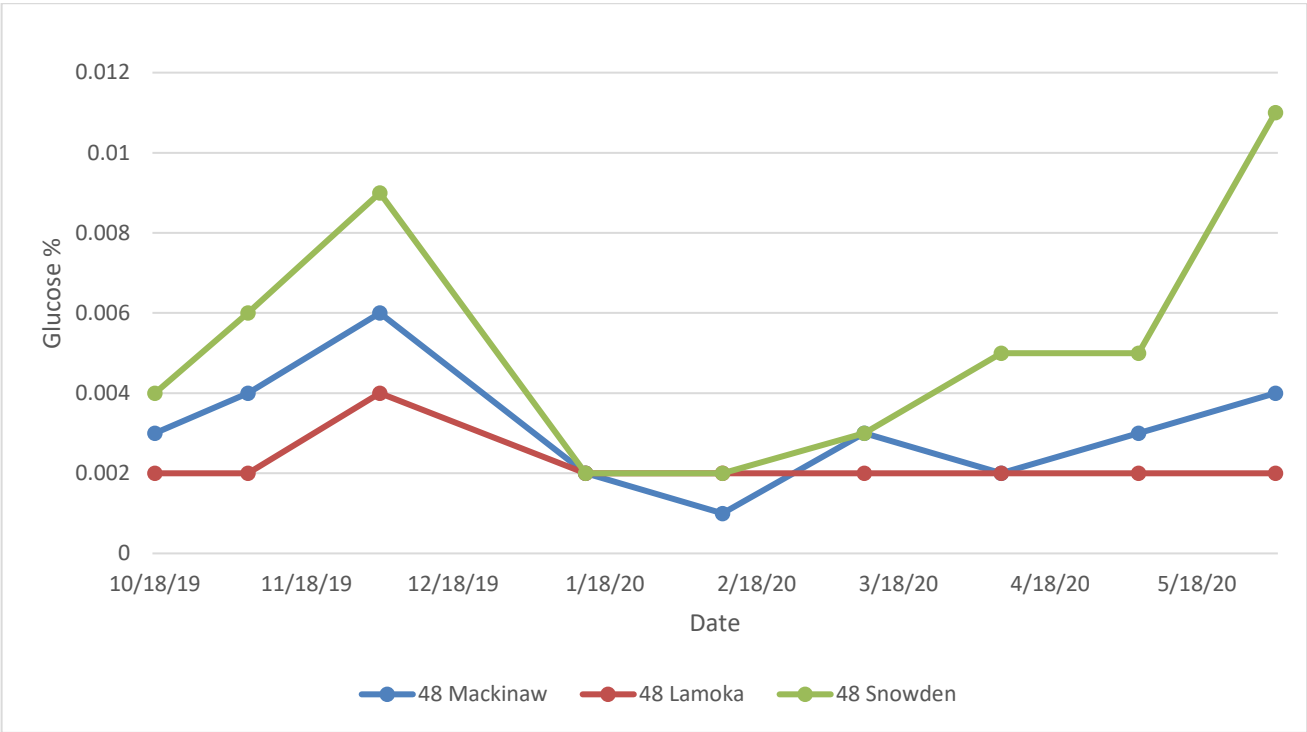


Figure 6. Mackinaw sucrose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

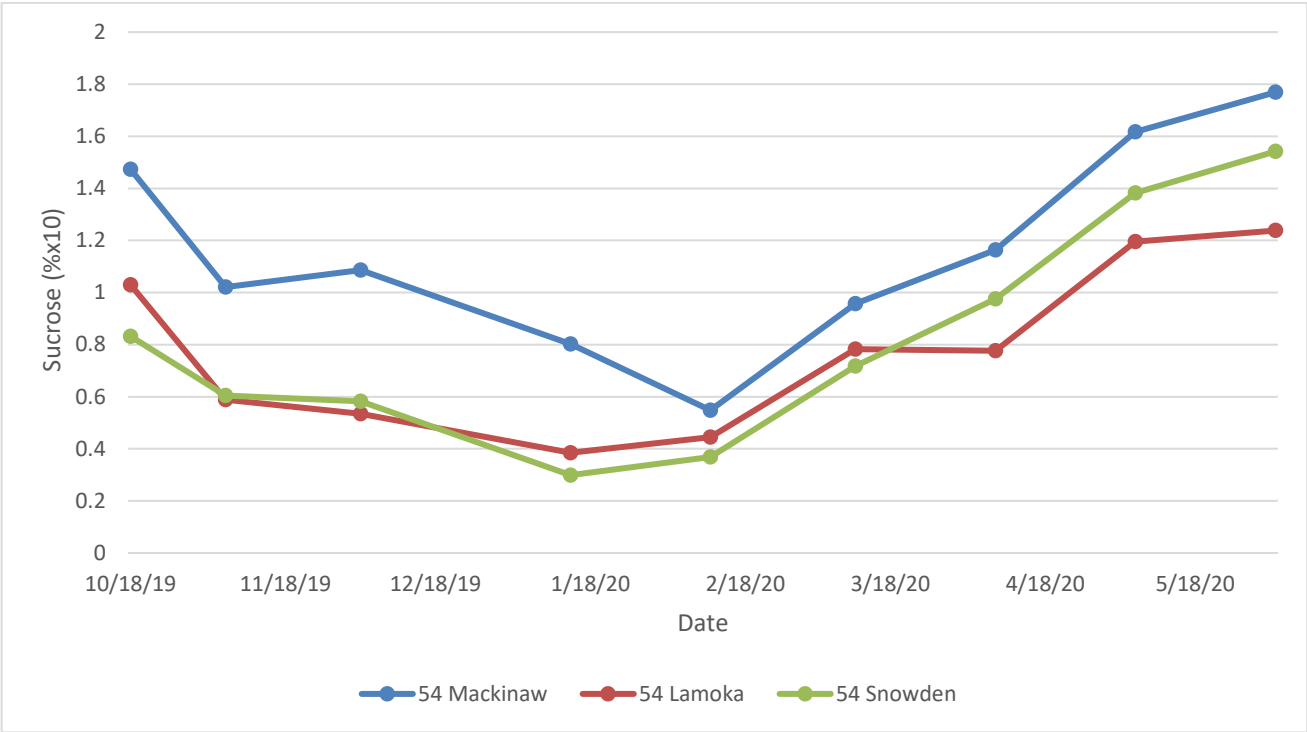
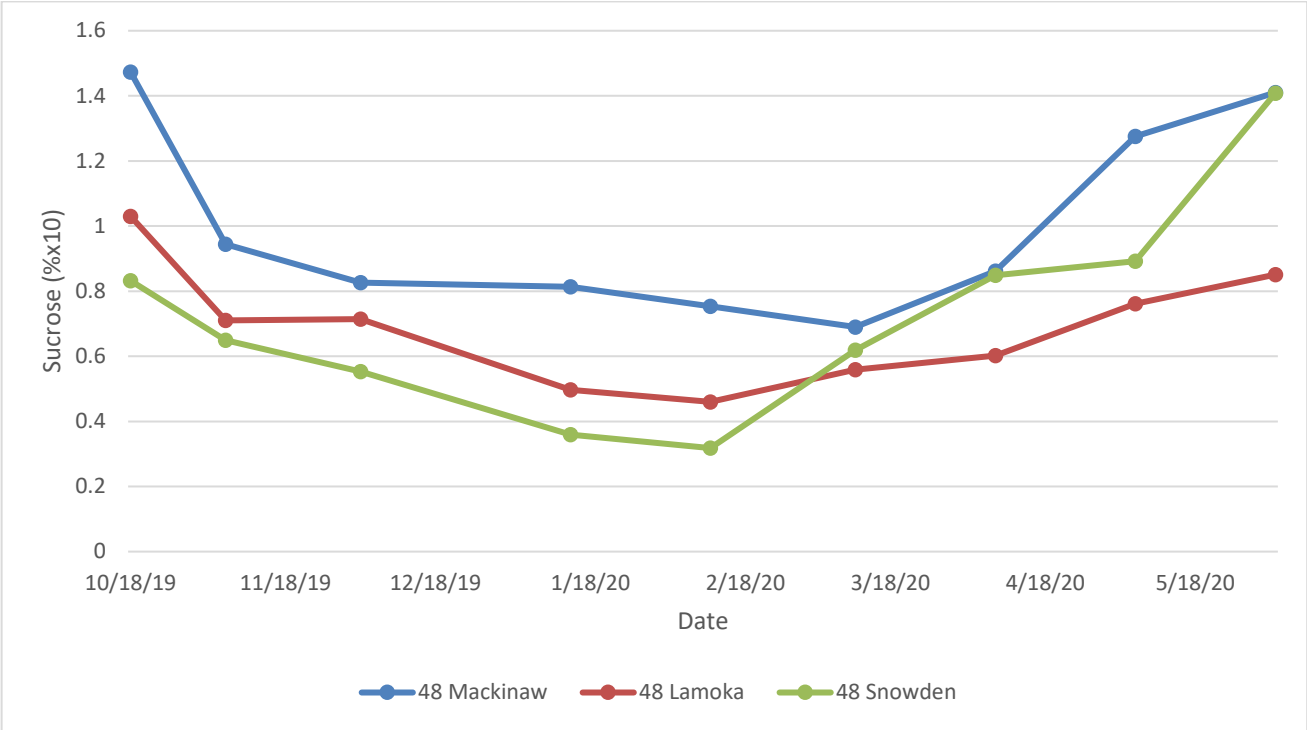


Figure 7. Mackinaw percent defects for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

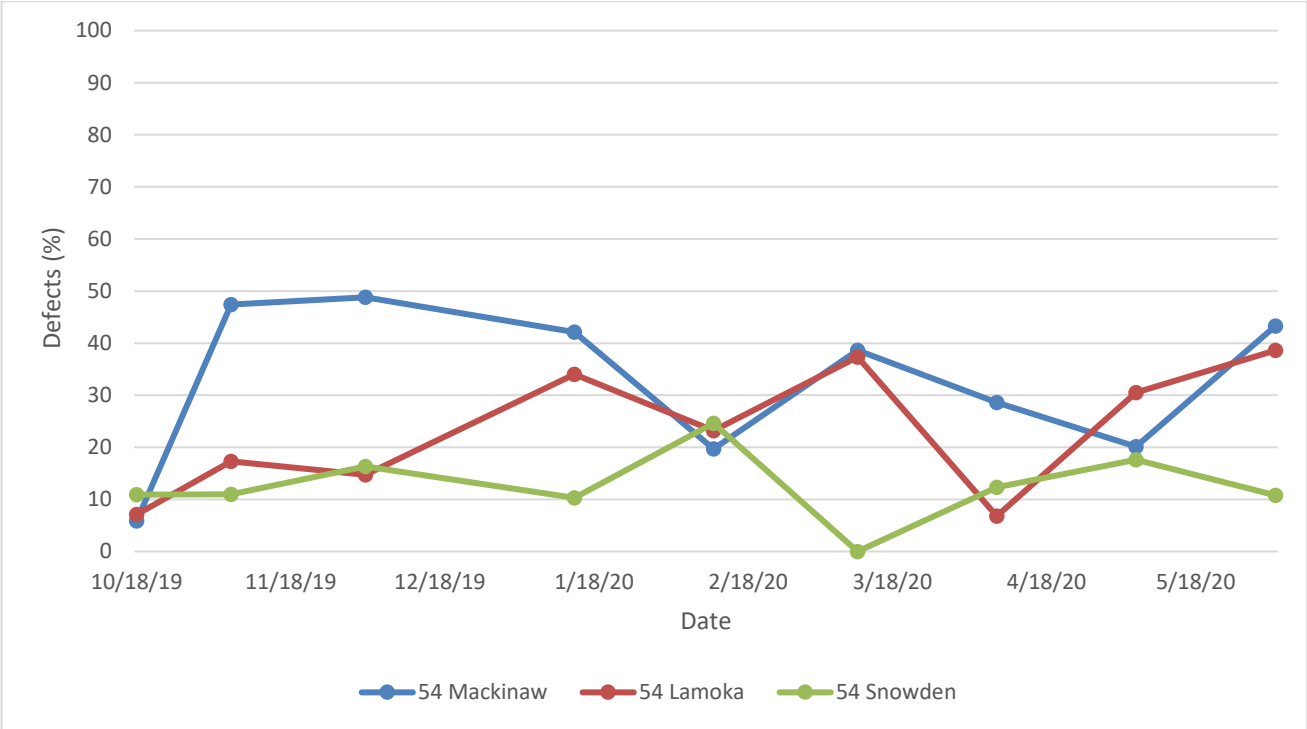
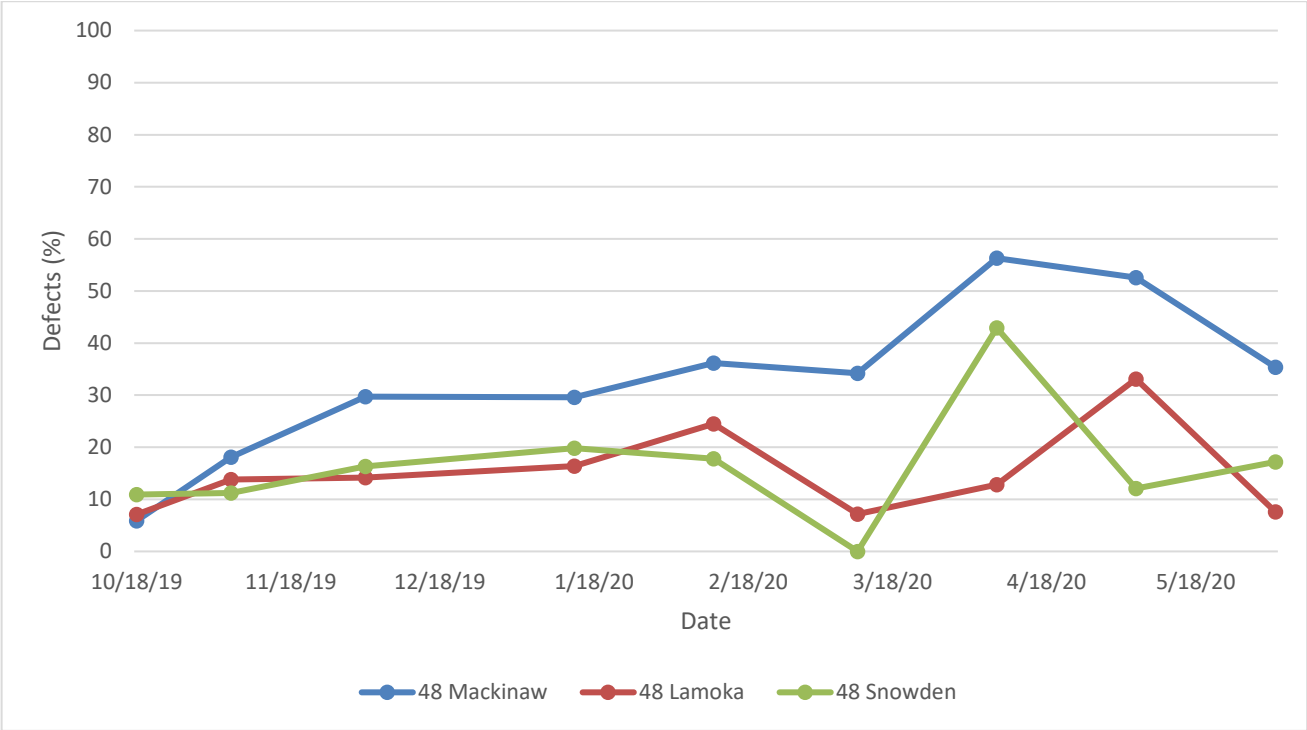
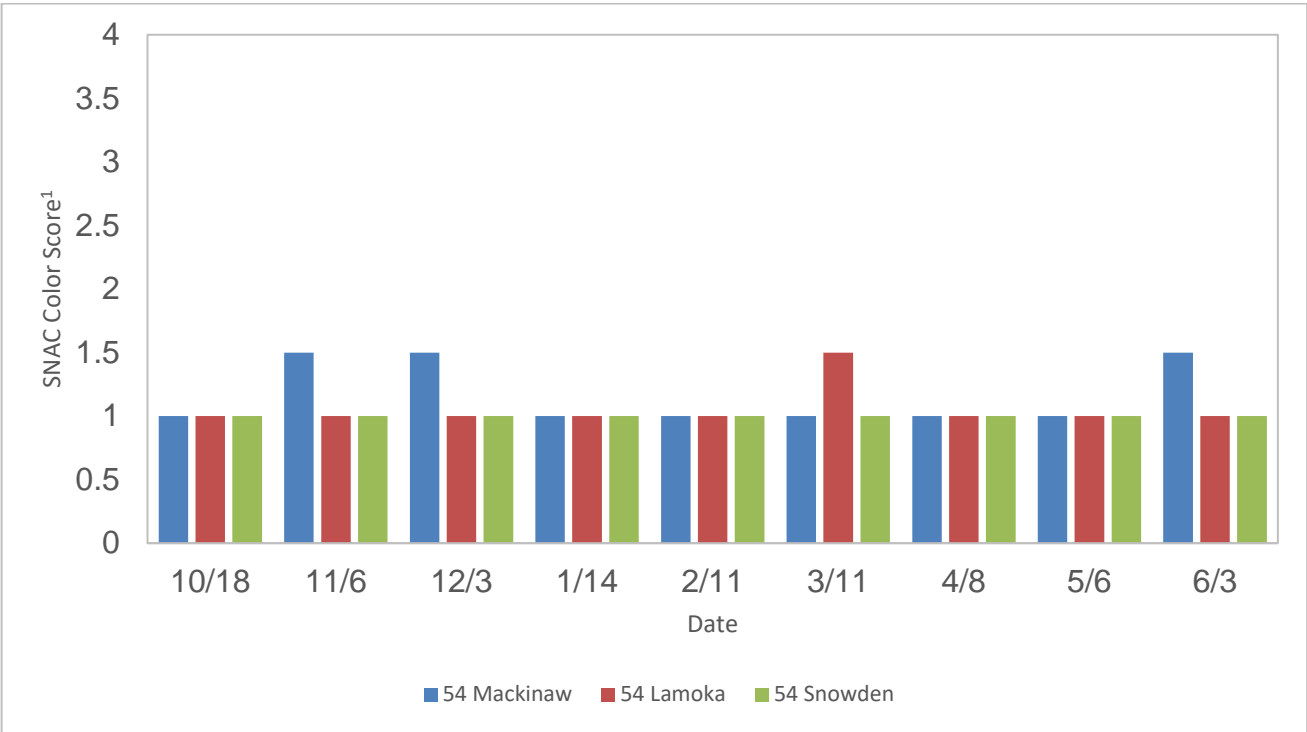
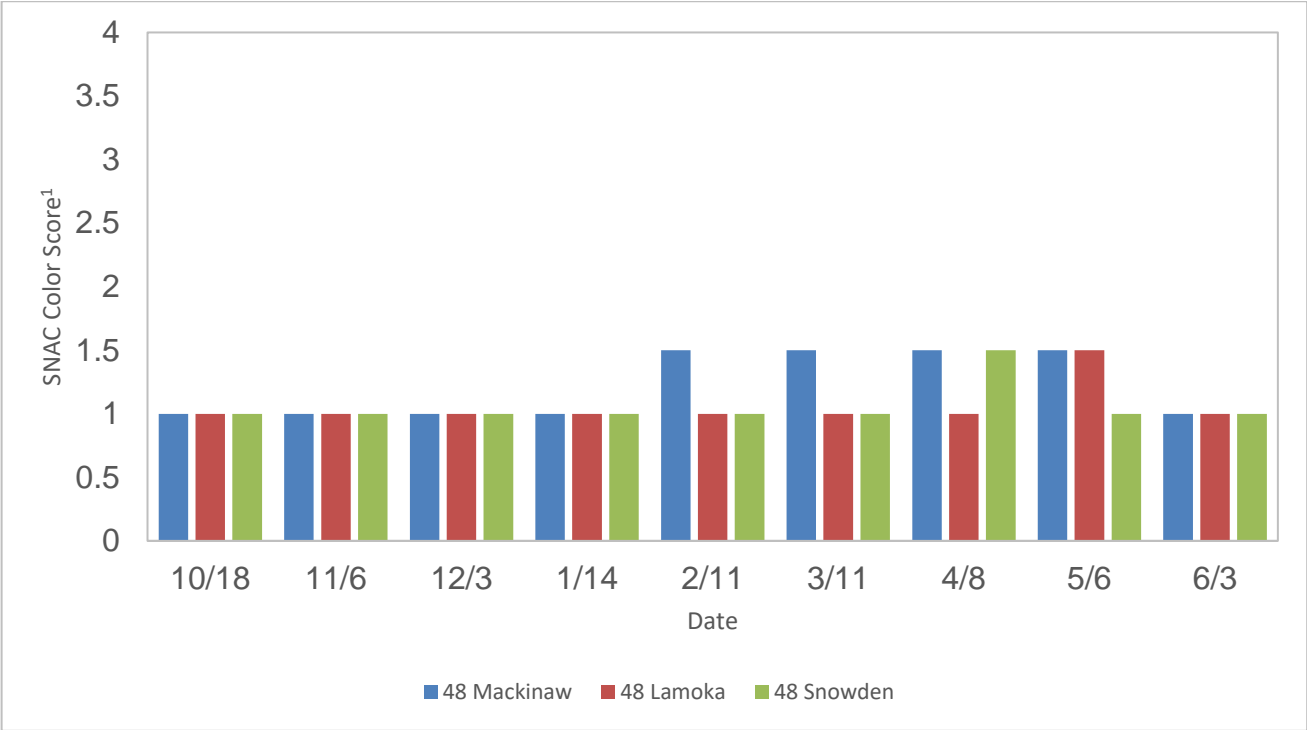


Figure 8. Mackinaw SNAC Color Score (1 = lightest, 5 = darkest) the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.



Petoskey (MSV030-4): This variety had glucose concentrations like those of Lamoka for the duration of storage at both temperatures. Concentrations did not exceed 0.005% at both 48°F and 54°F (Figure 9). At 48°F the sucrose concentrations were more like those of Snowden and were slightly lower than those of Lamoka. When stored at 54°F the sucrose concentration followed a similar trend, but increased after the April sample, ending higher than the 48°F sample (Figure 10). Chip defects in this variety were consistently low, again like those of the check varieties. The 54°F sample had higher defects in November, over 30%, but the percentage then decreased until the final sample (Figure 11). As another indication of good chip quality and full season storage potential, the chip color at both temperatures was rated as a 1 using the SNAC color score (Figure 12).

Table 5. Petoskey (MSV030-4) monthly chip quality pictures from Techmark Inc.

Month	48°F	54°F
October		
November		
December		
January		











February	 <p>2/11/20 SWAC SWAC TECHMARK, INC. 19</p>	 <p>2/11/20 SWAC SWAC TECHMARK, INC. 19</p>
March	 <p>3/11/20 SWAC SWAC TECHMARK, INC. 19</p>	 <p>3/11/20 SWAC SWAC TECHMARK, INC. 19</p>
April	 <p>4/8/20 SWAC SWAC TECHMARK, INC. 19</p>	 <p>4/8/20 SWAC SWAC TECHMARK, INC. 19</p>
May	 <p>5/13/20 SWAC SWAC TECHMARK, INC. 19</p>	 <p>5/13/20 SWAC SWAC TECHMARK, INC. 19</p>
June	 <p>6/12/20 SWAC SWAC TECHMARK, INC. 19</p>	 <p>6/12/20 SWAC SWAC TECHMARK, INC. 19</p>

Figure 9. Petoskey (MSV030-4) glucose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

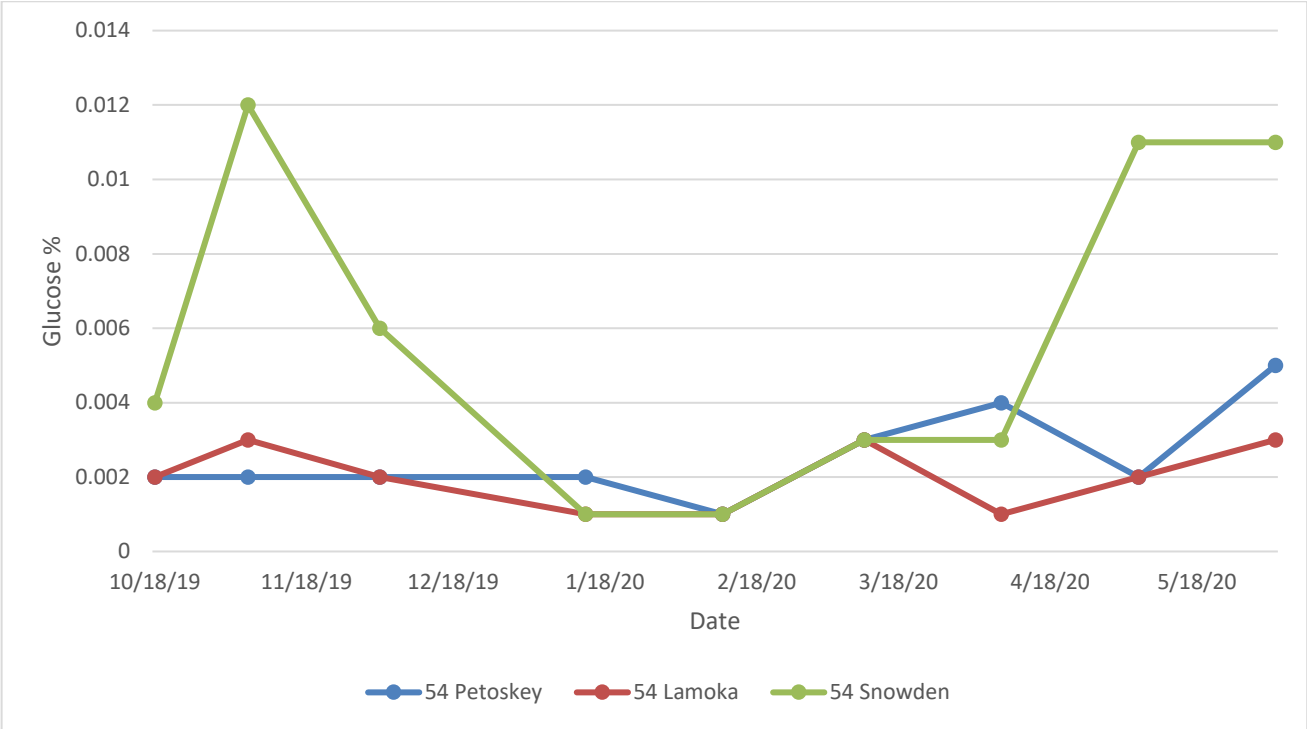
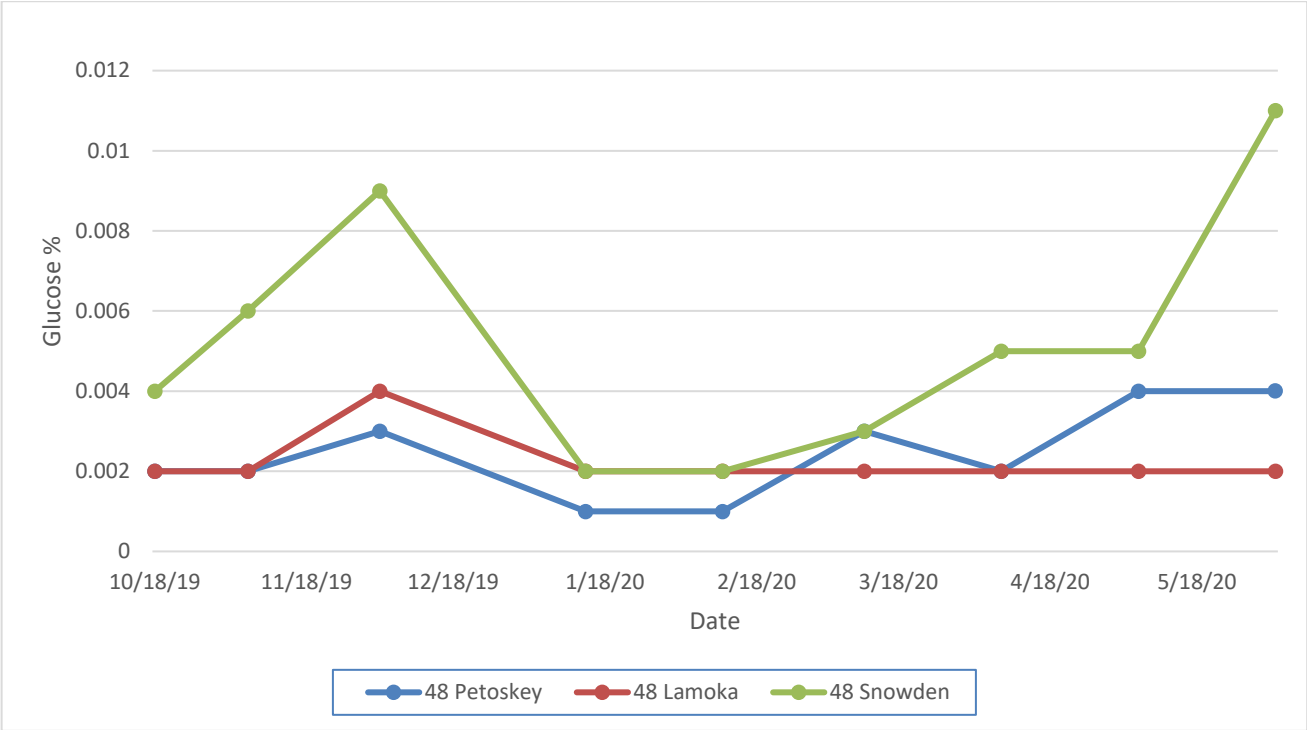


Figure 10. Petoskey (MSV030-4) sucrose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

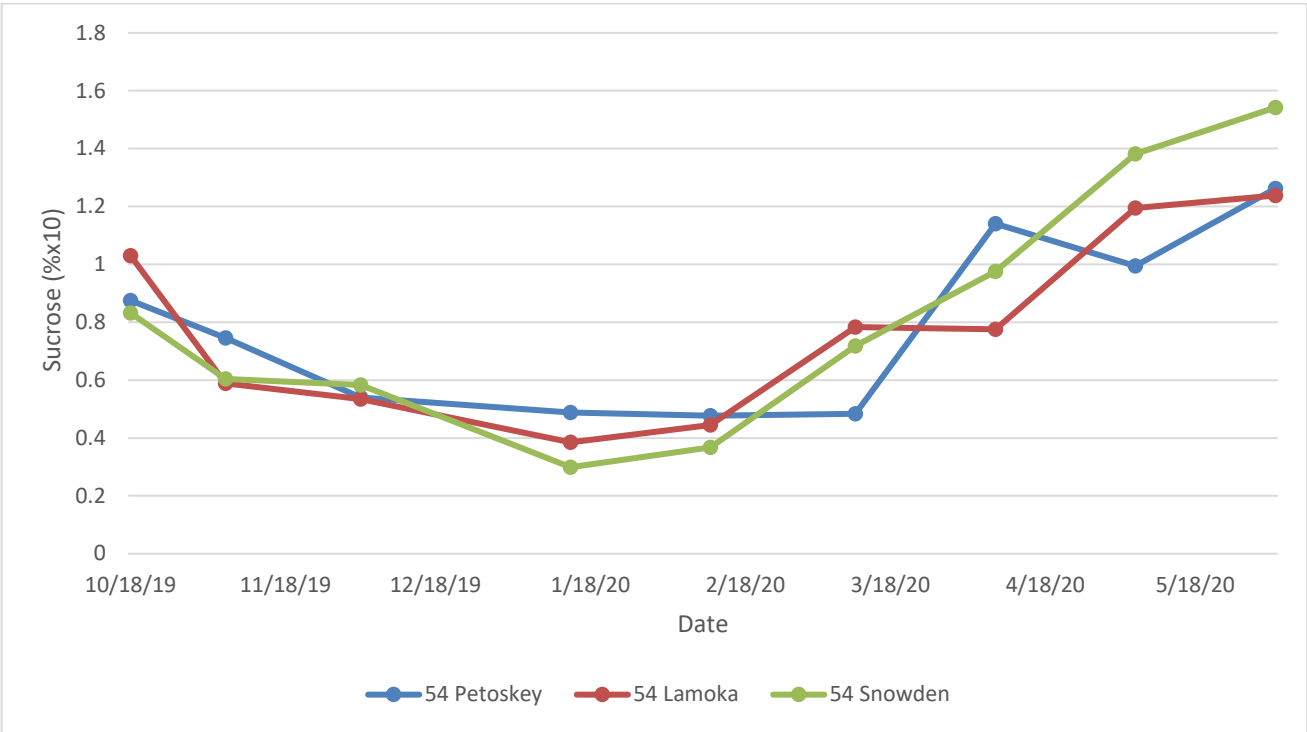
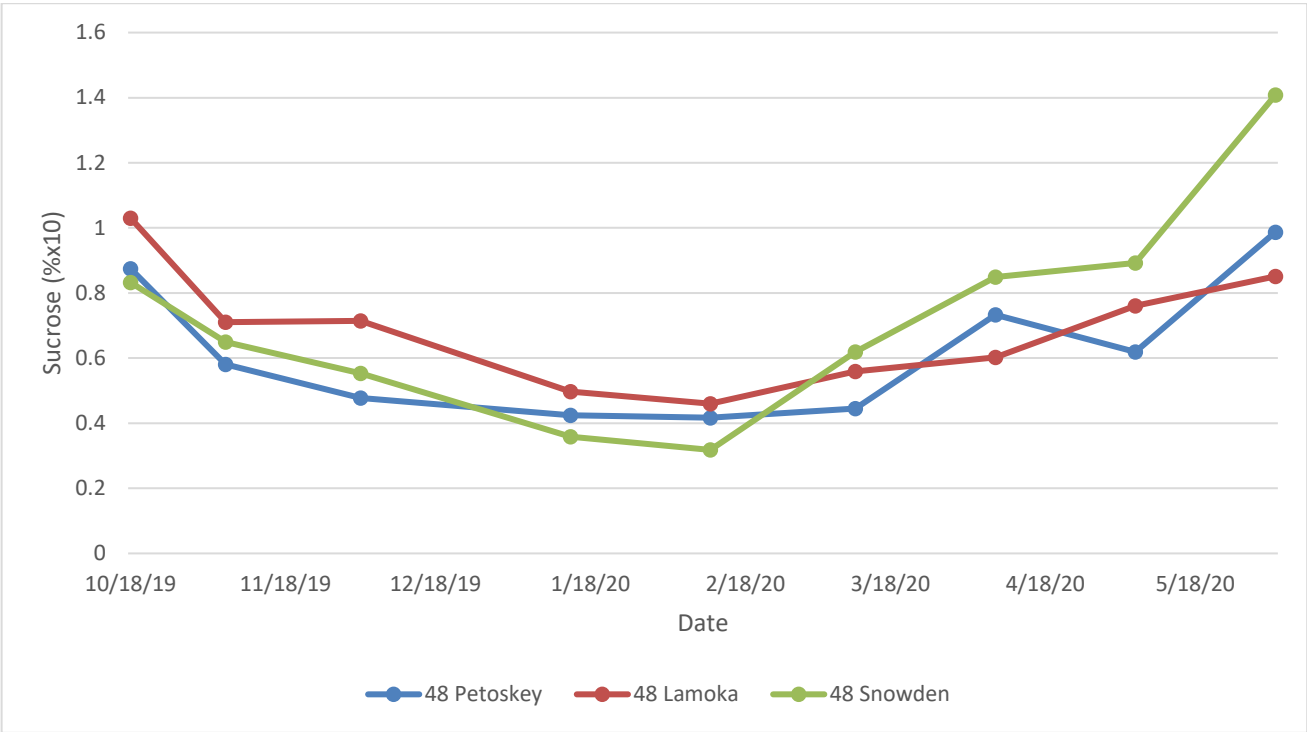


Figure 11. Petoskey (MSV030-4) percent defects for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

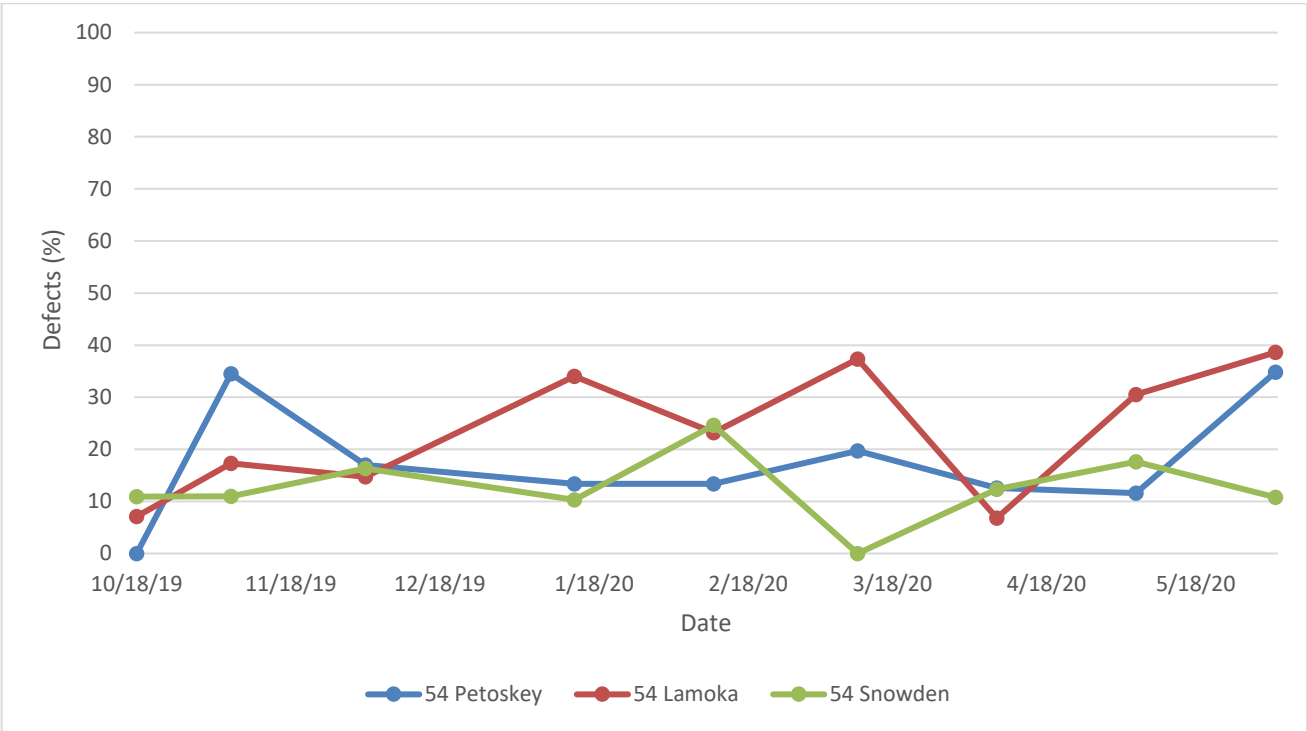
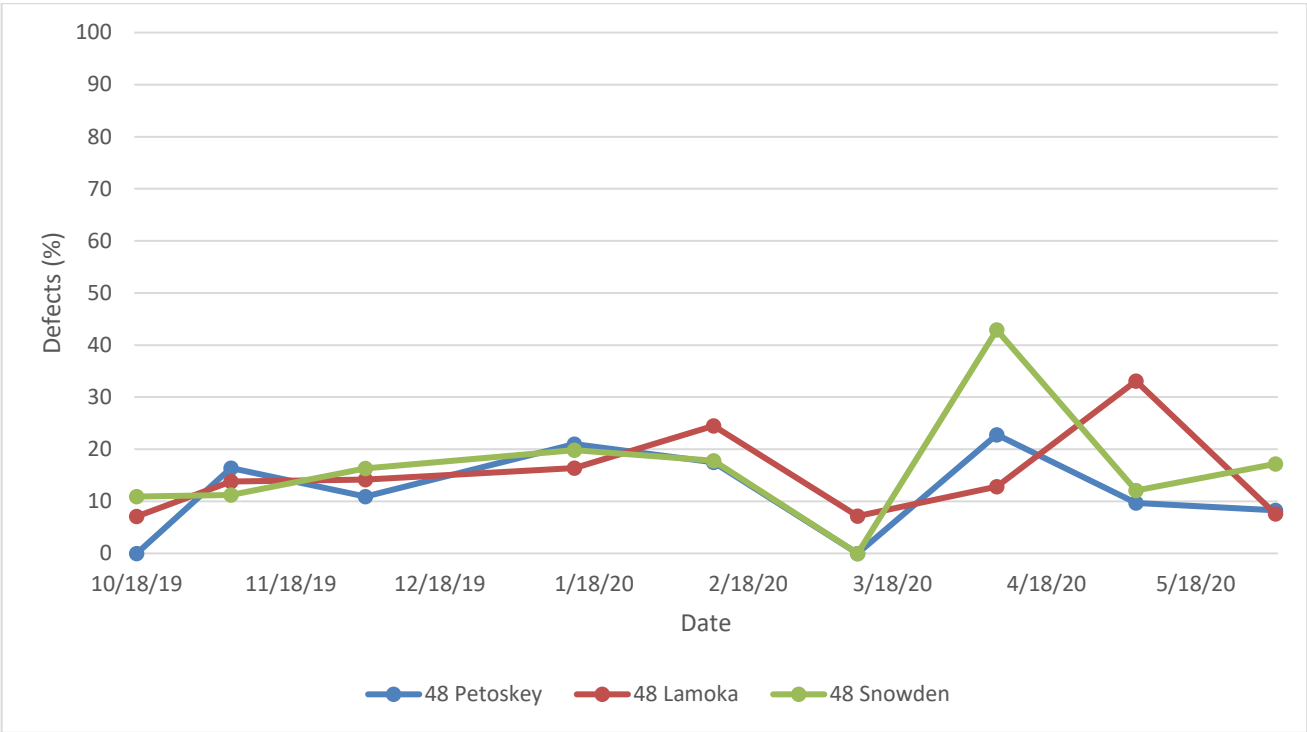
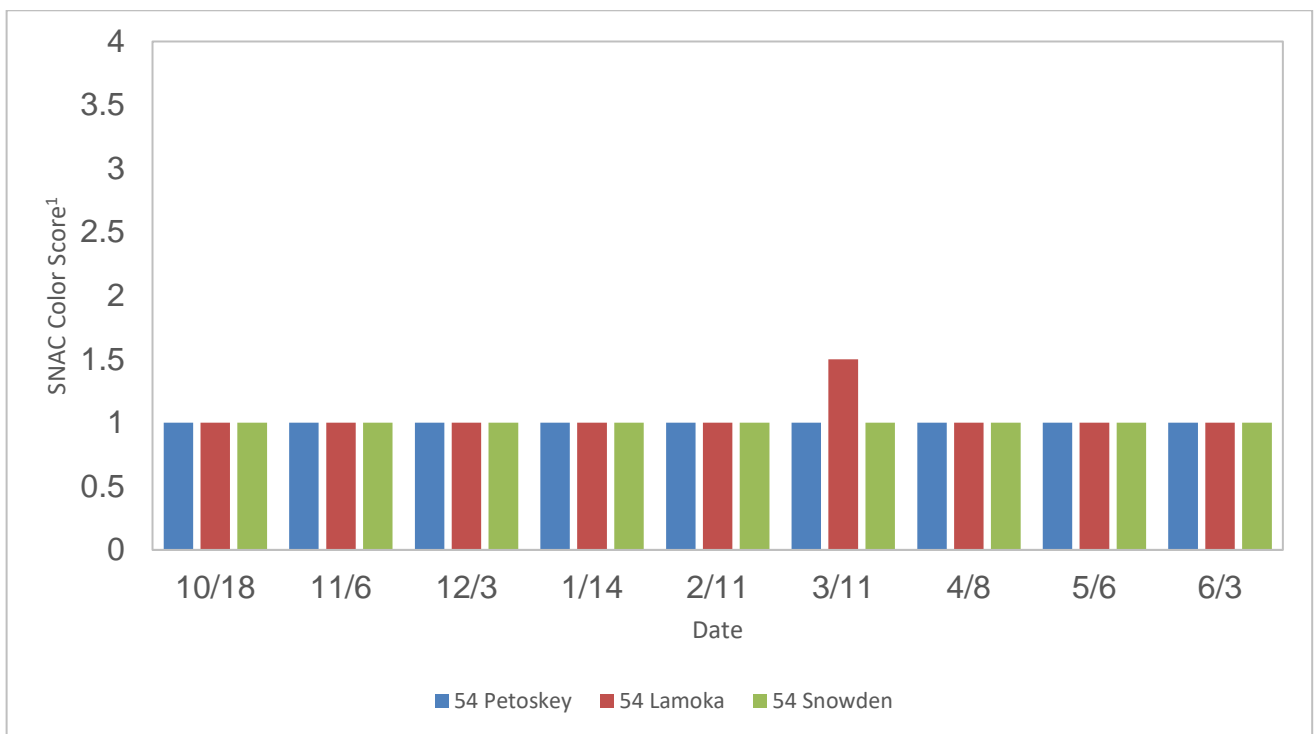
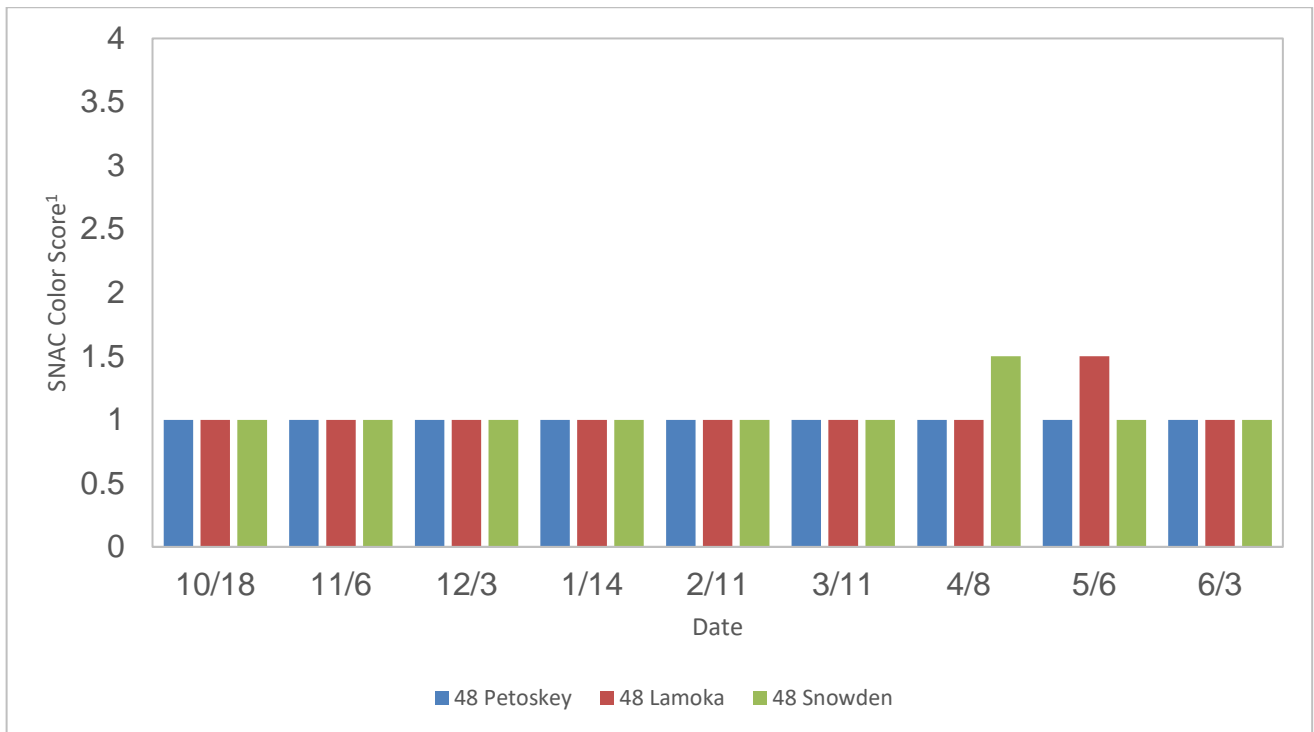









Figure 12. Petoskey (MSV030-4) SNAC Color Score (1 = lightest, 5 = darkest) the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.



MSW075-2: At 48°F, this variety did not display the decrease in glucose concentration that the check varieties had between December and March. MSW075-2 had glucose concentrations higher than the checks during these months. At 54°F glucose concentrations were between those of Lamoka and Snowden in all but one sample (Figure 13). At both temperatures, this variety had higher sucrose concentrations than the checks, excluding the June sample at 48°F (Figure 14). The sample stored at 48°F had higher chip defects, especially in the May sample with 70.5% total defects. Defects at 48°F were lower and consistent with those of the checks, indicating longer term storage potential at warmer temperatures (Figure 15). Chip color was never above 1.5 at both temperatures (Figure 16).

Table 6. MSW075-2 monthly chip quality pictures from Techmark Inc.

Month	48°F	54°F
October		
November		
December		
January		











February		
March		
April		
May		
June		

Figure 13. MSW075-2 glucose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

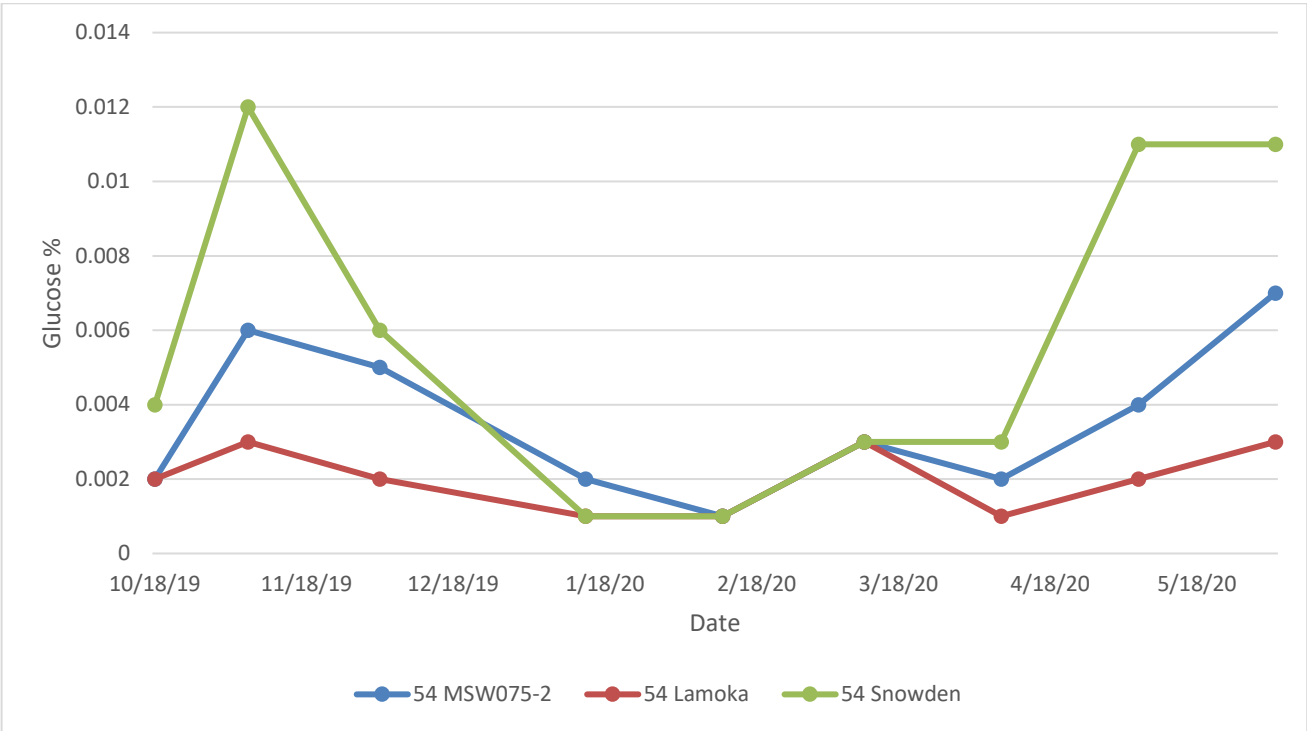
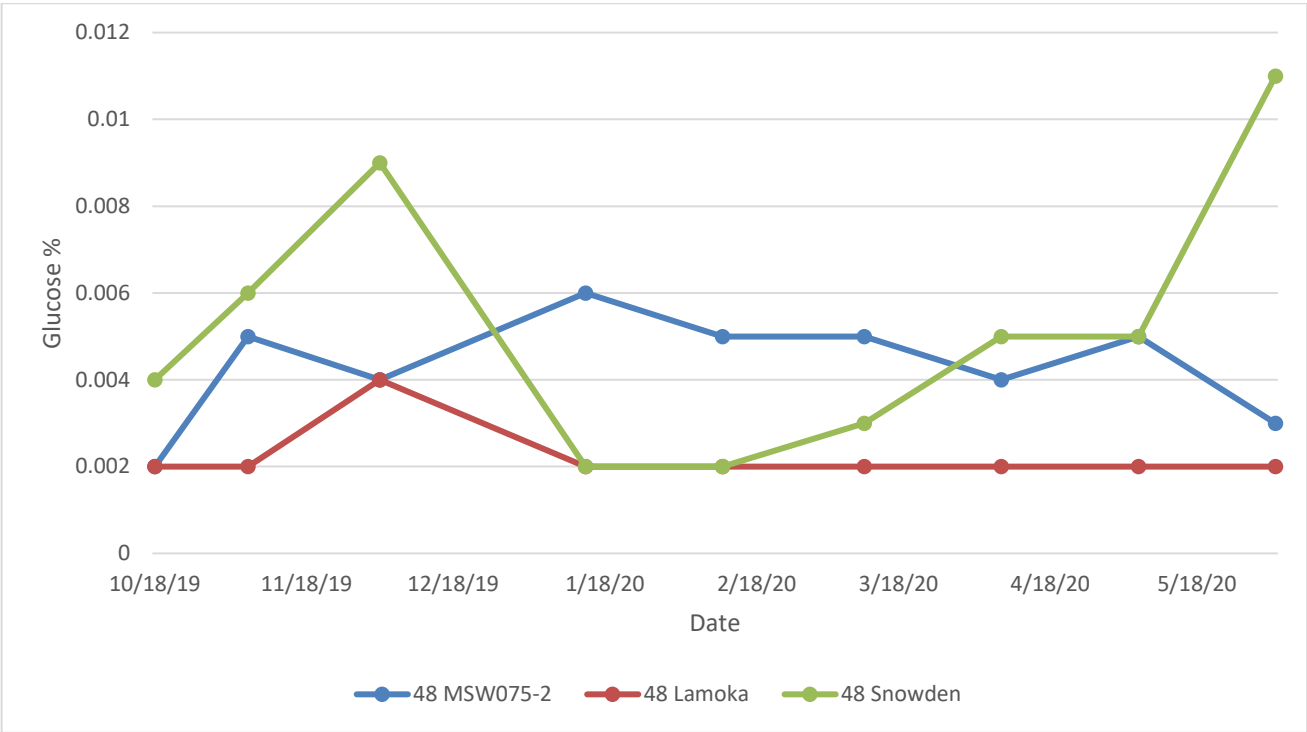


Figure 14. MSW075-2 sucrose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

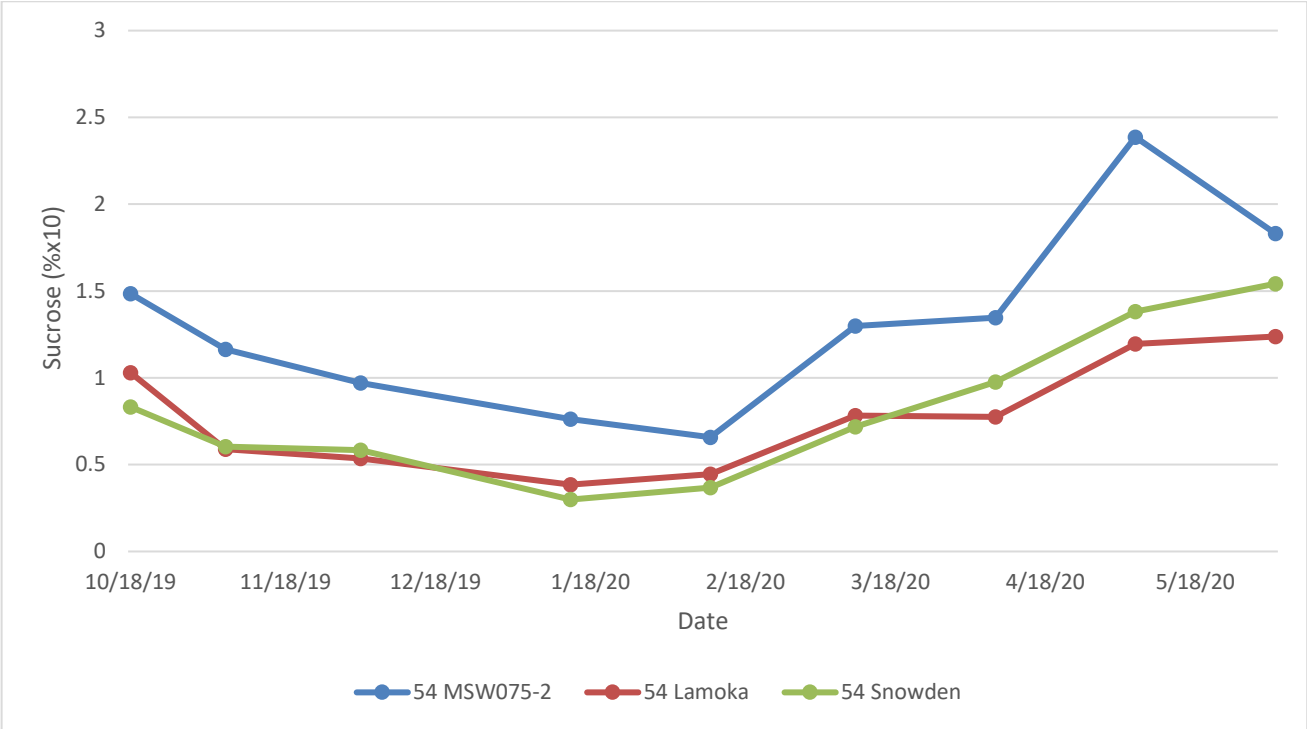
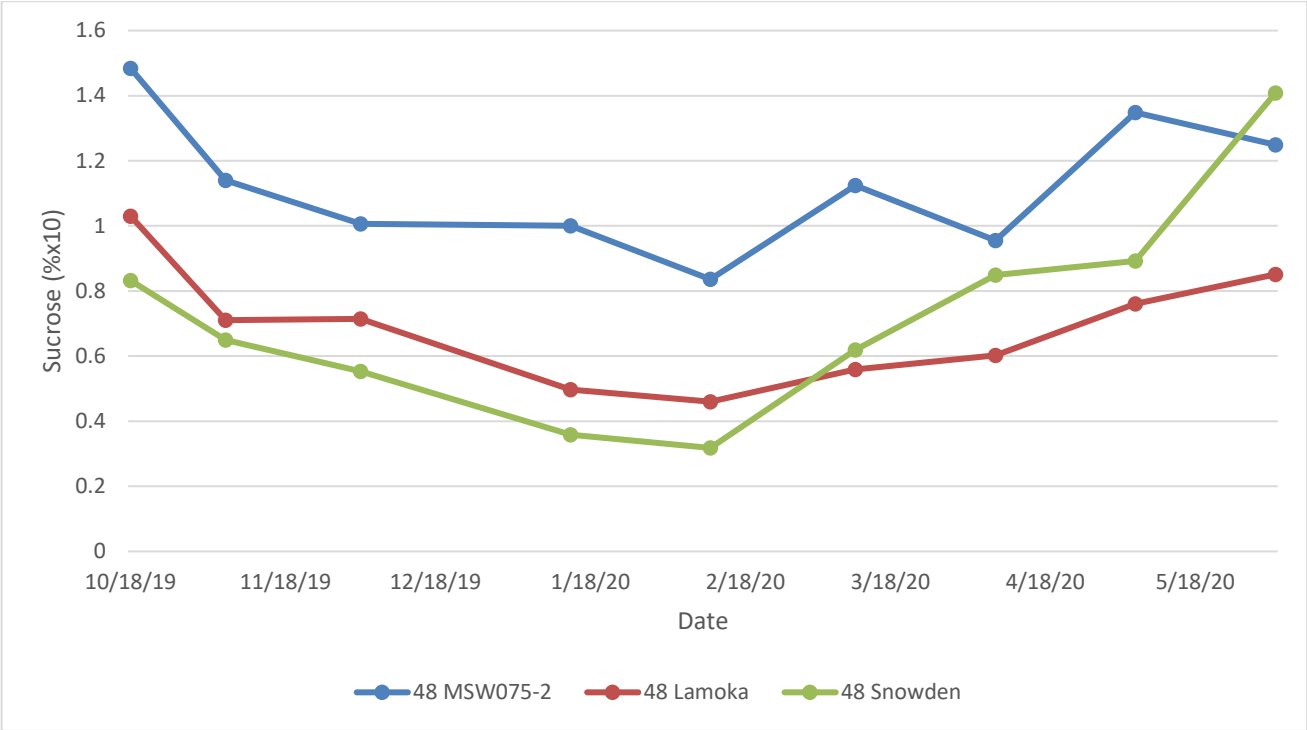


Figure 15. MSW075-2 percent defects for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

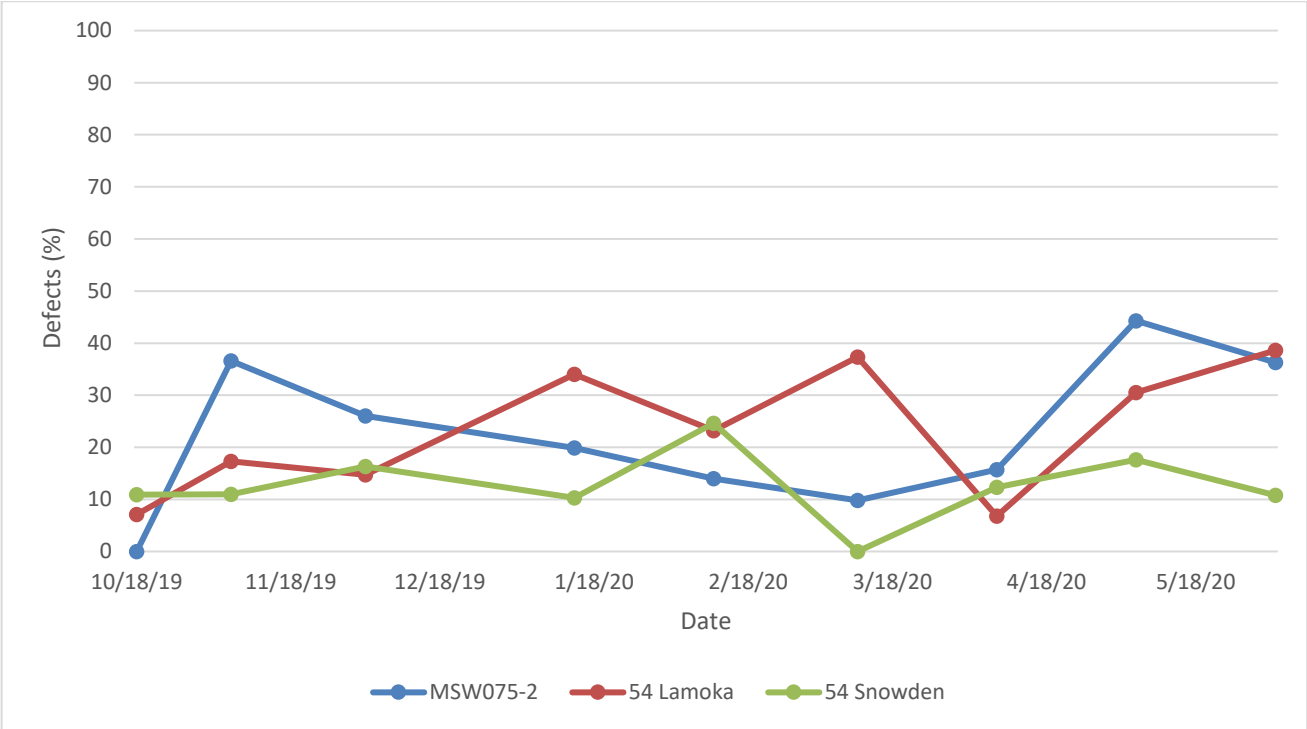
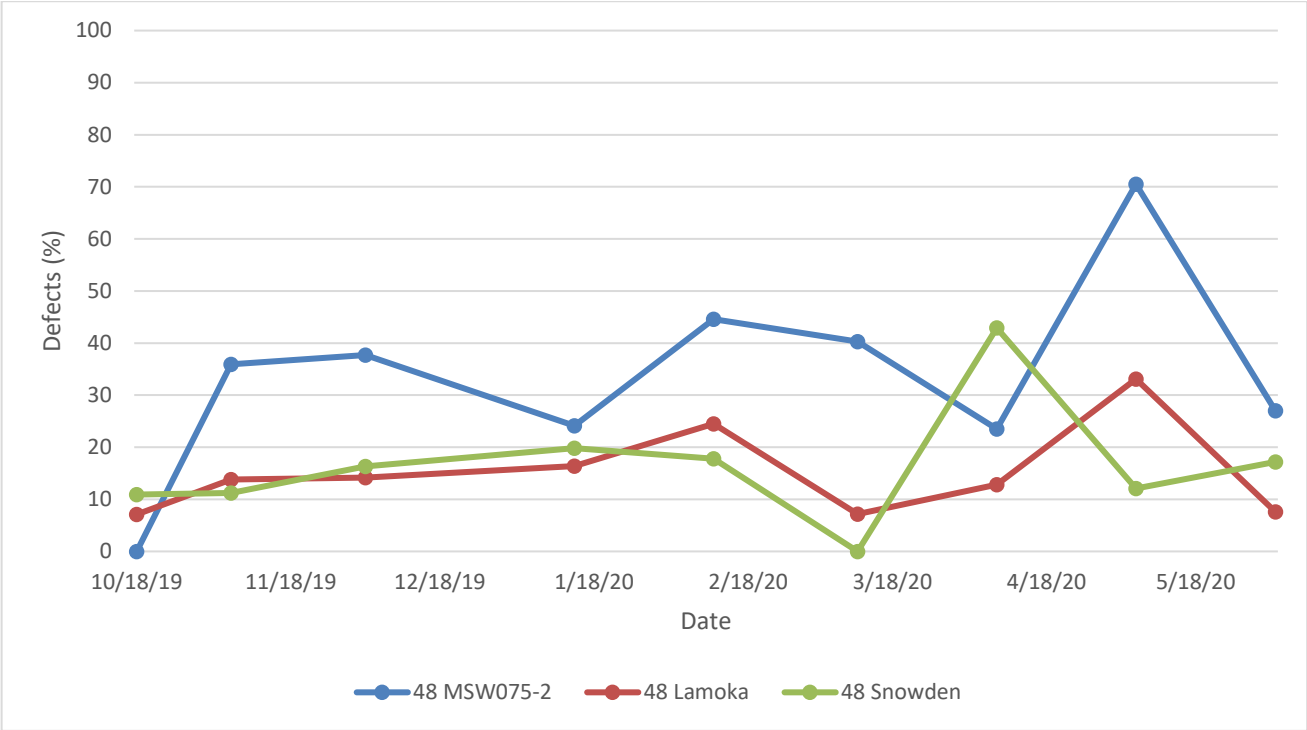
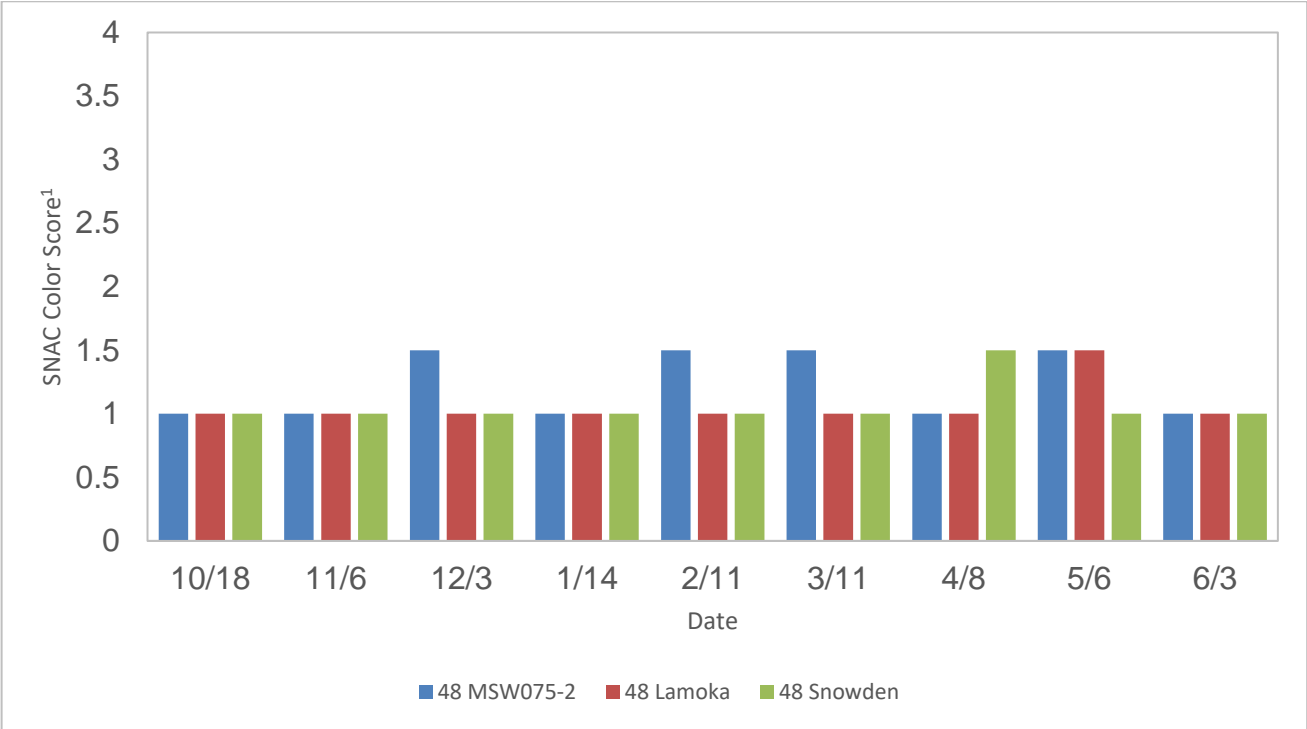
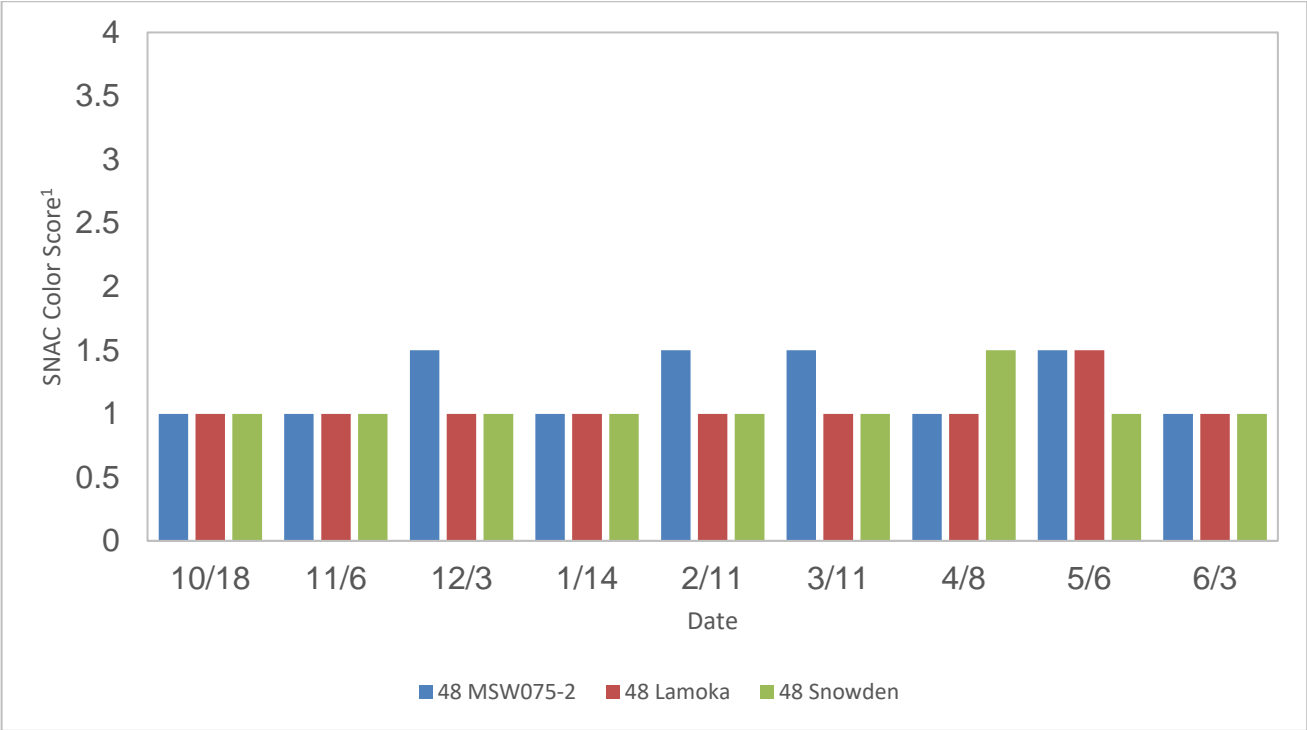









Figure 16. MSW075-2 SNAC Color Score (1 = lightest, 5 = darkest) the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.



MSZ219-14: At 48°F, this variety had a U-shaped trend in glucose concentration with the highest values at the November, May, and June samples. At 54°F glucose concentrations were initially high but decreased through February before slightly rising again (Figure 17). At both temperatures, the sucrose concentration was very similar to the check varieties (Figure 18). Samples at both temperatures had higher chip defects, especially the May sample stored at 48°F which had 78.9% chip defects (Figure 19). Despite the higher chip defects, the chip color of acceptable chips was generally good. It was 1.5 or below for all samples stored at 48°F and 2.0 or below for samples stored at 54°F (Figure 20)

Table 7. MSZ219-14 monthly chip quality pictures from Techmark Inc.

Month	48°F	54°F
October		
November		
December		
January		











February		
March		
April		
May		
June		

Figure 17. MSZ219-14 glucose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

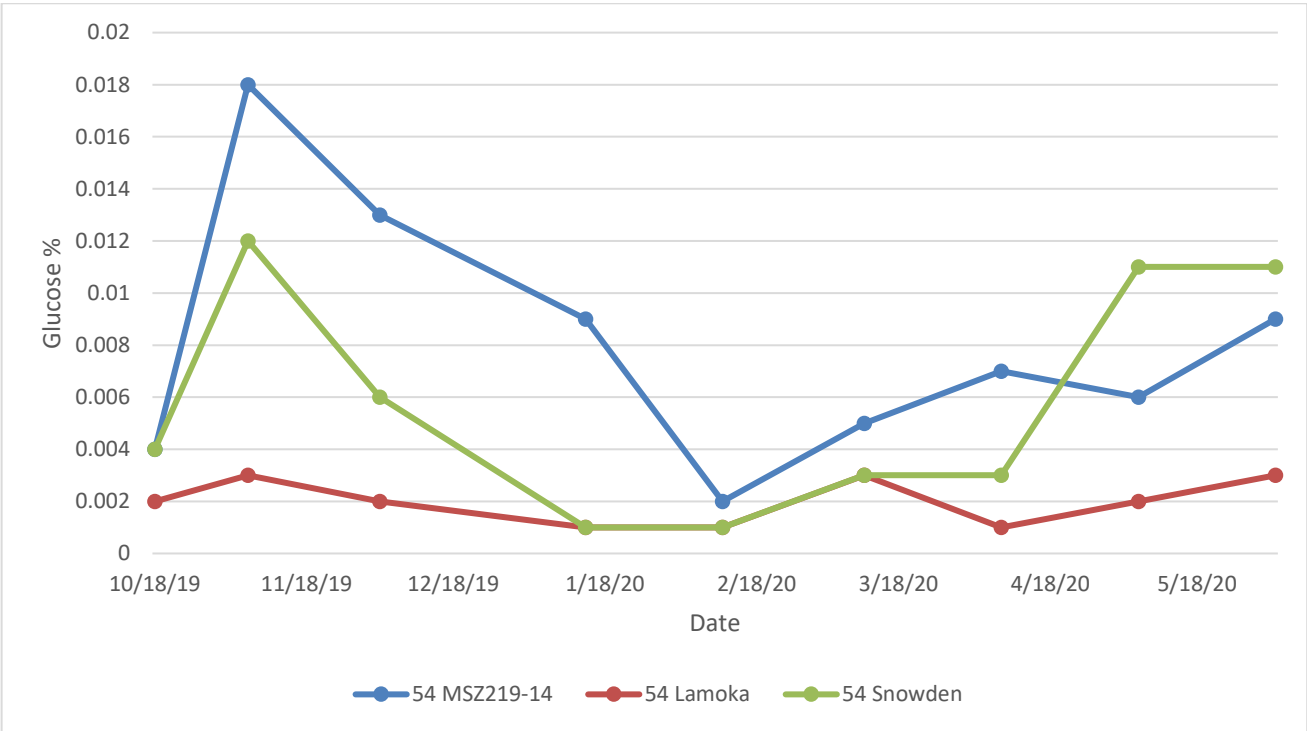
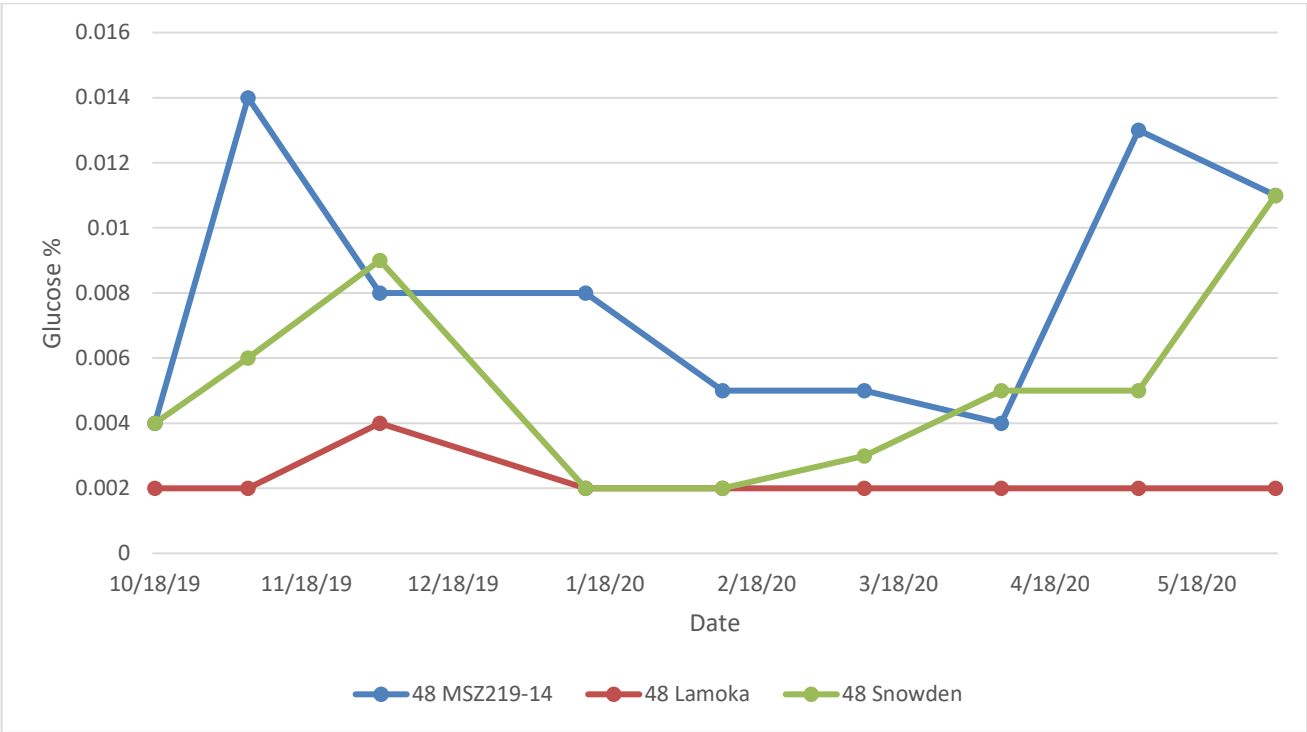


Figure 18. MSZ219-14 sucrose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

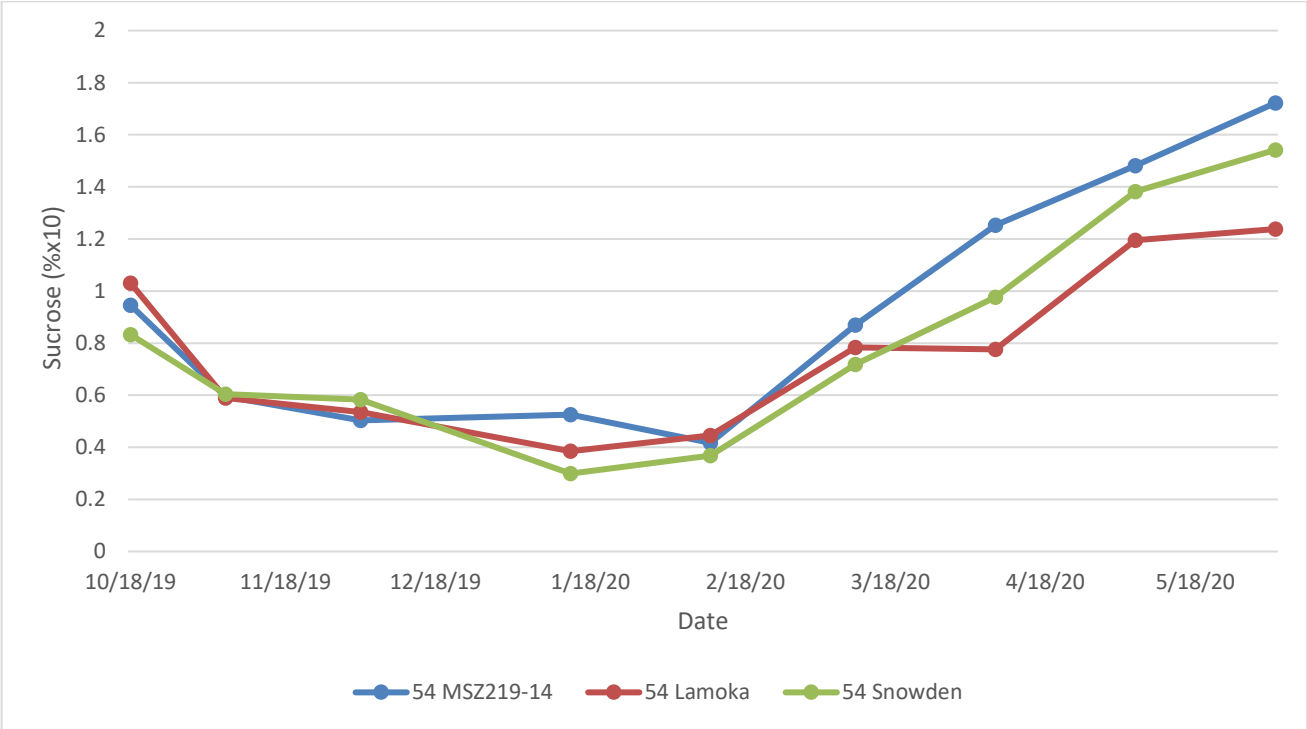
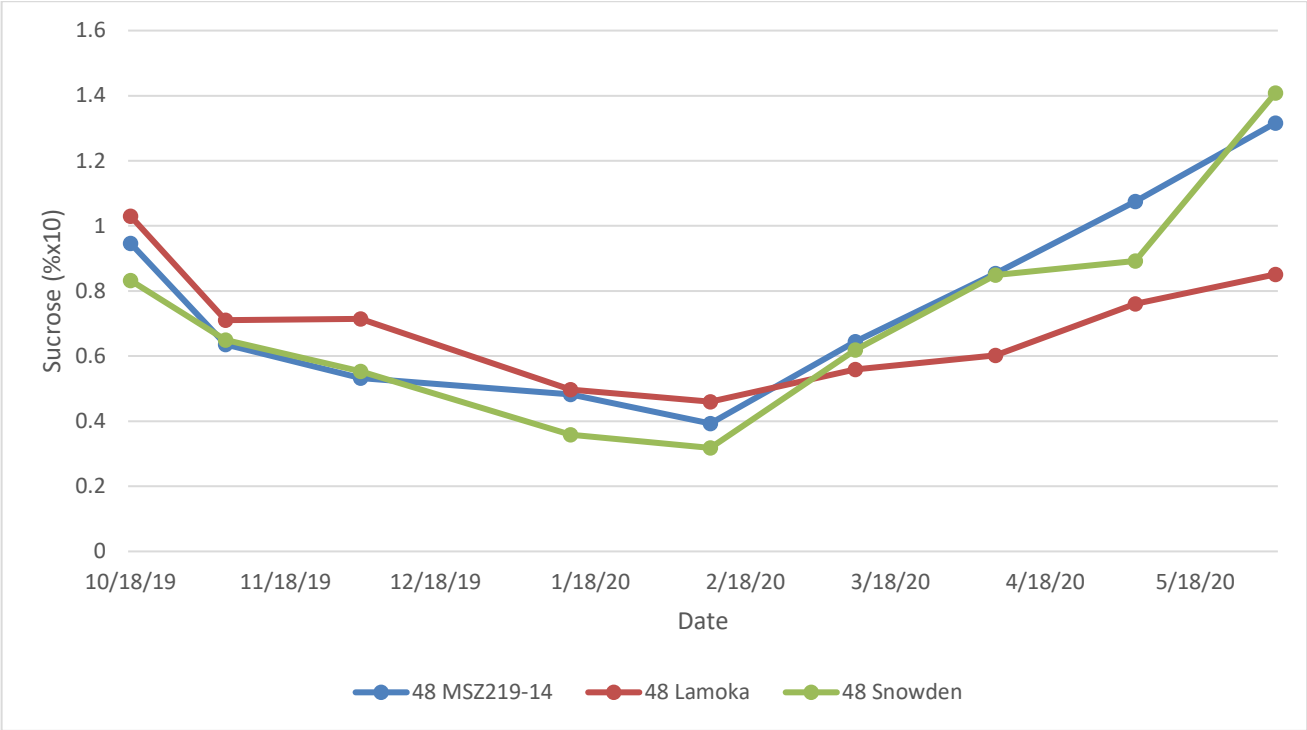


Figure 19. MSZ219-14 percent defects for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

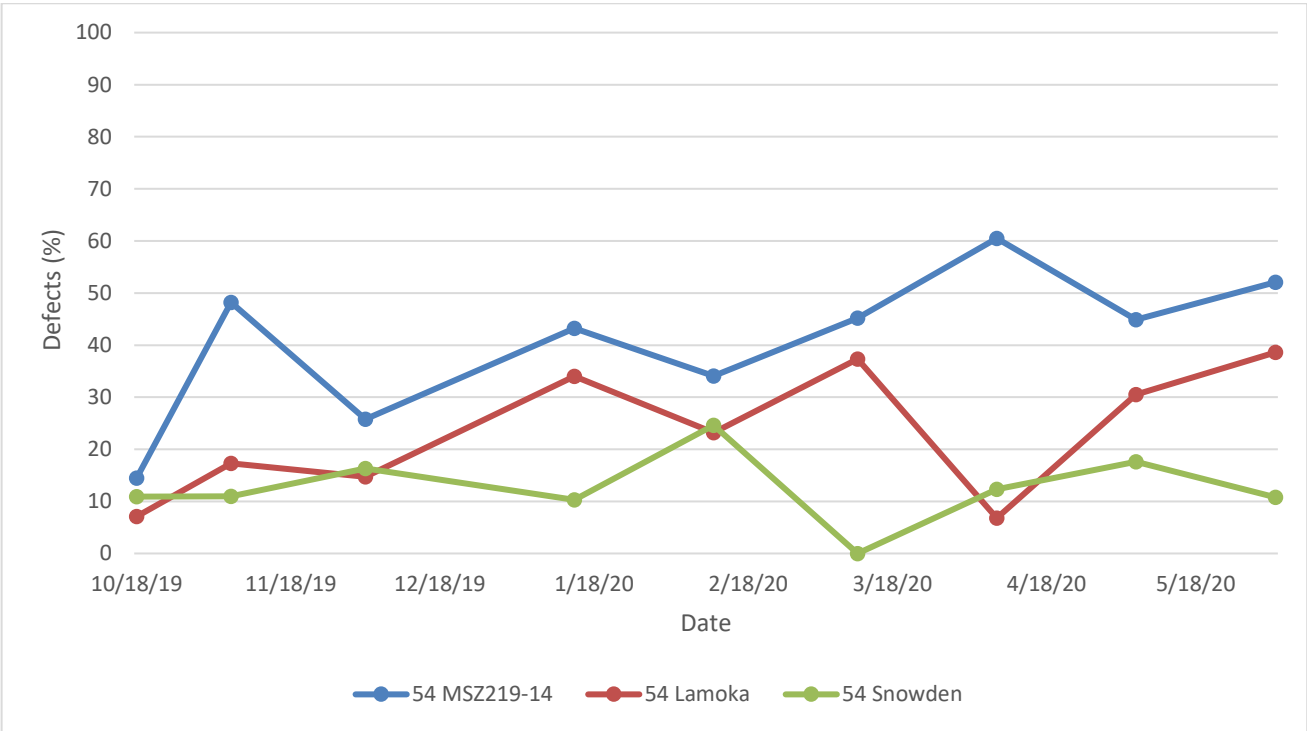
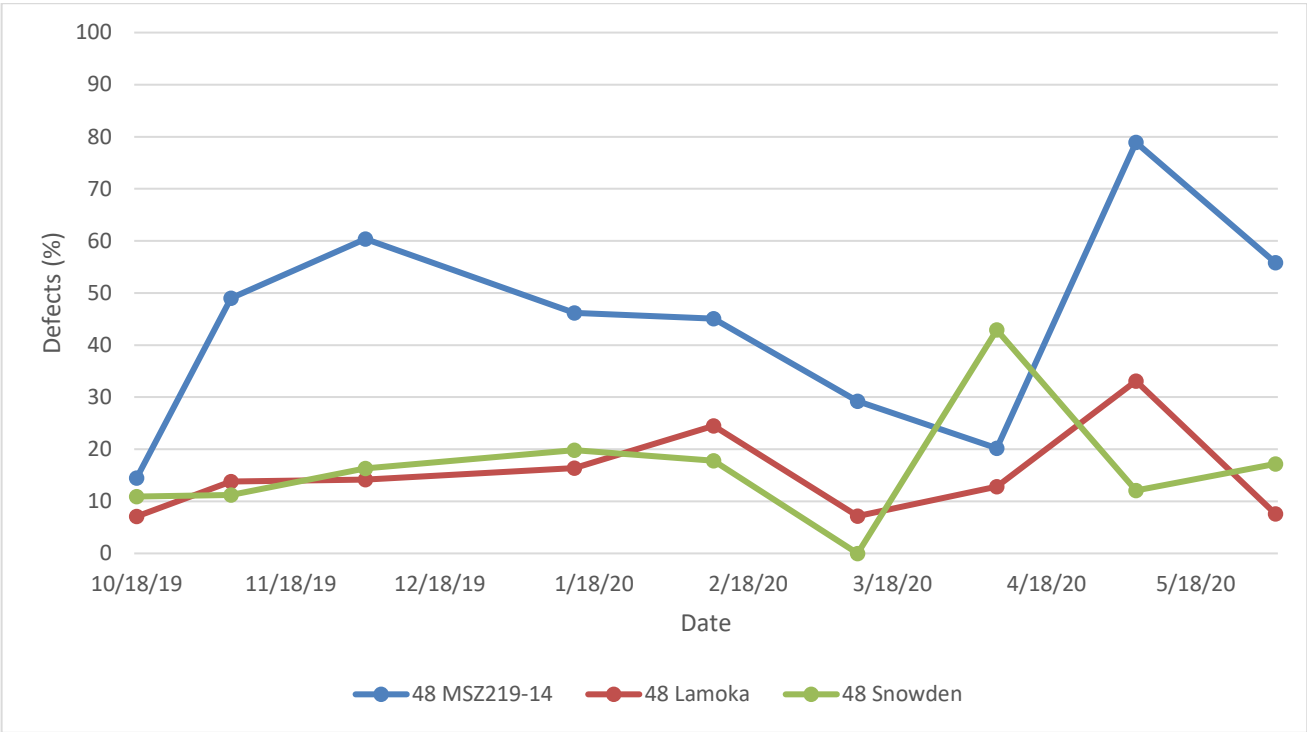
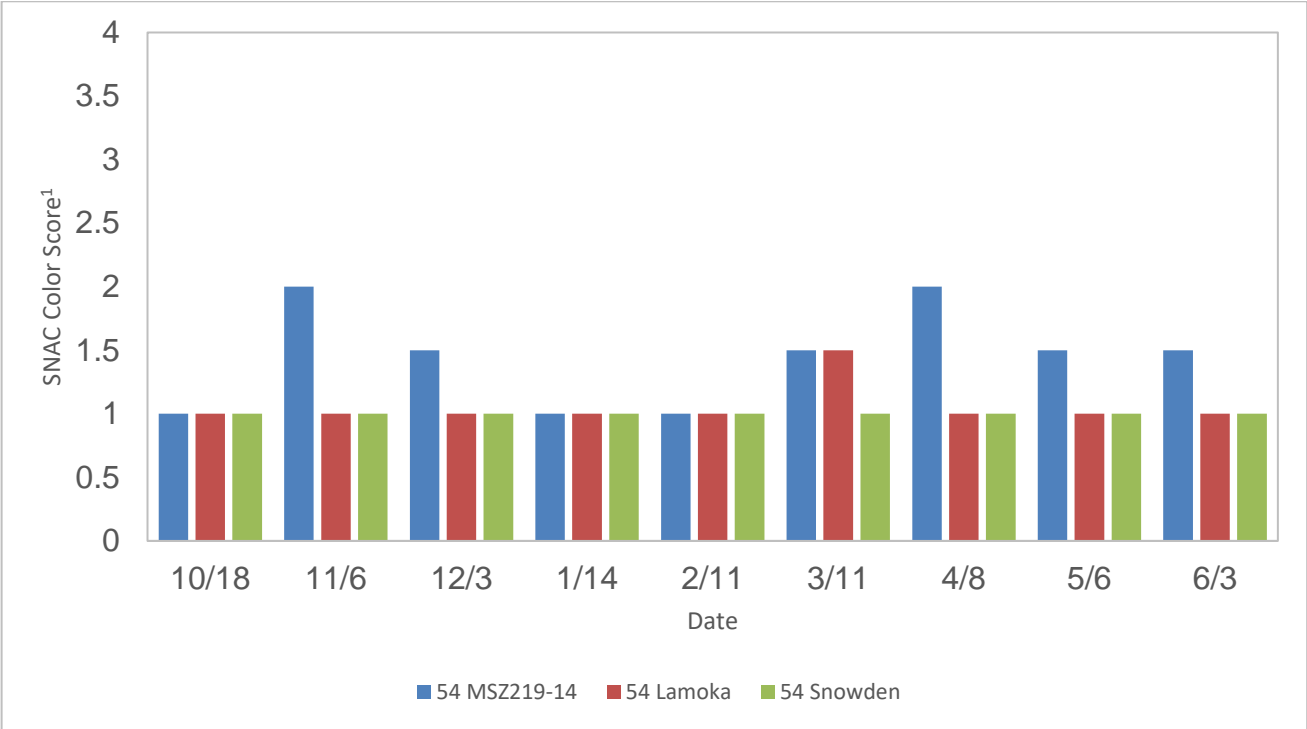
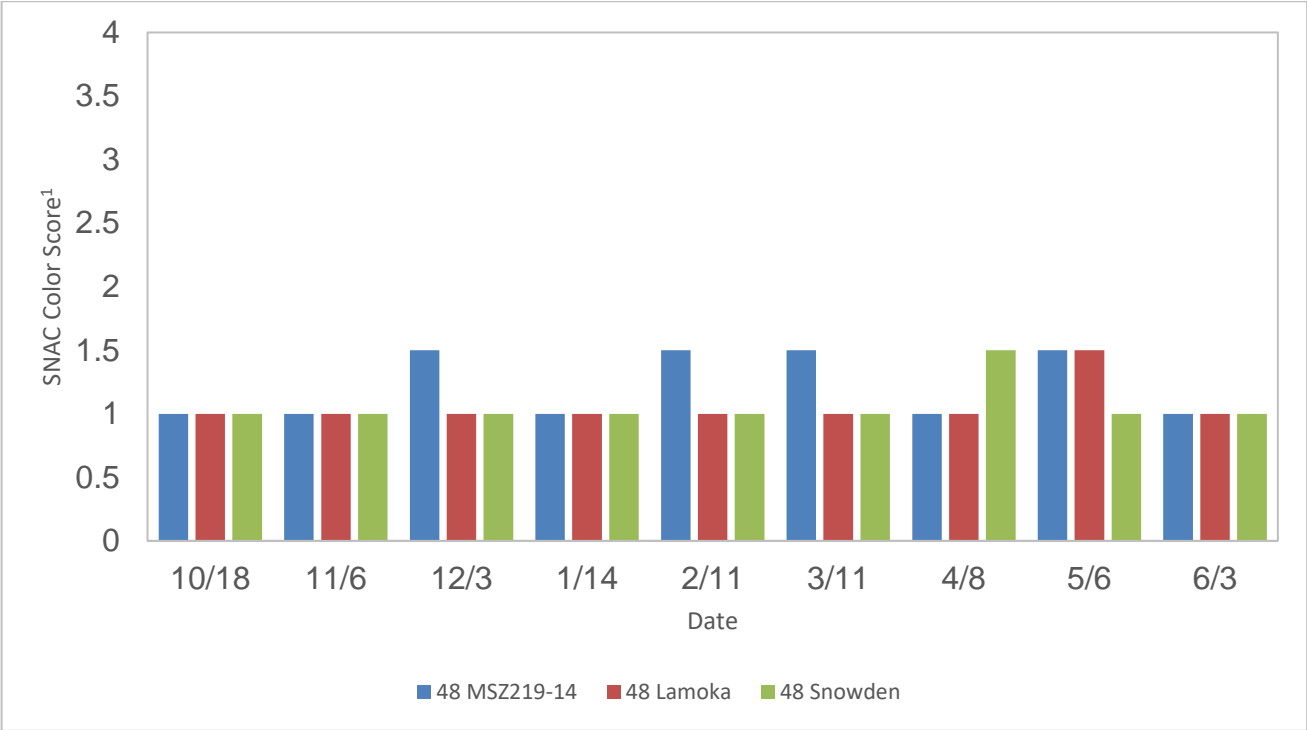









Figure 20. MSZ219-14 SNAC Color Score (1 = lightest, 5 = darkest) the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.



ND7519-1: While the initial glucose levels in samples stored at both temperatures were like those of the checks, the glucose levels greatly increased in the May and June samples to 0.085% and 48°F and 0.054% at 54°F (Figure 21). The sucrose levels at both temperatures began rising in March, causing the subsequent glucose increase (Figure 22). Chip defects were low in samples stored at 48°F until the April sample, and increased to 97.3% defects at the final sample. Samples stored at 54°F had an acceptable percentage of defects until the March sample, and defect incidence increased at each following sample (Figure 23). The rising sucrose and glucose led to darker chips in samples after April, with the final sample rated 2.5 (48°F) and 2.0 (54°F) (Figure 24). While this variety may not have long term storage potential, it had good chip quality through March at 48°F and February at 54°F (Table 8).

Table 8. ND7519-1 monthly chip quality pictures from Techmark Inc.

Month	48°F	54°F
October		
November		
December		
January		

February		
March		
April		
May		
June		

Figure 21. ND7519-1 glucose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

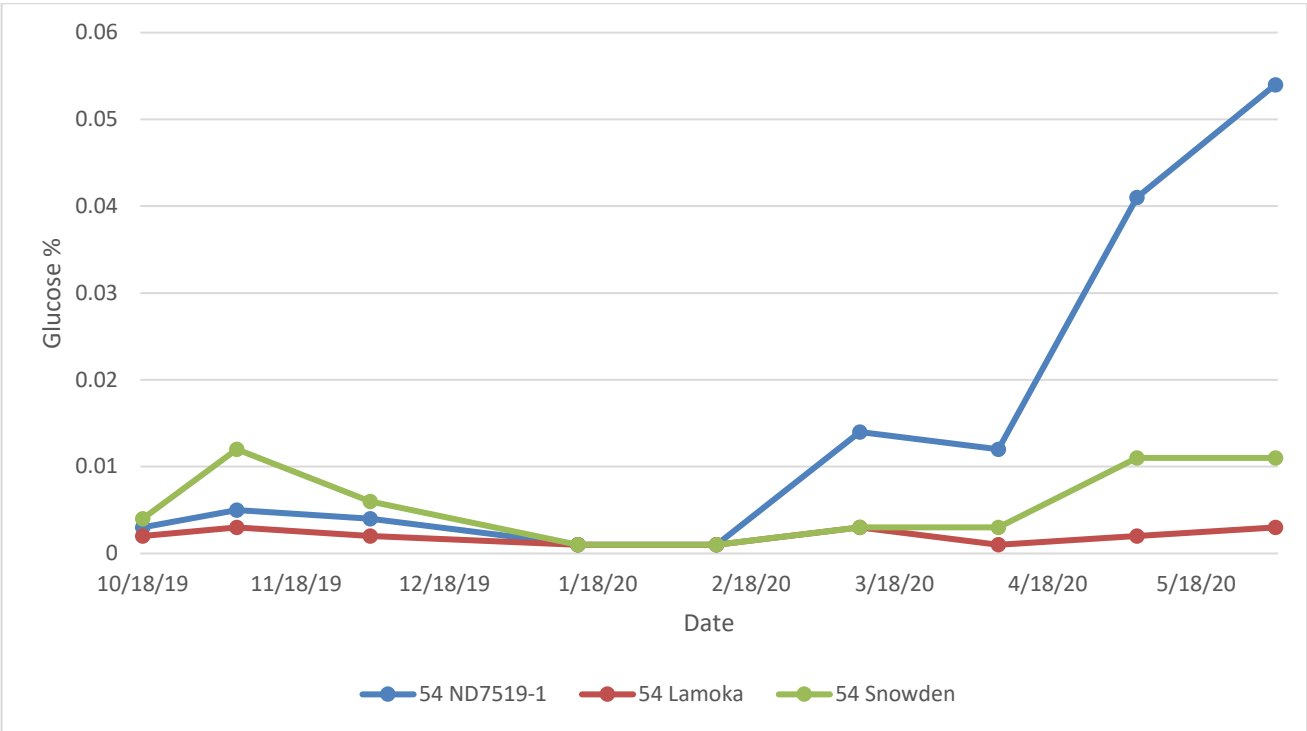
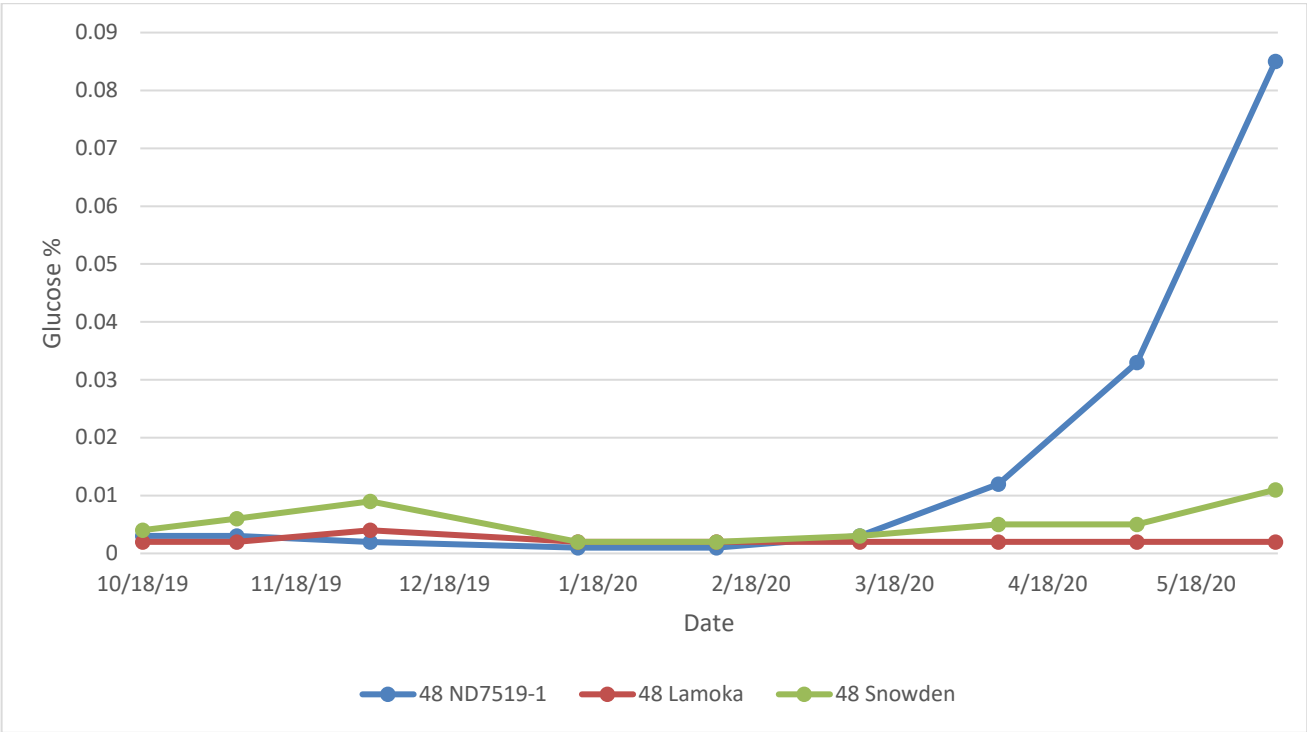


Figure 22. ND7519-1 sucrose concentrations for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

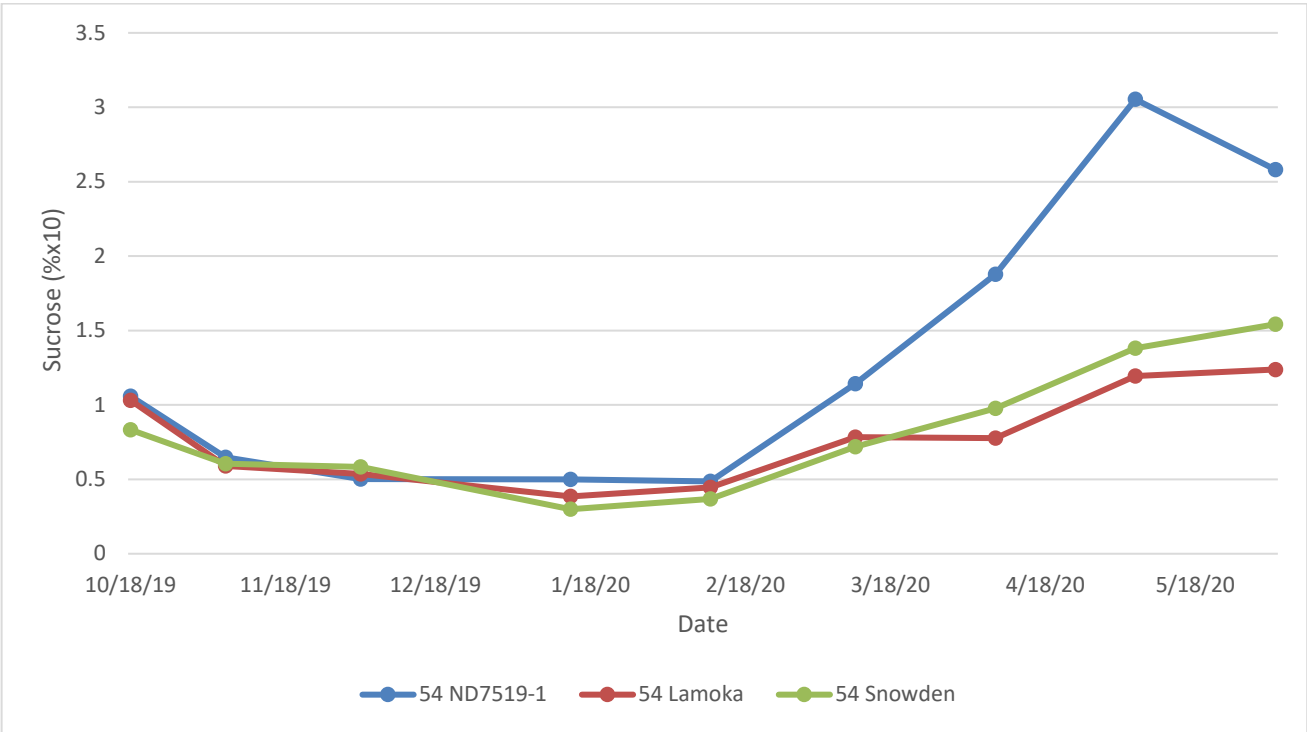
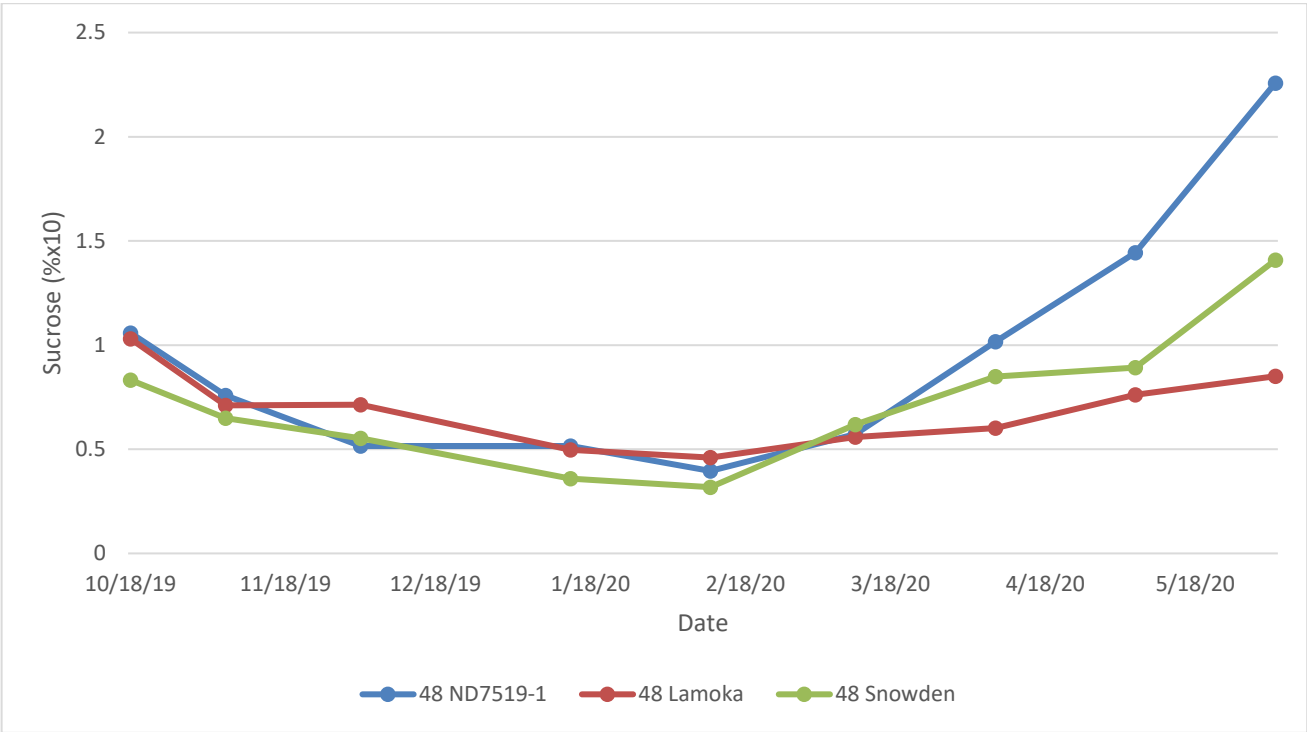


Figure 23. ND7519-1 percent defects for the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.

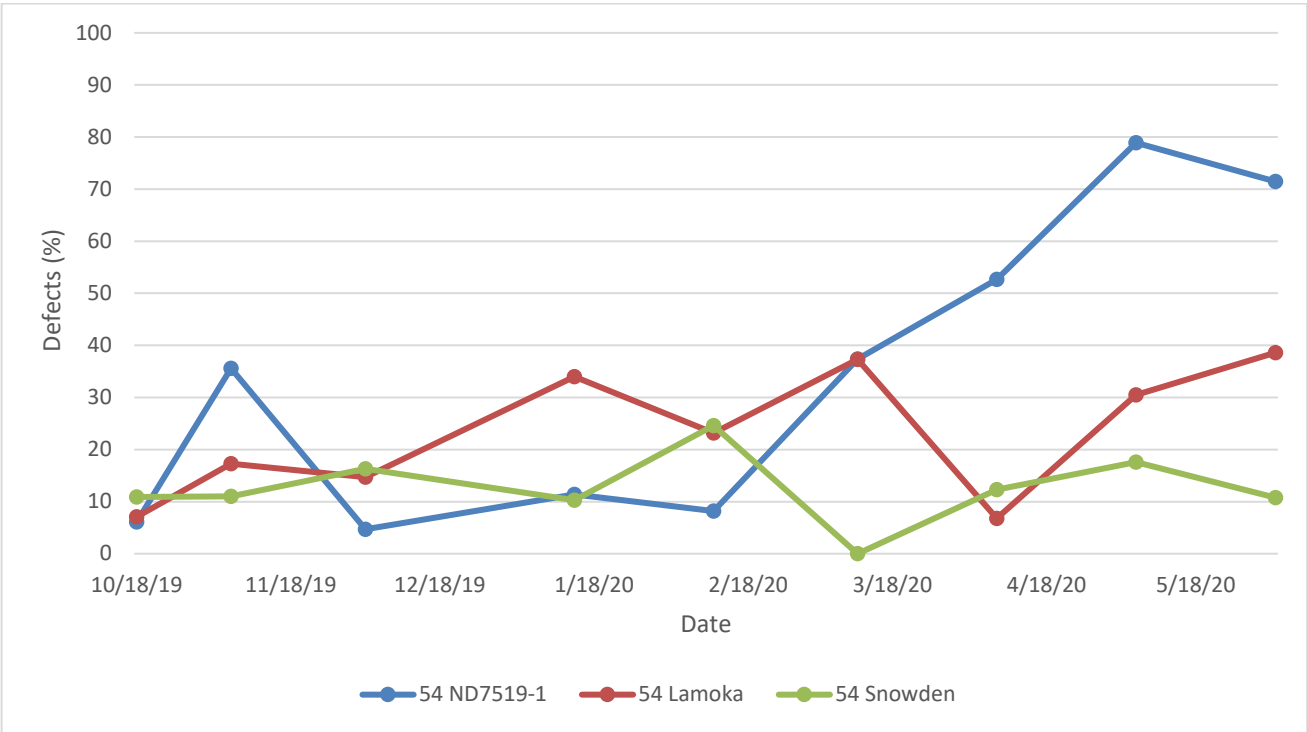
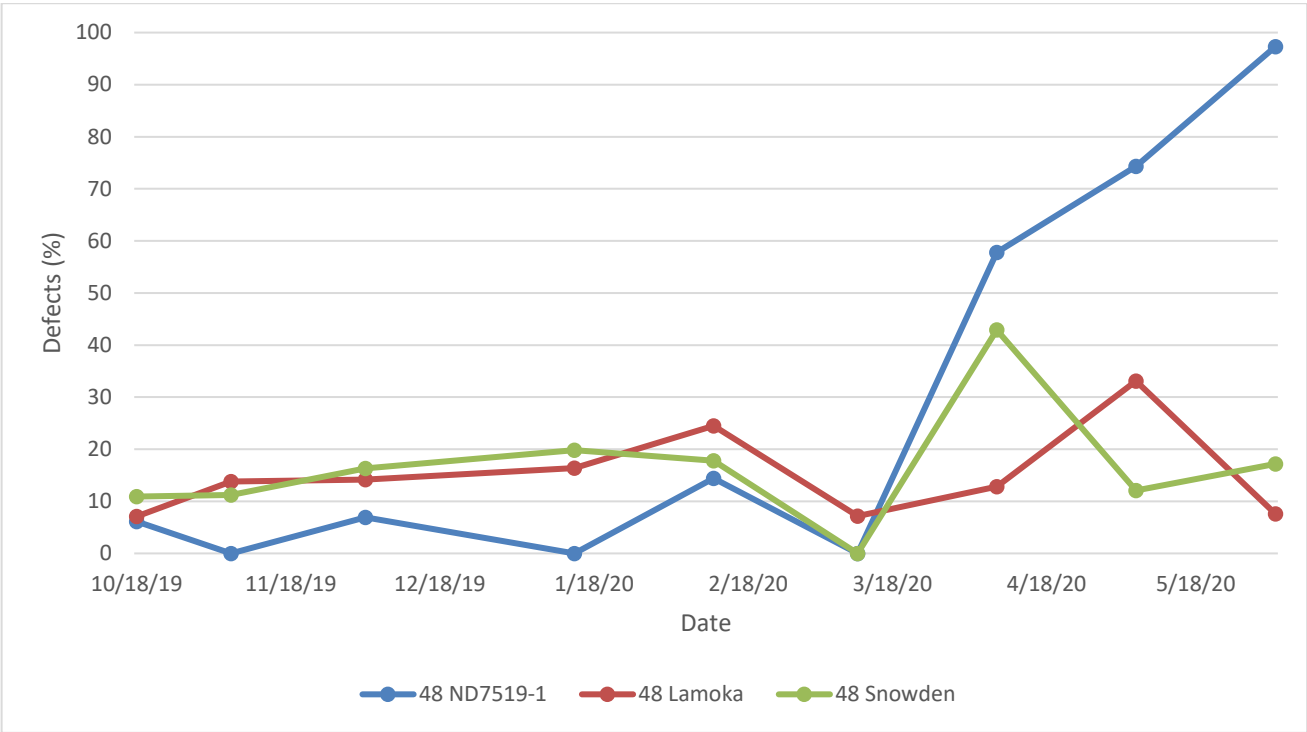
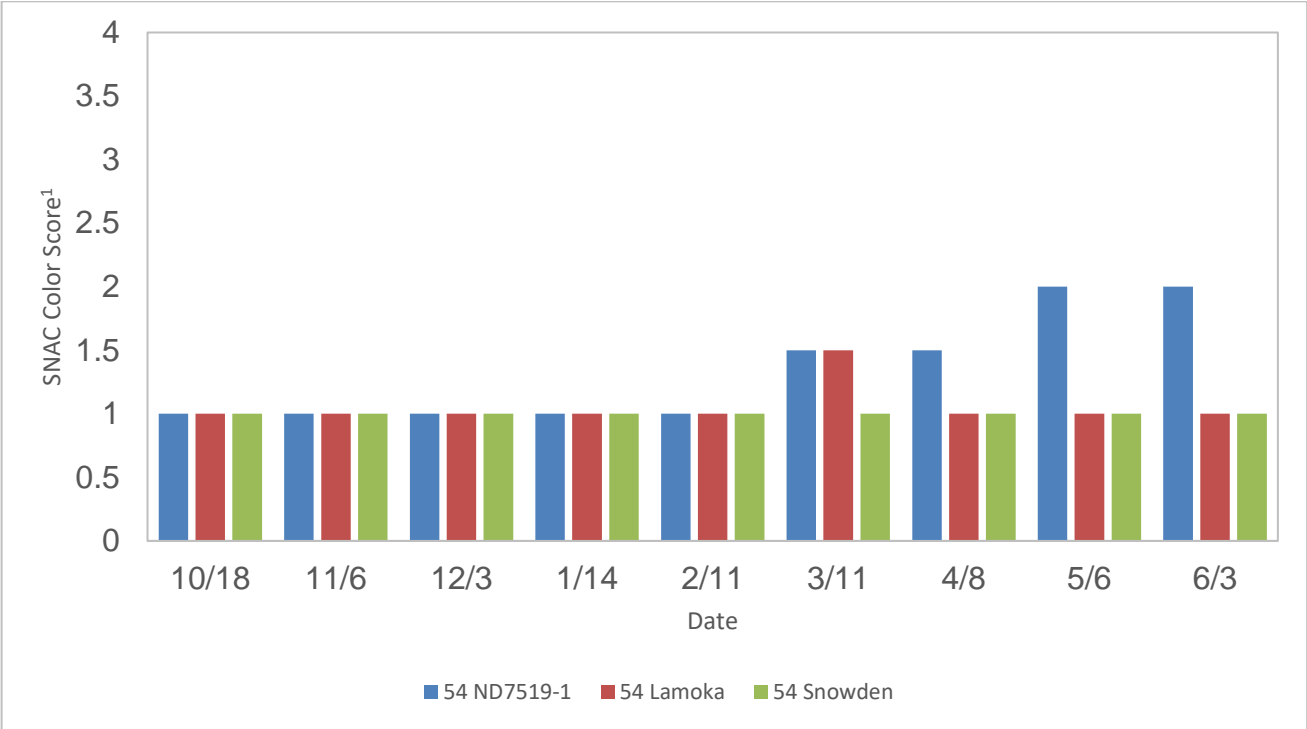
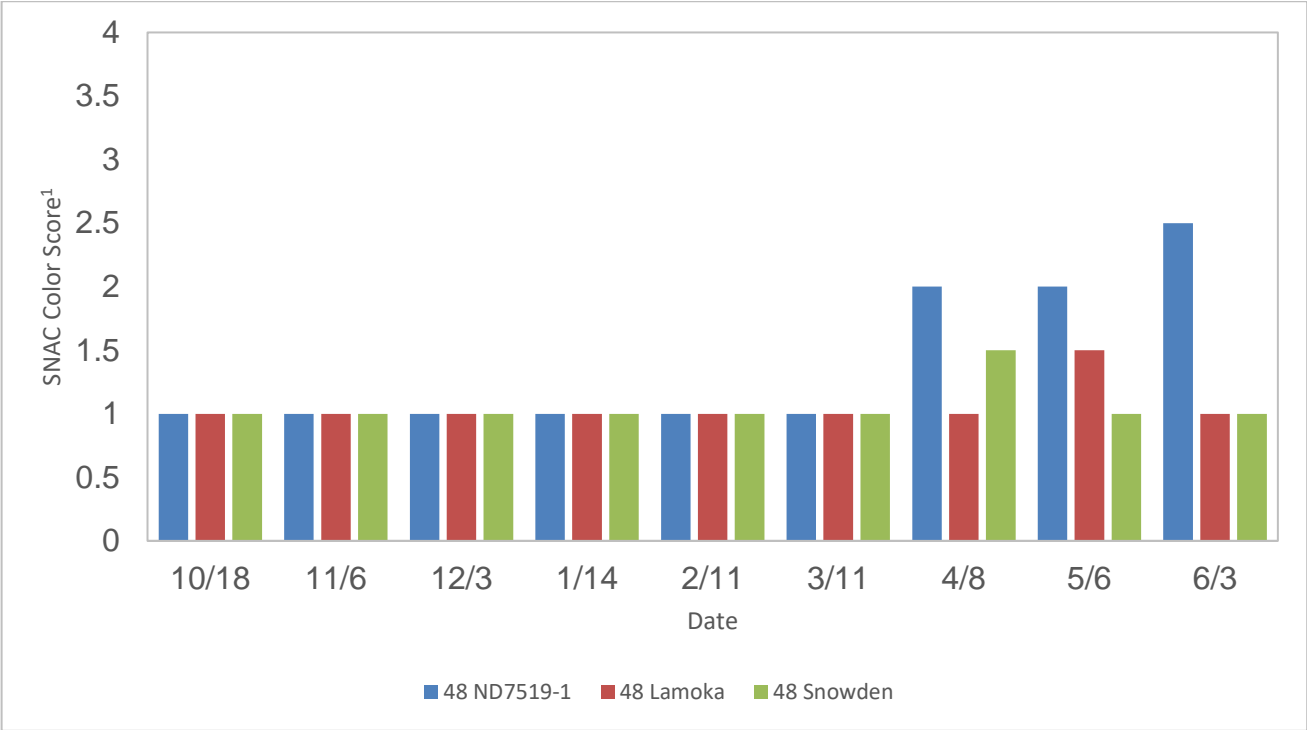






Figure 24. ND7519-1 SNAC Color Score (1 = lightest, 5 = darkest) the 2019-2020 storage season at 48°F (top) and 54°F (bottom) compared to Lamoka and Snowden.



Lamoka: This check variety can store through May with good chip quality. See individual varieties for comparisons on sugar, defects, and SNAC color scores.








Table 9. Lamoka monthly chip quality pictures from Techmark Inc.




Month	48°F	54°F
October		
November		
December		
January		

February		
March		
April		
May		
June		

Snowden: This check variety can store through May or June with good chip quality. See individual varieties for comparisons on sugar, defects, and SNAC color scores.

Table 10. Snowden monthly chip quality pictures from Techmark Inc.

Month	48°F	54°F
October		
November		
December		
January		

February		
March		
April		
May		
June		