Alternative Corn Varieties for the Michigan Craft Distilling Industry
2024-2025 Final Technical Report

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Abstract

In 2024-2025, our team received support from the Michigan Craft Beverage Council to continue investigating alternative corn varieties for Michigan distillers, with the goal of identifying unique varieties of corn suited to Michigan's climate and with favorable flavor qualities inherent in the spirit they produce. We've been able to categorize over 20 varieties by the region where they can perform agronomically and start describing grain quality and flavor that can be expected from them. Several varieties (Wapsie Valley, Oaxacan Green and MN 13) are being studied at larger scales in collaboration with distillers and farmers to enable expanded production.

Introduction

Corn is the most widely used cereal grain in whiskey products as most grain bills (recipes) are at least 50% corn, with some being as much as 100% corn. Corn can vary like any other crop in the color, composition, and flavor, among other attributes. There are many varieties of corn grown throughout Michigan and the United States. Most varieties are chosen by farmers based on yield potential or by distillers based on potential extract. This selection process has resulted in nearly all corn being hybrid #2 yellow dent varieties, which offer little variation to exploit for distilling relative to the impressive diversity available in corn germplasm generally.

Corn varieties other than #2 yellow dents can exhibit a wide range of phenotypic characteristics, particularly those varieties that are open pollinated instead of hybridized. As we explore the wider range of corn genotypes, we hypothesize that these unique varieties have different agronomic performance, grain quality, flavor profiles and aging potential. As the spirits industry becomes more competitive, the desire to have a unique product increases. Thus, distillers are interested in finding distinctive flavors in corn and developing stories around novel corn varieties for the purpose of marketing. The nuanced flavor of whiskey comes from a variety of sources: the grain and mash bill, the mashing process, water minerals and pH, yeast, and the technical parameters of distilling and aging processes. Inherent in grains are some key flavor compounds that are retained in the end product or are eventually involved in reactions during the aging process. Holding all processing variables consistent, varieties can be compared on a semi-micro scale to identify subtle differences in the distillate made from 100% corn mashes.

In 2024-25, our team received support from the Michigan Craft Beverage Council to continue investigating alternative corn varieties for the Michigan Craft Distilling Industry. This project is part of a multi-year effort started in 2022 and continuing at least through 2025. The goal of this research is to identify open pollinated varieties of corn suited to Michigan with unique flavor qualities inherent in the spirit they produce, and provide information, tools, seed and resources to farmers and distillers to use for production. To complete this goal, up to 20 varieties of corn were selected. The varieties were grown on MSU research farms throughout the state of Michigan in summer 2024. After harvest in Fall 2024, corn samples were transferred to labs at MSU for analysis, and the fermented beverage lab at Michigan State to mash, ferment and distill into un-aged 100% corn whiskey. The whiskey is currently being produced and analyzed using GC and HPLC analytics as well as evaluated by experts for flavor/aroma

characteristics. Larger fields (1 acre each) of three varieties that have high potential were grown to provide quantities of seed for batch production by craft distillers, and to increase seeds available for replanting in future years.

Objectives

The main objective of this body of research is to identify unique corn varieties that have desired qualities for distillers and are adapted to Michigan's climate. Furthermore, with guidance from the distilling industry, we intend to start the process of scaling-up seed production to service grower interest in varieties that are most suited for Michigan's unique corn production regions. The following are specific hypothesis for the project, which are consistent with previous funding cycles.

1. Corn variety has an impact on productivity, agronomic feasibility, and the un-aged whiskey distillate it produces
2. Unique corn varieties differ in adaptation across Michigan environments and production systems
3. Precursor compounds involved in aging reactions vary in concentration within each variety
4. There is a sensory and analytical effect of corn variety, which is concentrated and detectable in un-aged whiskey

Methods

Two years (2022-2023) of field trials comparing open pollinated corn varieties across multiple sites in Michigan proceeded the trials in 2024. In previous years, over twenty varieties of open pollinated corn were sourced from locations around the Midwest and Northeast. The varieties selected ranged from identity preserved heritage varieties to landraces to more recently developed varieties. A commercial hybrid #2 yellow dent variety has been used as a check. The varieties selected for the second year (2023) trial built upon successes and challenges of the first year (2022), and that process of variety refinement continued for the 2024 trials. Specifically, some of the varieties take too long to mature to be grown in northern Michigan. Similarly, some very short season varieties do not perform well in Southern Michigan. Given this information, we segregated varieties by location to avoid trialing those that we know will not be successful in certain areas based on previous research.

In total, over 20 varieties were grown (~May planting) in 2024 across three locations where randomized complete block designs were utilized to plant four replications of each variety. The three locations were in Kalamazoo, Ingham, and Alger counties, at MSU research farms. These locations have been chosen to provide a latitudinal gradient that will result in a wide range of climate and weather conditions across the state of Michigan. Each plot was approximately ten feet wide and 20 feet long, with some buffer space in between each plot. The corn was managed using best management practices for lower yielding conventional corn, including tillage, fertilizers, and pesticides to achieve the highest yield and protect grain from disease or degradation. Harvest was completed in the fall using a plot combine. Grain quality analysis was completed using NIR in Dr. Singh's lab, and other analyses using GCMS are still in process to identify and measure flavor compounds such as benzaldehyde and ferulic acid.

Bulk corn samples from the Kalamazoo location were delivered to Dr. Shriner's fermented beverage analysis lab. These samples are in the process of being milled, mashed, fermented, and distilled into an unaged whiskey distillate. The unaged whiskey made from each variety will go through multiple analysis including HPLC, GC and sensory analysis to help differentiate and describe the effect of corn varieties.

In 2024, we scaled the production of three primary varieties of interest, focusing on one variety that has performed well at each location and is also not commonly available at scale. These included Oaxacan Green in Kalamazoo, Wapsie Valley in Ingham, and MN 13 in Alger. After harvest, the Oaxacan Green and Wapsie Valley were offered to partner distilleries to use for batch production and provide feedback. Seed was saved from Oaxacan Green to replant at multiple farms in 2025. The corn trials at all locations were featured at summer/fall field days that highlight the sustainable agriculture work going on at these facilities.

Results

Similar to the 2023 season, the research trials conducted for objectives 1 and 2 showed variation in yield across the planted varieties. In both regions, the modern hybrid variety yielded significantly higher than the best alternative varieties (Table 1), 39% higher in Ingham, 48% higher in Kalamazoo, and 27% higher in Alger compared to the highest yielding alternative. There was no significant difference in the yield obtained from the Kalamazoo and Ingham locations, but both of those sites yielded higher than the Alger location.

The best yielding alternative variety in Kalamazoo County was Ohio Blue (143 bu/ac), while Choices F1 (which is a hybrid) performed well at all locations, and was a top yielder in Ingham (133 bu/ac) and Alger (89 bu/ac) Counties. Otto file also yielded well in Alger county (90 bu/ac) which is the first time we've observed a high yield with Otto File across the three years in our trial, pointing to the value of growing this variety in northern areas.

Plant height and lodging are major factors in determining feasibility of growing these alternative corn varieties. Longer season varieties that are feasible to grow in southern Michigan only (e.g. Bloody Butcher) tend to be taller, which comes with some increased risk of lodging from wind and difficulty harvesting. Shorter season varieties (e.g. Nothstine Dent) tend to have low ear heights which makes them more vulnerable to wildlife damage and lodging from wildlife pulling down the plants. Nothstine Dent and Strubbes Orange were nearly completely eaten by racoons in Kalamazoo. Data shown in Table 2 indicate plant and ear height as well as lodging across the three locations in 2024.

Three varieties (Oaxacan Green – Kalamazoo, Wapsie Valley – Ingham, MN 13 – Alger) were planted in larger fields to harvest enough grain for craft distillers to produce a batch of distillate for evaluation at commercial scales. All three sites were successful in growing the crops, but the drying process for this scale of production proved to be a challenge. The Oaxacan Green and Wapsie Valley were successfully dried to moisture content suitable for storage, but MN 13 spoiled before reaching appropriate moisture content. Oaxacan Green was sent to Mammoth Distilling, while Wapsie Valley was sent to Red Cedar Spirits. Both distillers were excited by the production results, and the distillate from both batches is currently being aged. Seed is commercially available in larger quantities for Wapsie Valley, but not for Oaxacan Green. Thus, a subset of seed from the Oaxacan Green was reserved for replanting on multiple farms across southern Michigan in 2025 to serve ongoing needs for this variety.

Table 1. Yield, grain moisture, and test weight at harvest information for the three locations.

	Yield (bu/A)			Moisture (%)			Test Weight (lb/bu)		
Variety	Kalamazoo	Ingham	Alger	Kalamazoo	Ingham	Alger*	Kalamazoo	Ingham	Alger
Atomic Orange									
Bloody Butcher	117.3			18.2			57.9		
Boone County White	98.9			16.7			56.0		
Choices F1	123.7	132.7	88.6	16.9	17.8		59.8	58.3	56.0
Dublin	126.6	88.9	50.6	18.0	16.8		59.3	57.9	52.9
Hickory King White	101.6			17.7			57.1		
Hopi Blue	68.1	34.7		14.3	13.2		55.0	52.0	
Jerry Peterson Blue	38.7	54.6	22.6	13.6	11.8		56.3	51.8	52.9
Jimmy Red	113.4			17.7			57.2		
MN 13	137.1	127.2	65.0	16.8	18.2		59.1	56.6	54.6
Modern Hybrid	211.9	215.6	114.6	16.9	16.9		58.1	53.5	55.8
Montana Morado									
Nothstine Dent	9.3	52.0			13.7			55.8	
Oaxacan Green	88.6	68.0	36.6	16.1	14.1		58.1	56.6	54.1
Oddfellow	86.1	115.1	57.4	15.2	16.5		59.8	59.1	58.1
Ohio Blue	143.0	99.0		19.4	17.9		59.1	56.3	
Otto File Flint Corn	32.6		90.3	12.5			58.6		54.9
Pencil Cob	84.5	86.6		14.6	17.2		53.8	51.7	
Reids Yellow Dent	127.7	92.1		18.4	17.8		58.8	57.1	
Strubbes Orange	9.2	40.2			12.9			54.7	
Truckers Favorite	98.5			16.6			58.8		
Wapsie Valley	106.0	96.1	52.8	17.1	17.9		60.1	59.4	54.3

Table 2. Plant height, ear height and lodging data for the three locations.

	Plant Height (meters)			Ear Height (meters)			Lodging (%)		
Variety	Kalamazoo	Ingham	Alger	Kalamazoo	Ingham	Alger	Kalamazoo	Ingham	Alger
Atomic Orange			1.3			0.1			60.0
Bloody Butcher	3.4			2.1			20.0		
Boone County White	3.7			2.2			26.3		
Choices F1	2.3	2.2	2.5	1.1	1.0	1.0	7.5	27.5	2.5
Dublin	2.8	2.6	2.9	1.5	1.3	1.5	10.0	47.5	2.5
Hickory King White	3.5			2.2			15.0		
Hopi Blue	2.6	2.3		1.2	1.0		47.5	90.0	
Jerry Peterson Blue	2.2	2.0	2.2	0.9	0.8	0.8	52.5	90.0	57.5
Jimmy Red	3.2			1.9			11.3		
MN 13	2.3	2.1	2.6	1.3	0.9	1.1	5.0	7.5	10.0
Modern Hybrid	2.5	2.2	2.7	1.3	0.9	0.9	0.0	0.0	0.0
Montana Morado			1.7			0.4			80.0
Nothstine Dent	1.6	1.8	2.2	0.6	0.7	0.8	60.0	27.5	72.5
Oaxacan Green	2.7	2.5	2.6	1.6	1.3	1.3	17.5	75.0	40.0
Oddfellow	2.2	2.1	2.2	1.0	0.9	0.7	31.3	7.5	25.0
Ohio Blue	2.7	2.3		1.5	1.3		5.0	0.0	
Otto File Flint Corn	2.1		2.5	1.0		0.9	37.5		45.0
Pencil Cob	3.1	2.8	2.7	1.8	1.5	1.5	7.5	25.0	30.0
Reids Yellow Dent	3.2	2.9		1.9	1.6		6.3	47.5	
Strubbes Orange	1.6	1.9	1.7	0.6	0.8	0.5	75.0	10.0	42.5
Truckers Favorite	3.4			2.1			12.5		
Wapsie Valley	2.5	2.6	3.0	1.4	1.3	1.4	25.0	55.0	5.0

Subsamples of grain from each harvested plot were collected for analysis in Dr. Singh's lab for protein, starch and fat using NIR, grain size, and key flavor compounds such as benzaldehyde and ferulic acid using GCMS. The NIR analysis was not very successful because the machines are calibrated for yellow corn, and the corns of other colors cause inaccurate readings. Grain size and GCMS analyses are ongoing and will be reported with the 2025 samples when completed.

Ten pounds of grain from each variety at the Kalamazoo County location were mashed and distilled in Dr. Nicole Shriner's research laboratory to determine amount of distilled product that could be produced from a sample of each variety. All but two of the varieties have been processed and analyzed at the time of this report, but analyses of distillate are ongoing. Dr. Shriner has a separate grant project to dig into the details of flavor compounds associated with each of the varieties.

Alternative corn varieties tend to do best at different locations across Michigan. Based on our research we've been able to group them into some categories below.

- Suitable for all Michigan locations
    - Choices F1, Dublin, MN 13, Oaxacan Green, Oddfellow and Wapsie Valley, Jerry Peterson Blue
- Southern Michigan only
    - Bloody Butcher, Boone County White, Hickory King White, Jimmy Red, Ohio Blue, Reids Yellow Dent, Truckers Favorite, Pencil Cob, Hopi Blue
- Northern Michigan preferred
    - Atomic Orange, Montana Morado, Nothstine Dent, Otto File, Strubbes Orange

Additional tables or charts available on request from the principal investigator.

Communication Activities

We've been able to showcase our corn research at several events between summer 2024 and spring 2025, including Artisan Grain Collaborative Barnstormer Tour, KBS LTER All Scientist Meeting, MCBC Board tour of plots on MSU main campus, UPREC Anniversary Celebration, KBS LTAR Field Day (side tours), Soil Health Institute tour, MSU Farm Managers Seminar, Michigan Craft Beverage Summit, and interactions with individual distilleries. Ears from different varieties were also displayed during several other events and tours at KBS as talking points.

Working directly with distilleries to batch distill certain varieties and increase seed/production has been a great way to engage in the stakeholder community around this topic. There's also been interest from tribes in Michigan about the corn trials that we are following up in the future.

Figure 1. A variety of the corns displayed for the MCBC tour of research plots in East Lansing, summer 2024

Budget Narrative

The project was conducted consistent with the budget proposed by the principal investigator and approved by the State of Michigan. The Corn Marketing Program of Michigan has been providing additional funding ($10-20K per year starting in 2023) for agronomic trials with a subset of these varieties at two locations in southern Michigan. We've primarily been using these funds to evaluate optimal seeding rates for Wapsie Valley, Ohio Blue, Bloody Butcher and MN 13, learning which varieties can tolerate modern high seeding rates.

Several Michigan distillers have volunteered time to help with evaluation of the varieties post harvest, including some corn bread trials with a subset of varieties and also participating in our panel of tasters for distillate produced in Dr. Shriner's lab.