



When is intensive too intensive? The production of table beets in three vs. four row spacing

IN A NUTSHELL

Ann wanted to know if there was a yield benefit to growing four-row compared to three-row beets in a three foot bed system. She also wanted to investigate whether there is a difference in labour required for weeding and disease pressure between the two systems.

- Using an Earthway seeder with no thinning, Ann found no difference in beet yield between three-row and four-row plantings.
- Ann observed three-row beets were less labour intensive for weeding and that she could use time-saving tools like a wheel hoe longer into the season.

FARMER-RESEARCHER

Ann Slater, Ann Slater Organics

FUNDING

Brian and Joannah Lawson Family Foundation
The Arrell Family Foundation

MOTIVATION

Ann was curious about the yield comparison between planting three rows of beets and four rows of beets on an approximately three-foot bed system.

In favour of three-row beets, they are easier to weed and seem to get more light and have better airflow that cuts down on leaf-type disease.

In favour of four-row beets, they are more intensive and, therefore, have the potential for higher yield.

To get to the root of the question, she conducted the following research trial.

METHODS

Ann planted four replicates each of three-row (control) and four-row spacing (treatment) in a 100-foot bed with a three-foot width (**Figure 1**).

Ann managed the beets in the three- and four-row systems similarly, including working and shaping the beds, and then covering them with landscape fabric on May 15, 2022. Ann grew Boro, an F1 variety of organic red table beets (*Beta vulgaris*), which matures in 50 days. She planted each of the treatments on May 31, 2022 with an Earthway Seeder using the beet plate, which seeds densely. She used no fertilizer or irrigation during the growing season in 2022 or in the previous growing season. Ann did not thin the beets. She weeded both treatments with a wheel hoe on June 13, and a hand hoe on June 20 and 27, 2022.



Earthway seeder with beet wheel.



Randomized and replicated beet spacing trial planted in a 100' bed.

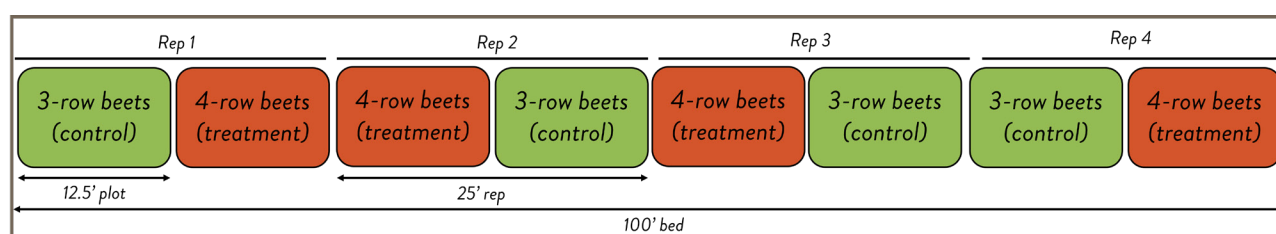


Figure 1. Experimental design of Ann's trial to compare three-row and four-row beets in southwestern Ontario. The total bed (100' x 3') was split into four 25' replicates. Each replicate was split in two 12.5' plots.

DATA ANALYSIS

To evaluate the effect of three- and four-row spacing on beet yield, we used a paired t-test to calculate a p-value based on the difference we observed between the two treatments.

We used a cut-off value of 0.05, meaning we wanted to have 95% confidence in any difference we observed. If the p-value was less than the cut-off value, we had confidence to say the treatment produced differences. If the p-value was more than the cut-off value, we concluded there was no statistical difference.

We could make these statistical calculations because Ann's experimental design involved replication of the treatments.

FINDINGS

YIELD

For yield, Ann needed to see a least significant difference (LSD) of 11.4 kg to detect a significant difference between the three-row and four-row beet plantings. Given this, she found no statistically significant difference in the mean yield between the two row spacings (**Table 1**).

In fact, beet yield was remarkably similar among treatments ($P=0.95$) and variability in yield was driven mostly by weed pressure along the bed, as seen in **Figure 2**. The 2021 season was a challenging year for weeds, which caused the trial area to have a varied weed seed bank and higher weed pressure at one end of the bed.

Ann harvested beets at various sizes given size preferences by customers. While she did not measure beet size per treatment, she made note of sizing and didn't see any difference between the treatments.

WEEDING LABOUR

Ann took notes and observations on weeding labour and effort but, because she only did this twice, we could not perform statistical analysis.

Nevertheless, Ann noted that it generally took less time to hand weed the three-row beet system compared to the four-row beet system (**Table 1**). She also noted that on June 27 it would have been possible to wheel hoe the three-row system, which would have sped up the weeding process; but not for the four-row system because the plant foliage was too thick.

CONTEXT AND CAVEATS

In this trial Ann had to harvest some beets with tops on for market and some beets without tops for her CSA. This is because another succession of beets that she would have harvested with their tops did not meet the quantity needed for market.

June and July 2022 were dry, and hand weeding replicates 3 and 4 would have required irrigation after weeding. Ann does not usually irrigate beets and, therefore, wanted to avoid irrigation even though this resulted in some notable weed pressure in those replicates.

She also found during the second week of August that there was some wilting of leaves in both the three-row and four-row beet systems and attributed this to a change from dry to adequate moisture, plus hot and humid conditions.

Table 1. Total yield and total weeding labour hours for beets grown in three-row and four-row systems.

TREATMENT	YIELD (KG) \pm SE	WEEDING LABOUR (MIN)
THREE-ROW	22.4 (± 3.37)	20
FOUR-ROW	22.5 (± 3.20)	32
P-VALUE	0.95 NS*	**
OBSERVED DIFFERENCE***	-0.1	-12
LSD	11.4	**

*NS = not significant

** Data collected on only two replications so we were unable to run statistics

*** Observed difference calculated as yield or weeding labour in the three-row (control) system - the four-row system (treatment)

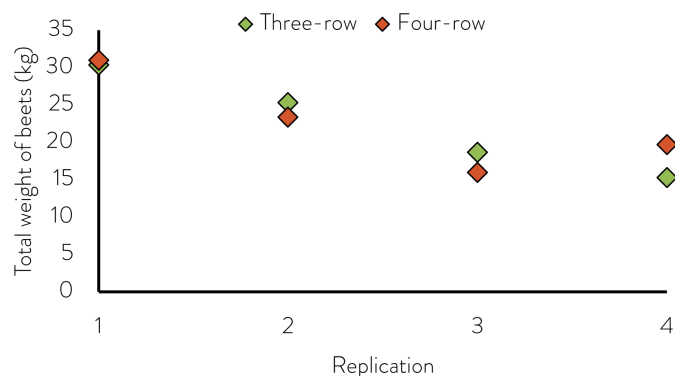
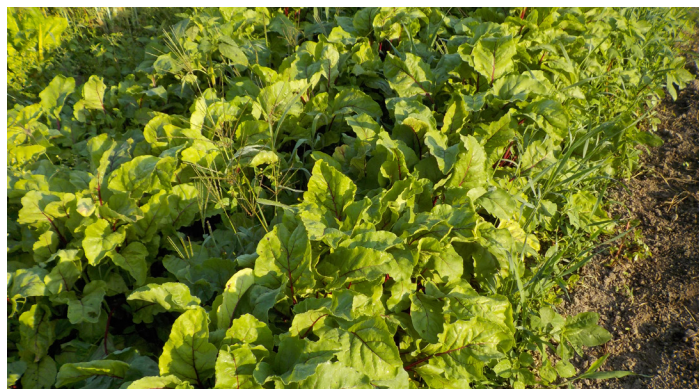
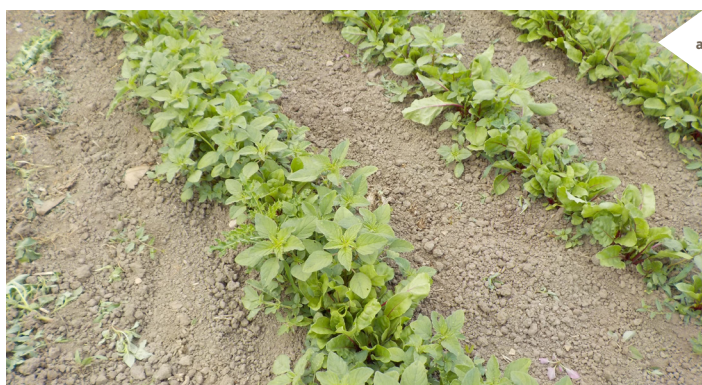


Figure 2. Total yield weight of beets grown in three-row and four-row systems in four replicates each.



Unweeded beets in replicate 3, one of the weedier replicates in the trial, on July 30th.



a)



a)



b)



b)

a) Three-row beets before hand weeding; **b)** three-row beets after hand weeding.

a) Four-row beets before hand weeding; **b)** four-row beets after hand weeding.

NEXT STEPS

This trial confirms Ann's gut instinct on three-row versus four-row beets. Based on this trial, Ann will only plant three-row beets going forward. Observations from this trial will also encourage her to more critically observe how intensively other crops can be planted in her market garden.



Harvested beets from replicate 1 on July 29.

TAKE HOME MESSAGE

Ann found that there was no difference in yield between three-row and four-row beets on her three foot bed system. She also observed that weeding effort and labour might be less in the three-row system, based on the fact that she would be able to use tools like a wheel hoe longer than she could in the four-row system. These results suggest there are limits to how intensively beets can be planted, if increased yield is the goal.