NC-140 Fuji and Honeycrisp Apple Rootstock Trials in New Jersey: 2021 Growing Season

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Over the past 8 years, the New Jersey Horticulture Society has consistently supported both the NC140 2014 Honeycrisp and 2014 Fuji rootstock trials in New Jersey with their NJ Horticulture Society Grant Fund. These trials are part of the larger NC-140 Regional Rootstock Project which is also partially funded through the US Hatch Act in partnership with the USDA, NIFA and Agricultural Experiment Stations.

Our NC140 project seeks to make the best rootstocks available to fruit growers! Our project focuses on selecting and testing rootstocks that enhance the vigor, yield, disease and insect resistance of widely grown apple (and other tree fruit) cultivars. New Jersey has been part of NC-140 since 1988. Trials are established at multiple locations throughout the North America to observe and record the performance of commercially significant cultivars with different promising new rootstocks.

Overview of the Rootstock Trials

The New Jersey NC140 apple rootstock trials have been established at the Rutgers Snyder Research and Extension Farm in Pittstown, NJ since 1990. This includes both the 2014 Honeycrisp and 2014 Fuji rootstock trials. The Honeycrisp apple trial was established at a spacing of 4' x 12' (907 trees per acre), and the Fuji trial is at a slightly wider spacing 5' x 13' (672 trees/acre). The trees have been managed in accordance with the commercial standards as written in the 2021/2022 New Jersey Tree Fruit Production Guide.

The Honeycrisp planting has 14 rootstocks (B.10, G.11, G.202, G.214, G.30, G.41, G.935, G.969, M.26 EMLA, M.9 NAKBT337, V.1, V.5, V.6, V.7).

The Fuji planting includes only 11 rootstocks (G.11, G.202, G.214, G.30, G.935, M.9 NAKBT337, M.26 EMLA, V.1, V.5, V.6, V.7).

Data are collected from each of the plantings at harvest. Data collected from the Honeycrisp trial included total yield per tree, total number of fruits per tree, number of suckers per tree (not reported) and circumference. Data collected from the Fuji trial included total yield per tree, total number of fruits per tree, number of suckers per tree (not reported), circumference, tree height (not reported) and tree width (at widest part) (not reported).

At the Annual NC-140 Technical Committee Meeting in 2021, it was decided that an adequate amount of data has been obtained from the Fuji trial. Thus, 2021 was the last season of data collection for this trial.

2021 NJ Growing Season

The 2021 growing season was profitable for the tree fruit industry in part due to optimal weather conditions. Temperatures held steady in the early growing season, with no major damaging freeze events during bloom (Figure 1). This resulted in excellent cropping. Fortunately, temperatures were optimal, and rain was limited in the spring, thus there were ample opportunities for spring fruit thinning (Figure 1).

There was steady rain throughout the growing season culminating in a major rain event at the beginning of the fall (Figure 1). This resulted in very large fruit size. Ap-

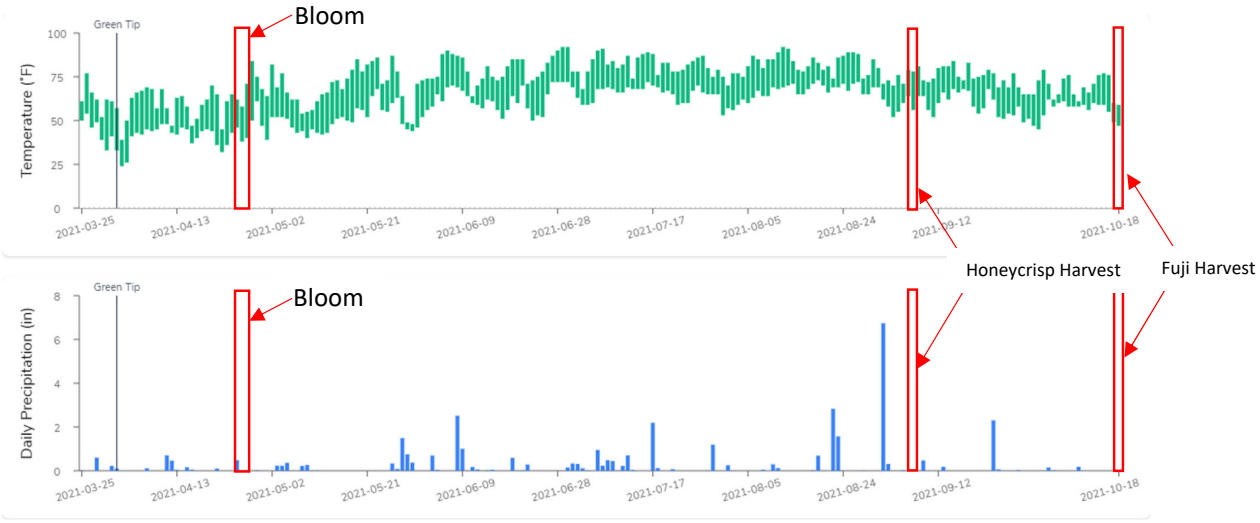

Figure 1. Daily temperature and precipitation totals (in) throughout the 2021 growing season at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

ple harvest was a little early at first but slowed down to normal by mid-September. Apples were able to hang on the trees beyond normal picking days to improve fruit color that was poor due to warm temperatures.

Table 1: Average yield and vigor data collected in 2021 from the 2014 NC-140 Honeycrisp Rootstock T Rutgers University Snyder Research and Extension Farm Pittstown, NJ.

Rootstock	Average TCSA (in^2)	Average Yield (lb)	Average Individual Fruit Weight (oz)	Average Yield Efficiency (lb/in^2)
G.969	5.27 CDE	13.2 B	8	2.5
V.1	6.82 EF	19.8 AB	8	2.9
V.6	7.75 F	24.2 AB	7.6	3.1
G.935	4.50 BCD	19.8 AB	8.8	4.4
V.5	6.36 EF	39.6 AB	7.2	6.2
V.7	6.82 EF	46.2 AB	8.8	6.8
G.214	3.72 ABC	28.6 AB	9.2	7.7
B.10	3.72 ABC	35.2 AB	8	9.5
M.9T337	3.57 ABC	35.2 AB	8.8	9.9
G.41	3.88 ABC	37.4 AB	9.6	9.7
G.30	5.58 DE	61.6 A	9.2	11
G.202	2.79 AB	33 AB	8.4	11.8
M.26EMLA	4.34 BCD	57.2 AB	10.8	13.1
G.11	2.79 A	37.4 AB	7.2	13.4

Means separated within columns by Tukey's HSD (P=0.05).

Results

Honeycrisp. The rootstock V.6 resulted in the largest Trunk Cross Sectional Area (TCSA) for Honeycrisp (7.75 in^2) (Table 1). *TCA is the best measure of tree size for research purposes*. However, it was not significantly larger than the other Vineland Series rootstocks included in the study V.1 (6.82 in^2), V.5 (6.36 in^2), and V.7 (6.82 cm^2) (Table 1). The smallest TCSA G.11 (2.79 in^2) was not significantly smaller than a number of rootstocks including G.202 (2.79 in^2) , G.41 (3.88 in^2), M.9T337 (3.57 in^2), B.10 (3.72 in^2), and G.214 (3.72 in^2) (Table 1). Average yields were fairly consistent across all rootstocks, G.30 (61.6 lb) was statistically the largest and G.969 (13.2 lb) was the smallest (Table 1). All other rootstocks were not statistically different from the highest or lowest yielding rootstocks (Table 1).

Individual average fruit weight nor yield efficiencies were statistically different across the rootstocks (Table 1). Average fruit weight ranged from 7.2 to 10.8 oz (Table 1). Average yield efficiency ranged from 2.5 lb/in^2 to 13.4 lb/in^2 (Table 1).

Fuji. The smallest TCSA in the Fuji trial was G.202 (4.81 in^2), however it was not statistically smaller than G.11 (5.89 in^2), G.214 (5.58 in^2), G.30 (7.75 in^2), G.935 (5.58 in^2), M.26 (7.75 in^2), M.9T337 (6.36 in^2) or V.1 (7.91 in^2) (Table 2). The three largest TCSAs were rootstocks V.5 (9.3 in^2), V.6 (9.46 in^2), V.7 (9.15 in^2) and none were statistically different (Table 2).

The average yields, individual fruit weights and yield efficiencies were all statistically similar across rootstocks. Average yields ranged from 101.2 lb to 147.4 lb per tree (Table 2). Average individual fruit weight ranged from 5.95 oz to 7.28 oz (Table 2). Average yield efficiencies ranged from 12.3 lb/in^2 to 21.66 lb/in^2 (Table 2).

Comparison of Honeycrisp and Fuji. The Fuji trees surpassed the Honeycrisp

Table 2: Yield and vigor data collected in 2021 from the 2014 NC-140 Fuji Rootstock Trial at Rutgers University Snyder Research and Extension Farm Pittstown, NJ.

Rootstock	Average TCSA (in^2)	Average Yield (lb)	Average Individual Fruit Weight (oz)	Average Yield Efficiency lb/in^2
V.5	9.3 BC	114.4	6.67	12.3
V.1	7.91 ABC	101.2	6.72	12.79
V.7	9.15 BC	123.2	7.28	13.46
M.26EMLA	7.75 ABC	114.4	8.96	14.76
V.6	9.46 C	147.4	6.37	15.58
G.30	7.75 ABC	123.2	6.14	15.9
G.214	5.58 A	107.8	5.95	19.32
G.935	5.58 A	112.2	5.71	20.11
G.202	4.81 A	101.2 A	6.71	21.04
M.9T337	6.36 ABC	136.4	6.70	21.45
G.11	5.89 A	127.6	6.98	21.66

Means separated within columns by Tukey's HSD (P=0.05).

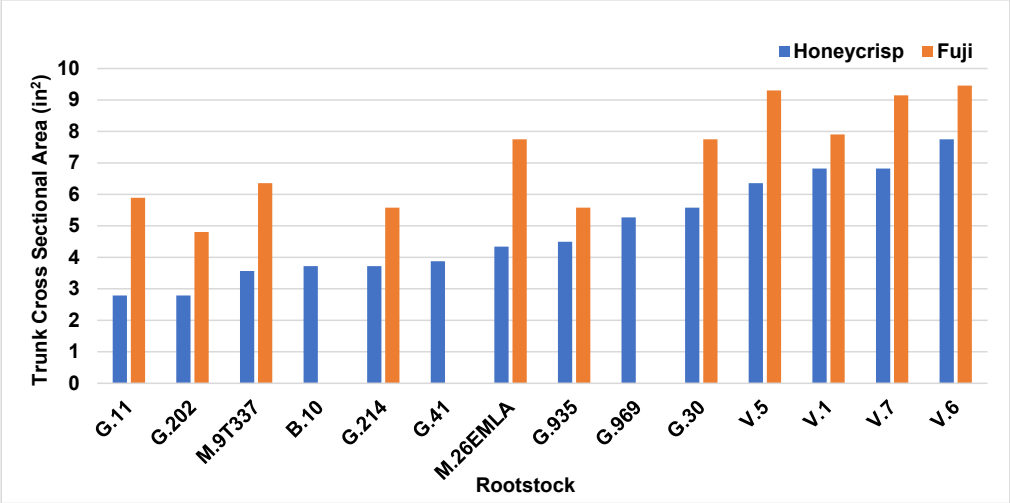

Figure 2. Average Trunk Cross Sectional Area in 2021 for the Honeycrisp and Fuji 2014 NC-140 Apple Rootstock Trials at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

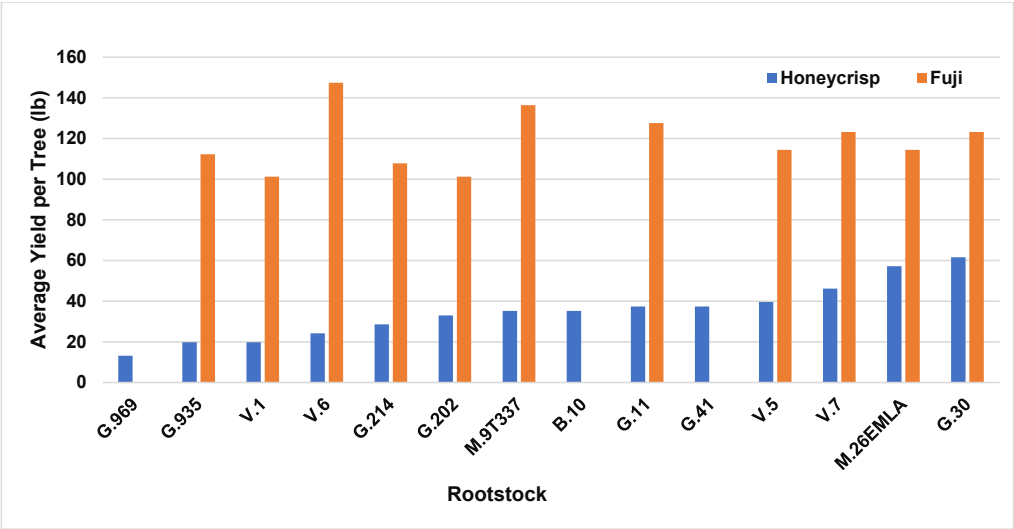

Figure 3. Average yield per tree in 2021 for Honeycrisp and Fuji 2014 NC-140 Apple Rootstock Trials at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

trees in size for each rootstock on which they were both grafted (Figure 2). The Fuji trees also surpassed Honeycrisp in average yield per tree (Figure 3) and yield efficiency for all rootstocks onto which they were both grafted (Figure 4). The 2021 growing season was the on year for this plot of trees, Fuji is notoriously biannual.

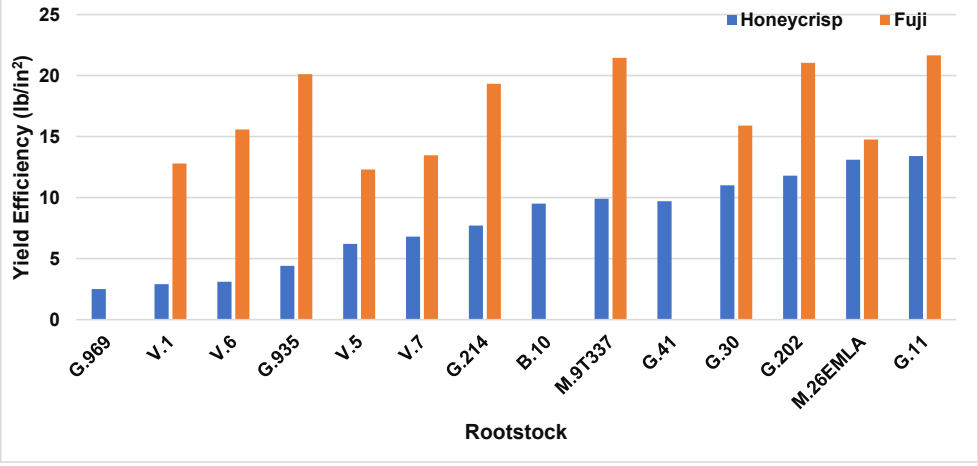

Figure 4. Average Yield Efficiency (Yield/TCSA) in 2021 for both Honeycrisp and Fuji 2014 NC-140 Apple Rootstock Trials at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

Five year NC140 summary papers for both the 2015 Fuji and Honeycrisp rootstock trials[1] "Early Performance of 'Honeycrisp' Apple Trees on Several Size-Controlling Rootstocks in the 2014 NC-140 Rootstock Trial Early Performance of 'Honeycrisp' Apple Trees on Several Size-Controlling Rootstocks in the 2014 NC-140 Rootstock Trial, 2021

Discussion

This is the 8th and final year for the 2014 NC-140 Fuji trial. Collaborators of this trial decided to terminate it because the yields and yield efficiency have begun to level off in trials throughout the USA. This was also illustrated in our 8 years of New Jersey trial data

The 2014 Honeycrisp trial will continue for two more years as planned. The vineland series rootstocks (V.1, V.5, V.6, and V.7) have consistently had the largest TCSA and yields have been generally higher in the Geneva series rootstocks. We therefore do not recommend the Vineland stocks tested (V.1, V.5, V.6, and V.7) for tall spindle.

The 2021 NJ Honeycrisp trial tended to be the off year due to biannual bearing. G.969 s was almost blank for yield where it had been the most yield efficient with the highest yield in 2020. The best rootstock across the board in 2021 for Honeycrisp yield in was G.30. It resulted in the statistically highest yield for Honeycrisp and it was one of the most consistently high yielding rootstocks in this NJ study. This illustrates that G.30 may not display as much of a tendency toward biennial bearing as other Geneva rootstocks.

Although this was not as clearly seen in the 2021 growing season, in previous years in NJ the rootstocks, G.969 and G.935 have significantly outperformed the other stocks in yield efficiency in New Jersey and at sites throughout the United States and Canada. However, in 2021 G969 with Honeycrisp was almost blank indicating biannual bearing. G.30 was much more uniform across previous years for Honeycrisp.

Note: we cannot recommend G.935 because as it has exhibited latent virus susceptibility across the USA in commercial plantings. Therefore, only virus-free bud would can be used to propagate cultivars on G.935. ***Since there are no virus free budwood programs currently in the USA*** that check for all apple viruses, we cannot recommend G.935.

Our recommendation for Honeycrisp

G.30 is our preferred rootstock selection for NJ for Joneycrisp. While it is one of the larger trees by TCSA, we feel that when paired with Honeycrisp in a tall spindle system it will be very precocious, not prone to biannual bearing, very resistant to fireblight, tolerant to specific apple replant disease, and *Phytophthora* crown and root rot, and is not susceptible to latent viruses.

More Notes that **G.30 rootstock** that has been evaluated in numerous NC-140 and other rootstock trials over the years. It is the right vigor for well managed

Honeycrisp Plantings especially on replant sites. G.30 fell out of favor with our US nurserymen as it is hard to propagate so there are very few stoolbeds of G.30 and therefore limited production. G.30 is available from Willamette Nurseries in Canby, Oregon. http://www.willamettenurseries.com/ and is available for propagation at Wafler Nursery in NY https://waflernursery.com. G.30 precocity and productivity are also similar to M.26. G.30 is highly resistant to fireblight and quite resistant to crown and root rots, but susceptible to woolly apple aphid. G30 was tested in the 1994 NC-140 Semi-Dwarf Apple Rootstock Trial with the cultivar Gala (and perhaps others). G.30 can be brittle at the graft union, and must be well supported as it is in a tall spindle system.

Conclusions

The Vineland (V.1, V.5, V.6, and V.7) series rootstocks we tested and M.26 EMLA, G.30 continue to show significant vigor in both the 2014 Fuji and Honeycrisp NC-140 rootstock trials. In particular, V.6 had the greatest TCA for both Fuji and Honeycrisp scions. The Vineland rootstocks tested with Fuji were too vigorous for a tall spindle system. None of the Vineland rootstocks, M.26 EMLA, or G. 30 look good in tall spindle with Fuji. Establishing this trial at 3' x 12' instead of 5' x 13' would have increased competition between trees and may have improved performance in a tall spindle system. However, at the established 5' x 13'spacing, the average fruit weight, average yield per tree, and average yield efficiency was not significantly different among rootstocks, and none were stellar performers.

For Honeycrisp G.30 is our preferred rootstock selection for NJ.

For Fuji G.11 is our preferred rootstock selection for NJ.

Future Plans

A summary final paper will be published of the 2014 Fuji trial.

2023 NC-140 Apple hard Cider Trial

The NJ site will be established in 2023 at the Rutgers Snyder Research and Extension Farm. The hard cider cultivar Porters Perfection[3] will be utilized and evaluated on the following rootstocks G.11, G.41, G.202, G.210, G.213, G.214, G.890, G.935, G.969 and B.10. Porters Perfection is an English cider apple with cream colored flesh, a dark red overcolor, and a bitter-sharp flavor for cider blending quality.

For the 2023 Hard Cider apple trial, similar horticultural data will be collected from this trial as previous NC140 trials including, yield, crop load, fruit quality, biannual bearing, etc., as affected by rootstock. This hard cider apple trial was focus as well on juice/cider quality (sugars, titratable acidity, and pH) as affected by rootstock.

References

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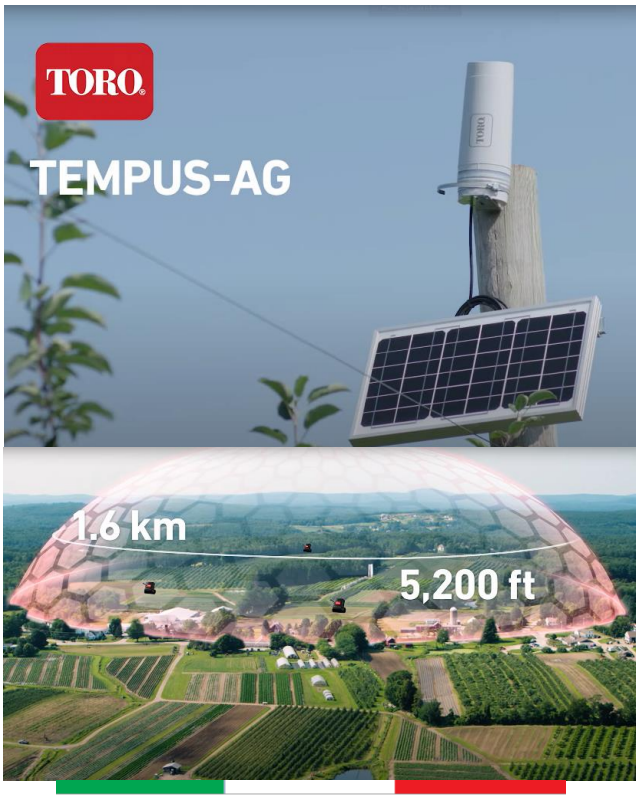

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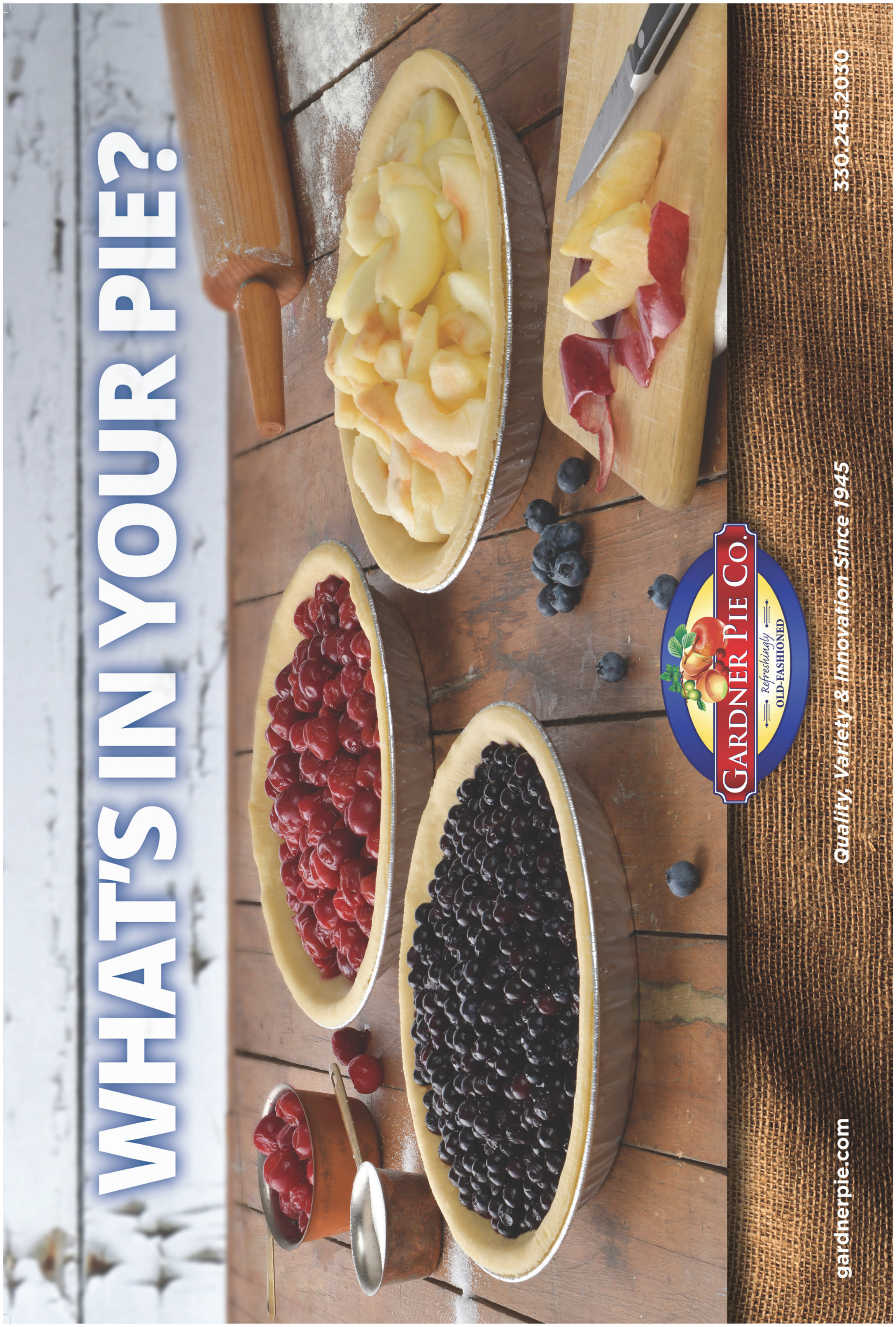
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