

Quinoa variety trial for landrace breeding in Ontario, continuation in 2023-2024

IN A NUTSHELL

Dean and Mira continued Dean's research from previous years to investigate the best varieties of open-source quinoa for organic production in Ontario during 2023 and 2024.

- Chadmo consistently performed on both farms and across all measurements
- Buffy also performed well, especially for Mira in 2024
- Inconsistent results for Buffy and other varieties might likely be due to seed age and loss of viability

MOTIVATION

Quinoa is a complete and gluten-free plant-based protein. It is a potentially great direct-to-market crop as it is generally used as an unprocessed grain, albeit cleaned and washed. The crop has the potential to help broaden crop rotation and appears to be relatively well suited for growing in North American regions, such as Ontario. The challenges which have arisen are the availability of seed, as well as access to regionally adapted, open-source varieties.

In the previous two years of research, Dean discovered that quinoa can be a difficult crop to work with. Available open-source varieties had mediocre germination rates and poor vigour in direct-seeded growing conditions where closely related weed species, like lambs-quarter, make it difficult to distinguish while weeding. However, with the success and proven viability of transplanted quinoa in his 2022 trial, Dean wanted to continue to screen and select for a landrace variety adapted to organic production in Ontario.

METHODS

VARIETIES

For these trials, Dean assessed six varieties of quinoa in 2023, including two varieties that performed well and displayed good genetics in a previous screening trial in 2021 (Buffy, Brightest Brilliant Rainbow) and four new varieties (Dave 407, Chadmo, Apellewa, Linares).

Mira joined the trial in 2024 and she and Dean trialed the same seed lot of three of his successful varieties again (Chadmo, Brightest Brilliant Rainbow and Buffy). Dean also included Dave 407 in his 2024 trial.

PLANTING & IN FIELD

Dean evaluated quinoa varieties based on similar crop rating parameters as his 2021 and 2022 trials: emergence as a percent, transplant vigour and field vigour on a rating scale, and yield. Dean grew out all the varieties in 4 x 200-cell plug trays of each in 2023. In 2024, all seedlings were grown in 128 cell trays. Seedling measurements included: germination percentage, vigour, and qualitative notes.

Dean transplanted up to 80 of the best seedlings from each of

2024



FARMER-RESEARCHER

Dean Orr, Mill Valley Farm

Mira Melien, Boreal Berry Farm

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From top to bottom: Linares (photo by Adaptive Seed); Apellewa (photo by Adaptive Seed); Dave 407 (photo by Adaptive Seeds)

the quinoa varieties in a randomized complete block design in four replicates. Each variety plot measured five feet by ten feet with 15-inch rows with six inch in-row spacing.

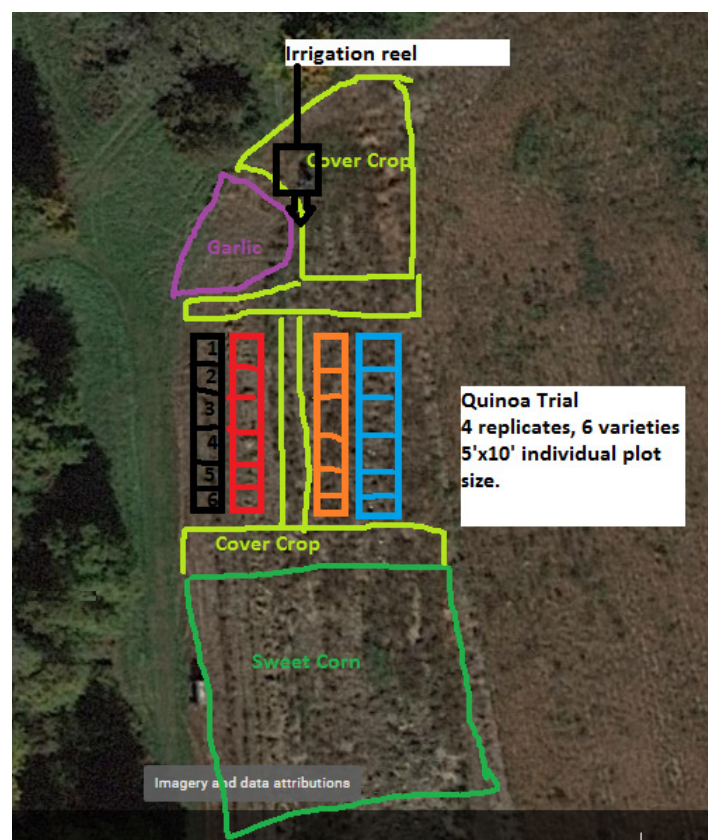
Dean assessed transplant survivability, field vigour and yield. Mira was able to collect yield in 2024, but Dean did not have yields available for either year.

DATA ANALYSIS

RANDOMIZED REPLICATED TRIALS

To evaluate the six quinoa varieties in 2023, we used a statistical model called analysis of variance (ANOVA) with a 95% confidence level to calculate the least significant difference (LSD). When the difference between two treatment means is greater than the LSD, we can conclude that there's a consistent difference between two treatments 95% of the time. We could make these statistical calculations because Dean's experimental design involved replication of the varieties being trialed.

Although Mira collected yield data, the 2024 trials did not have enough data to determine statistical significance.



2023 field layout at Dean's farm

Table 1. 2023 and 2024 Quinoa Varieties

VARIETY	SOURCE	VARIETY NOTES	NOTES	TRIALED IN 2023	TRIALED IN 2024
Linares	Adaptive Seeds	Highest yielding in other trials. Reported to grow well even at sea level. White seed.	Seed produced in 2022 and purchased in 2023	x	
Apellewa	Adaptive Seeds	Early ripening. White seed.	Seed produced in 2022 and purchased in 2023	x	
Dave 407	Adaptive Seeds	High yielding compared to other quinoa grown in low elevations. Short season. Orange seed.	Seed produced in 2022 and purchased in 2023	x	x
Dean's Buffy	Dean saved seed from 2022 trial	Farm saved seed.		x	
Chadmo	Association Kokopelli	Originated from an island off the coast of Chile. Resistant to pre-harvest sprouting during wet autumns. Brown to red seeds.	Seed produced in 2022 and purchased in 2023	x	x
Brightest Brilliant Rainbow	Wild Seed Garden Ltd	Colourful heads. Farm original variety.	Seed produced in 2021 and purchased 2022; Commercial check	x	x

FINDINGS

GERMINATION

In the 2023 trial, Chadmo and Dave 407 germinated best. Dean's Buffy had the lowest germination and Brightest Brilliant Rainbow and Buffy were also low (**Figure 1**). In the 2021 trial, Buffy and BBR germinated well. Therefore, Dean attributed this low germination to potentially the age of the seed (now two years old) or whether it was stored in the right conditions. With the Buffy seed Dean saved in 2022, he thought it was possible some of it may have germinated on the head in the field, hence its very low germination rate.

In the 2024 trial, both Dean and Mira found that Chadmo germinated well and grew vigorously. Dave 407 was slightly less uniform but also performed well. Dean and Mira both observed poor germination, less than 50%, in the BBR variety. Dean found Buffy to also be a poor germinator while Mira found it to be more robust.

Dean noted that in 2024 the spring was wet and cool so it was not likely due to environmental factors but rather the seed. He theorizes the seed may have a short viability window. The Buffy and BBR seed were over 3 years old. He noted in 2025 that when he grew the same seed lots again, the germination dropped significantly--no greater than 25% for all varieties. Despite being watered and adequate conditions, all the seedlings perished.

SEEDLING AND FIELD VIGOUR

In the 2023 trials, Dean noted that it was a hot, dry spring where the trays of seedlings experienced stress before planting. This was the primary reason he recommended moving from a 200 to a 128-cell tray for the 2024 trial. The seedling vigour followed a similar trajectory as their germination ratings with Dave 407 and Chadmo receiving top ratings. Buffy, Dean's Buffy and BBR all had similarly low ratings. See **Figure 2**.

However, the trial took an interesting turn in July 2023 when Dean recorded field vigour. Dave 407 and Linares both scored poorly. Dean theorized that these varieties had a difficult time recovering from environmental stress that occurred when they were in their trays. While the three underperforming varieties, Buffy, Dean's Buffy and BBR, achieved better field ratings. Dean wondered if these varieties had greater environmental stress tolerance than the others. Chadmo continued to perform consistently well and Apellewa performed similarly as seen in **Figure 3**. Dean also took observational notes about early heading. The varieties that scored poorly for field vigour also had the greatest amount of early heading. Dean reported Chadmo had the least.

In the 2024 trial, Mira observed that Buffy displayed the highest seedling vigour among all varieties, thriving even under the wetter and cooler spring conditions. Chadmo was slightly less vigorous, but had good growth when growing in trays. BBR lagged significantly in vigor, aligning with its poor germination rates. In the field she observed vigour was highest in Chadmo and Buffy, with Buffy maintaining a slight lead in overall performance. BBR's performance remained subpar throughout all stages of growth.

Dave 407 and Chadmo continued to have good seedling vigour for Dean. However, he was not able to take field vigour ratings in 2024.

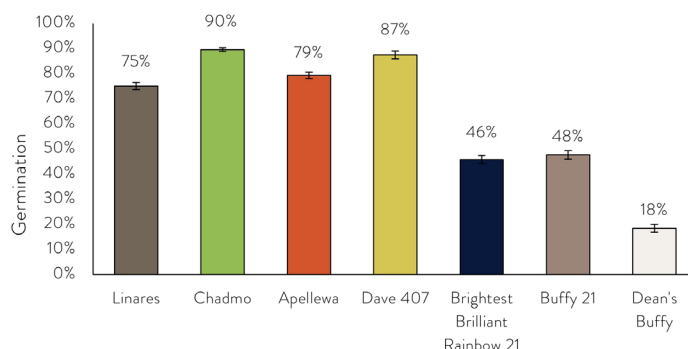


Figure 1. Percent germination in 2023

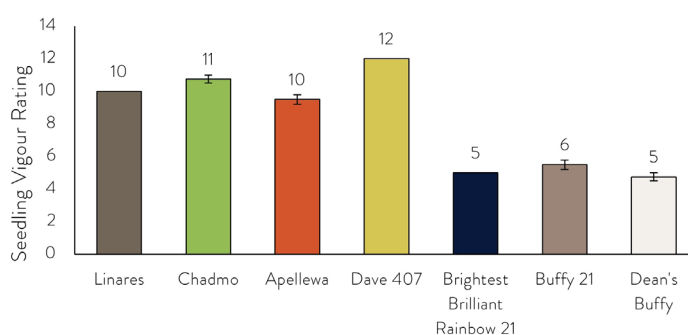


Figure 2. Seedling vigour rating in 2023

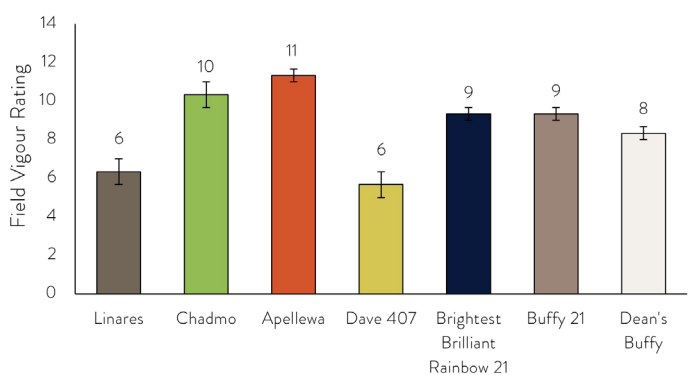


Figure 3. Field vigour rating in 2023

YIELD

In the 2024 trial, Mira was able to collect final yield numbers:

- Buffy averaged 2.1 pounds of cleaned seed per plot, extrapolated to approximately 1,460 pounds per acre. Buffy had dense, uniform seed heads.
- Chadmo averaged 1.9 pounds of cleaned seed per plot, extrapolated to roughly 1,320 pounds per acre. Chadmo had slightly less uniform heads.
- Brightest Brilliant Rainbow averaged 1.1 pounds of cleaned seed per plot, extrapolated to about 770 pounds per acre.

Dean did not collect yield data in 2023 and 2024.

NEXT STEPS

Through all of his trials with quinoa in Ontario, Dean recommends Chadmo and perhaps Buffy, the most successful varieties overall, could be grown out for seed, selected and saved as a landrace adapted to Ontario with the eventual goal of direct seeding. Additionally, he recommended further research on transplanting and harvesting quinoa, such that methods for these production methods are also improved. As always, additional new varieties may be trialed against the existing trialed varieties to search for an improved open-source quinoa.



From top to bottom: Buffy (photo by Association Kokopelli); Brightest Brilliant Rainbow (photo by Wild Garden Seed); Chadmo (photo by Association Kokopelli)

TAKE HOME MESSAGE

The 2023 trial gave Dean good data for which varieties to trial again in 2024. He also determined that seedlings would benefit from a larger cell size to prevent seedling stress and to help with transplant recovery.

The 2024 trial for Mira showed both Buffy and Chadmo performing well. Dean's germination and seedling vigour data also show Chadmo as a winner along with Dave 407.

Across the two years of trials, Chadmo seemed to perform the most consistently well across the various measurements and in a variety of conditions. For Mira, Buffy was the clear winner in her trial so perhaps more investigation is needed for this variety (especially since it previously performed well in the 2021 screening trial for Dean).

The inconsistent performance of Buffy (and possibly Brightest Brilliant Rainbow) across the two years of trial might indicate an issue with seed age. With germination and seedling vigour dropping consistently over the trials, a key takeaway for these trials is that quinoa seed likely has a limited seed viability of approximately two years. At four years old, it is almost unusable.