

Dry Farmed Culinary Corn Project

Adapting diverse, culinary corn varieties for dry farming in the Pacific Northwest

Project Update for 2022 Dry Farming Collaborative Winter Convening, Feb. 8th 2022

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“Establishing a participatory research network for drought-tolerant corn production in the Pacific Northwest”

This year, the dry farmed corn project work was made possible by a USDA Western SARE Professional & Producer grant with the above title, where our central aim was to establish a research network around collaborative dry farmed corn research. With this grant, we focused on three main corn varieties: Open Oak Party Mix dent corn, Oaxacan Green dent corn, and Dakota Black popcorn. With these varieties, we engaged in both participatory dry farmed variety trials, as well as breeding efforts to produce dry-farming-adapted selections of these varieties.

Dakota Black popcorn



Open Oak Party Mix dent

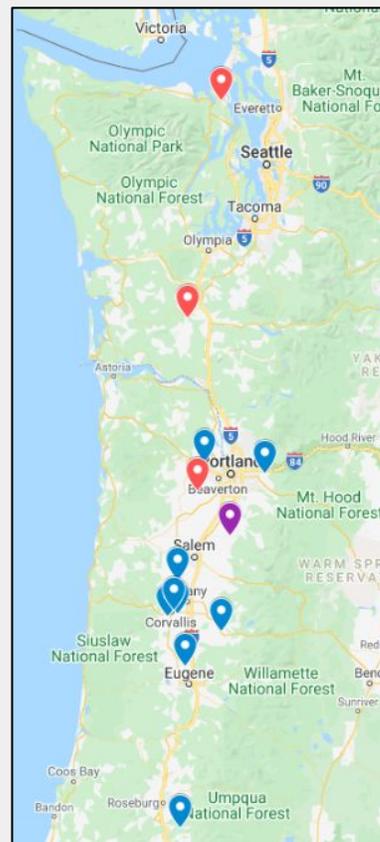


Oaxacan Green dent



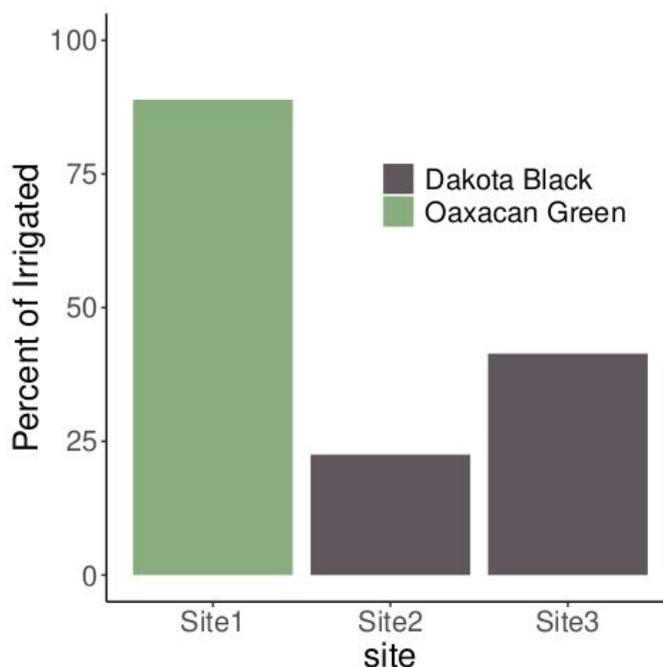
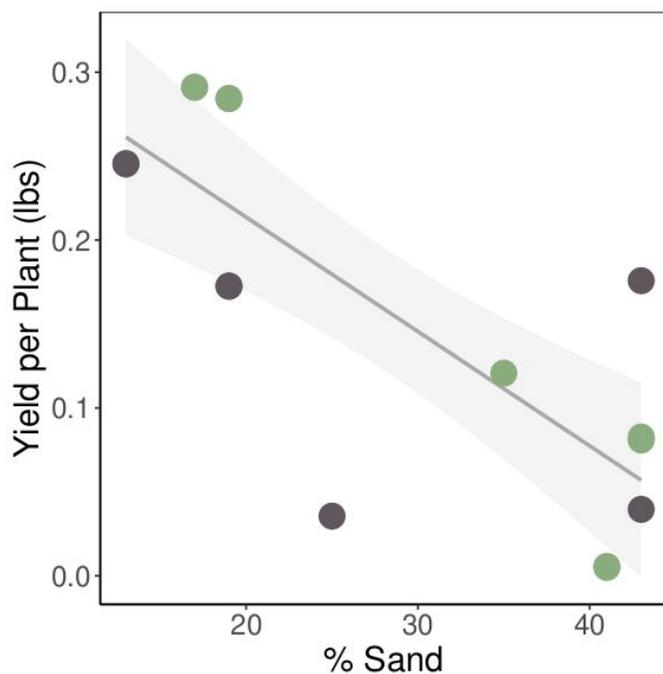
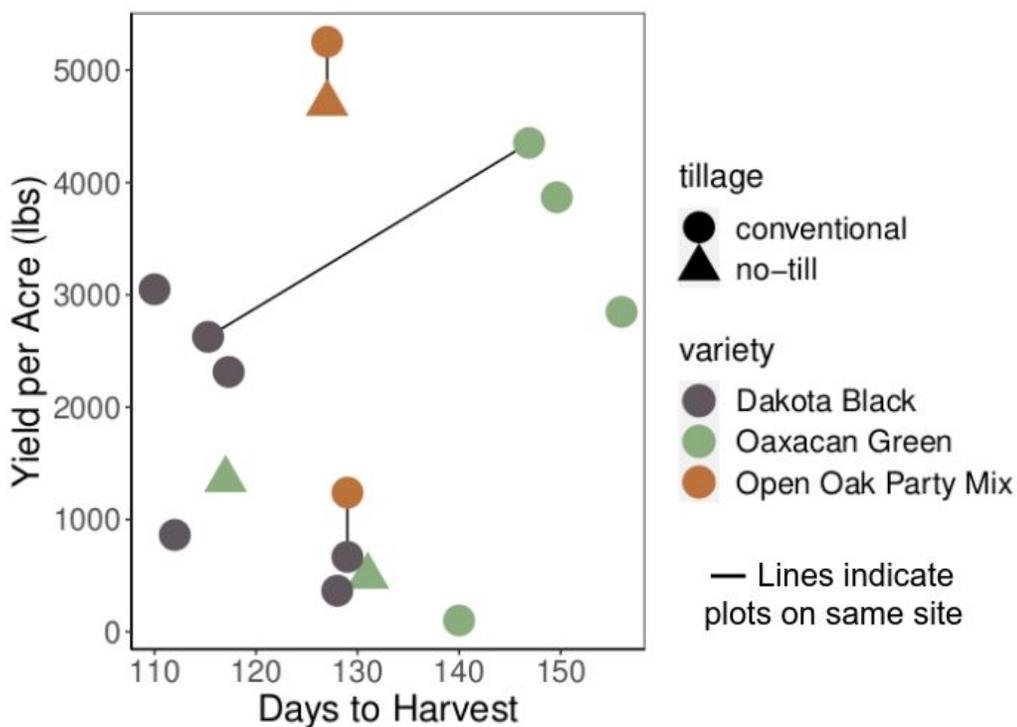
2021 Dry Farmed Corn Variety Trial Take-aways

- Eleven producers participated, from southern Oregon (Roseburg area) to the northern Olympic Peninsula in Washington.
- Producers collected soil moisture data, plant pollination timing and yield. Nine were able to provide at least some data for analysis.
- Participant plots ranged in size (100-12,000 sq. ft), tillage practice (e.g. conventional vs. no-till), and three sites provided an irrigated comparison.
- On all sites, corn was planted in early May to early June, at a density of 2 sq. ft. per plant. Growers were permitted to irrigate once at planting.
- Despite the historic heat wave, only three growers (red on map) experienced dry farming crop failures. These were due to poor site fertility / suitability, and being their first time dry farming at a particular site.
- Lower dry farmed yields were associated with sandier soils with less clay and lower available water holding capacity.
- Nine of the eleven producers are interested in participating in future dry farmed corn projects.

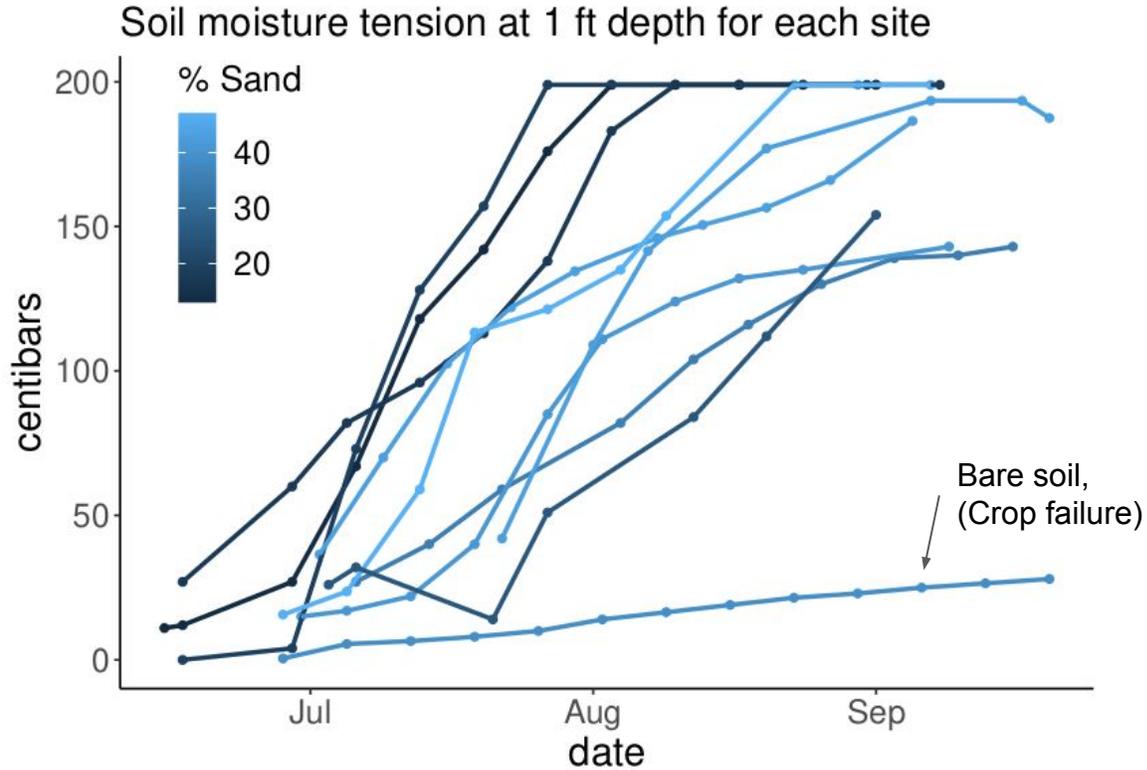


2021 Dry Farmed Corn Variety Trial Results summary, continued

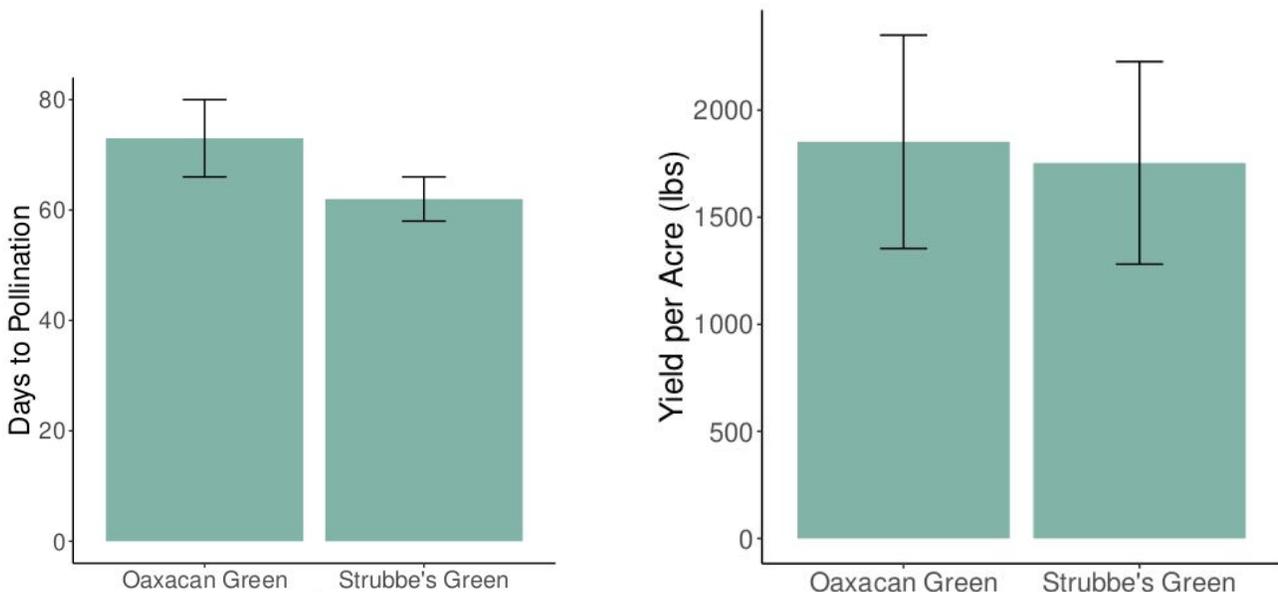
Top: Graphical summary of variety trials across twelve sites. Each point represents a dry farmed corn plot on a site. Triangles represent no-till dry farming management, circles represent conventional tillage, and lines are drawn between plots on the same site. **Bottom left:** While project sites varied considerably in scale and management, a higher soil sand content appeared to correlate with decreased dry farmed corn yield potential on a given site. **Bottom right:** The three sites examining dry farmed vs. irrigated corn comparison observed variable relative success of dry farming.



2021 Dry Farmed Corn Variety Trial Results summary, continued



Top: Summary of soil moisture at 1 ft. depth at ten sites throughout the growing season. Moisture sensors were placed next to corn plants to approximate soil moisture availability, which was measured as soil water tension, in centibars (kPa), i.e., the amount of pressure required to extract water from soil particles. Higher values indicate drier soil. Sandier soils (lighter blue) generally have inherently less water tension, so it is difficult to compare water availability between sites using this measure. However, as you observe the numbers go up, you can assume plant roots are accessing water at that time.. **Bottom:** Two sites compared the earlier season Strubbe's Green dent to the later season Oaxacan Green dent, and found that Strubbe's Green on average takes 11 days earlier to mature (left), and produces 95% of the yield of Oaxacan Green corn when dry-farmed (right).

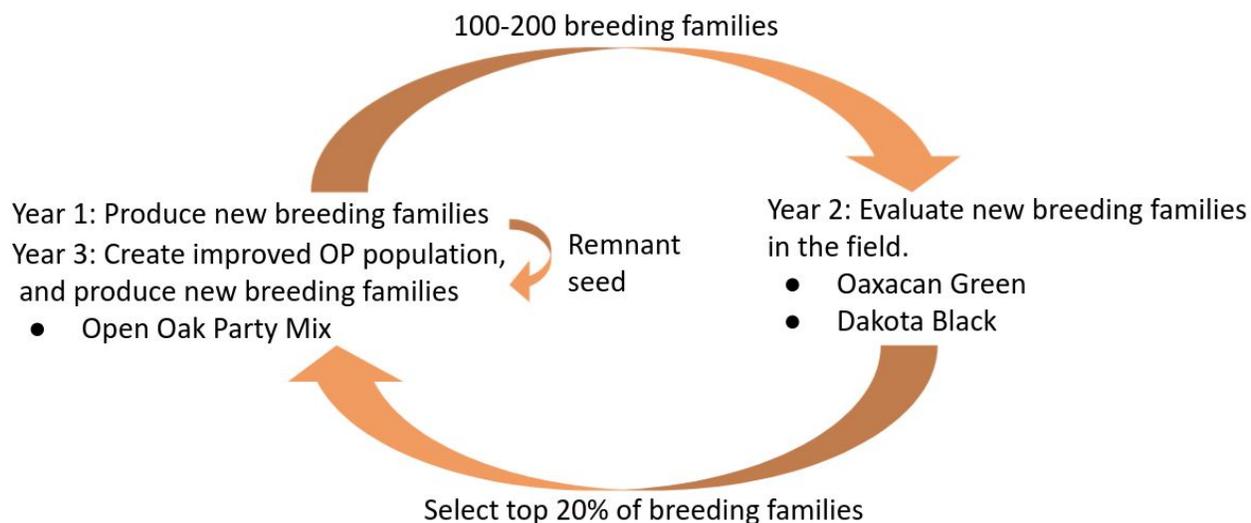


2021 Dry Farmed Corn Breeding Progress Report

We are using recurrent selection (see below) to improve Open Oak Party Mix dent corn, Oaxacan Green dent corn, and Dakota Black popcorn for improved dry farming performance and enhanced agronomic and culinary traits. In 2021, we partnered with the Dry Farming Institute 501(c)3, to grow out our best dry-farmed selections of Open Oak Party Mix, to yield an improved open-pollinated population, which in 2022 we will evaluate against the original Open Oak Party Mix (Adaptive Seeds). In 2021, we also conducted dry farmed field evaluations of Oaxacan Green dent and Dakota Black popcorn (see next page).

Breeding Methods: Recurrent Selection

This method adapts varieties much more rapidly than mass selection (e.g. selecting the best ears), and still yields a diverse, open-pollinated population for future adaptation.



Breeding Family Generation: Each of the 100-200 breeding families represents a group of full-siblings, produced through hand-pollination of two randomly-selected plant parents of a varietal population growing in a field. Remnant seed is saved for future recombination.

Field Evaluation of Breeding Families: Breeding families are grown in 20-ft. strip plots, replicated across the same field, and at least one other field site. They are evaluated for dry-farmed performance, sometimes with irrigated comparison, in addition to desired plant, ear and kernel characteristics.

Recombination of Top Breeding Families: Original seed from the top ~20% of breeding families are equally pooled together and planted in a field, and allowed to open-pollinate, or recombine, to produce a diverse, improved population. To start a new, recurrent selection cycle, new breeding families can be created through hand-pollination of this population.

Status of Varieties: Dakota Black Popcorn and Oaxacan Green dent corn have undergone one year of dry farmed evaluation of breeding families, and we will recombine the top families in 2022 for improved varieties. Open Oak Party Mix underwent its first breeding family evaluation in 2020. In 2021, we recombined the top breeding families, and generated new breeding families to evaluate this 2022 growing season.

2021 Dry Farming Breeding Progress Report, continued.

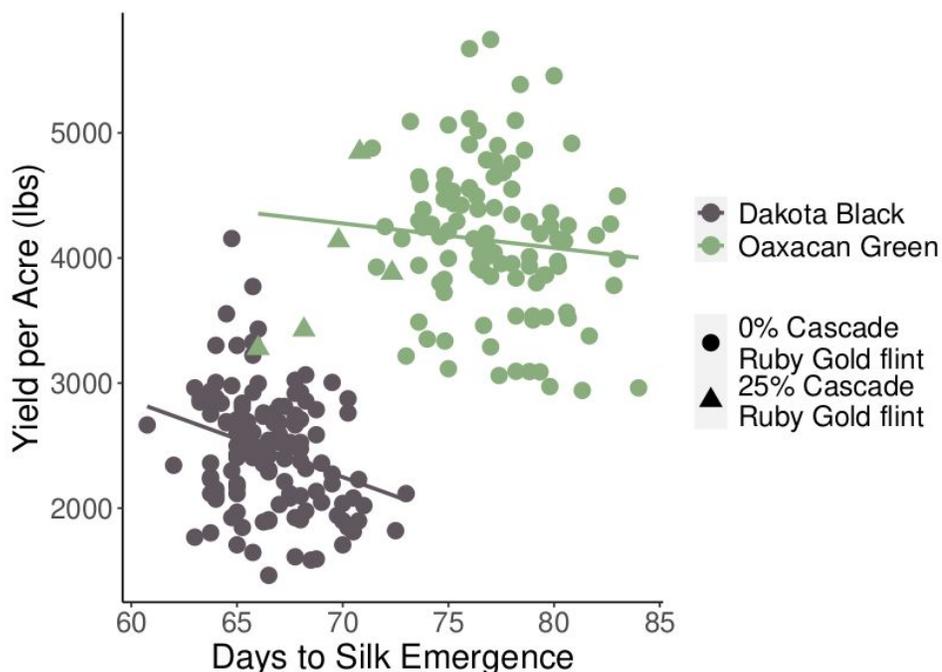
Methods for 2021 Breeding Evaluations of Oaxacan Green and Dakota Black

- Two sites per variety, three total sites near Corvallis, OR, , 2-3 reps per family per site.
- Irrigation at planting at two of three sites. Otherwise, no irrigation for the rest of the season
- Mid may to early June planting dates
- Breeding families planted in 20' strip plots at a spacing of 12" in-row, 30" between row
- Families valuated for dry farming performance (total yield, ears per plant, and anthesis silking interval (ASI)).
- Oaxacan Green dent corn: 108 full-sibling breeding families. Additional selection criteria included early maturity, reduced lodging, and decrease off-colored kernels
- Dakota Black popcorn: 130 full-sibling breeding families. Additional selection criteria included increased popping rate, larger ear size, and spiky vs. smooth kernels

Results Summary of Breeding Evaluations

Breeding families of both varieties, each depicted as a point on the plot below, differed significantly based on dry farmed yield and days to silk emergence. Silk emergence timing is influenced by plant genetics, and is also delayed by drought stress. Within each variety, the later-maturing breeding families generally yielded less than earlier ones (see trendlines), likely due to less water availability during pollination. The five green data points shaped like triangles are Oaxacan Green breeding families that have a $\frac{1}{4}$ genetic background of the earlier-maturing Cascade Ruby Gold flint corn. These genetics may help make our selections of Oaxacan Green dent corn mature faster.

The reported plant metrics will be part of an overall selection index for each variety, which will also include variety-specific selection criteria of other plant and culinary traits. In 2022, we will produce open-pollinated seed with the top 20% of breeding families for each variety in 2022, which will ultimately be released to the public with no patent restrictions.



Project supported by: