

Initial Testing of Weeding Robots in Vegetable Production Systems in Ontario, Canada

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Introduction

Several weeding robots promise to provide: reduced soil compaction, a lower carbon footprint, reduced inputs (seed, herbicide, etc.), less labour requirements, scalable mechanical weeding, and ease of use. However, questions about their practicality and return on investment remain.

In order to test these claims, three autonomous weeding robots were trialed and compared to conventional vegetable growing practices in Ontario, Canada. The Naïo Dino, Nexus “La Chèvre,” and FarmDroid FD20 were operated with side-by-side control comparison trials to collect and analyze metrics important for practical farming considerations, such as:

- Weed suppression,
- Crop health, and
- Soil health.

AgRobotics Technologies Tested

FarmDroid (Seeding & Weeding Sugar Beets & Rutabaga)

- Solar-charged batteries
- 24-hours autonomous operation (sleep mode when batteries are low)
- Seeder, and inter- and intra-row mechanical weeder



Naïo: Dino (Weeding Carrots)

- Rechargeable lithium batteries
- Up to 10 hours of autonomous operation
- Inter-row guidance and mechanical weeding



AgRobotics Technologies Tested

Nexus La Chèvre (Weeding Onions & Carrots)

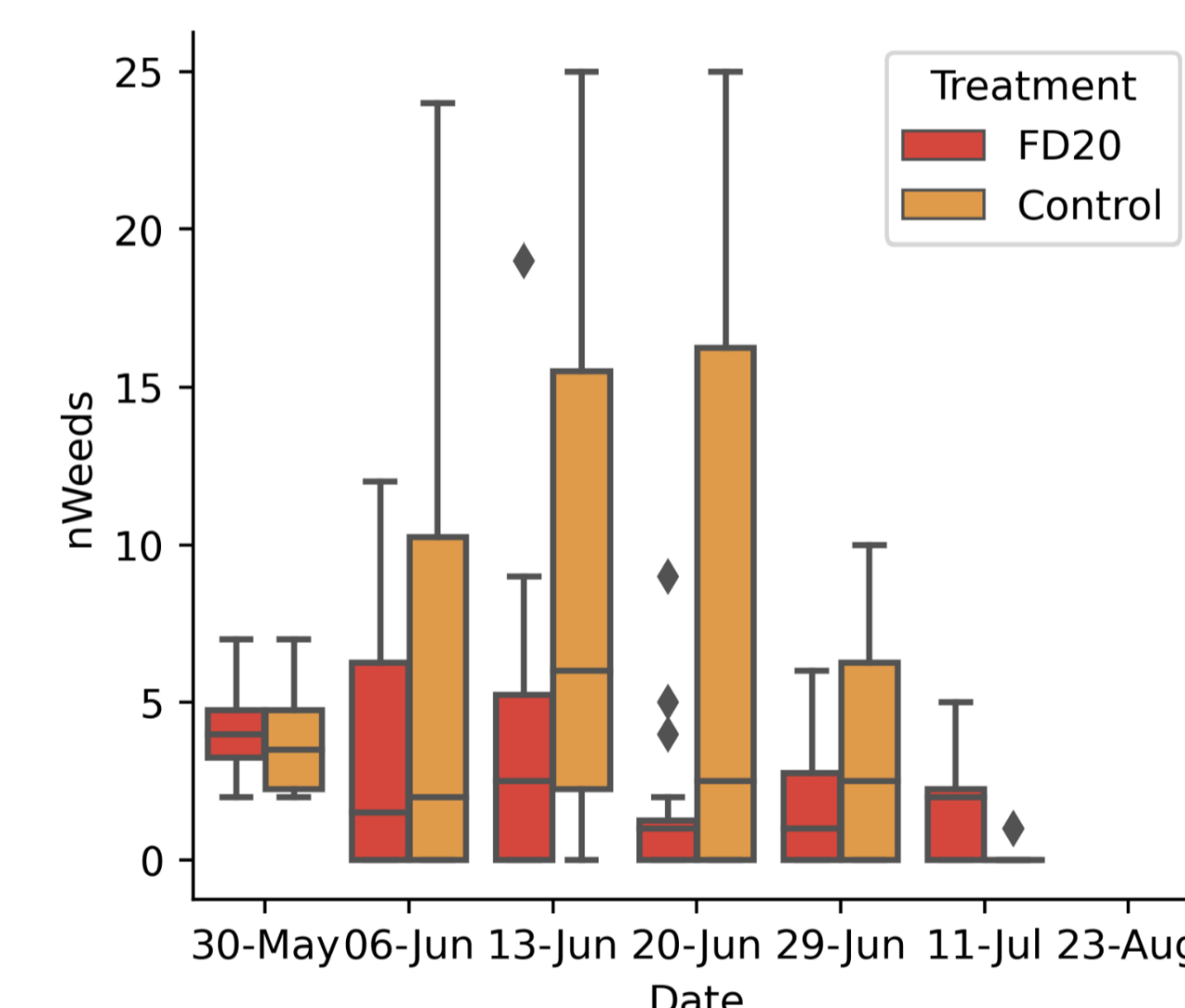
- Electric hybrid motor
- 24-hour autonomous operation
- Machine vision inter- and intra-row mechanical weed removal



Results and Discussion

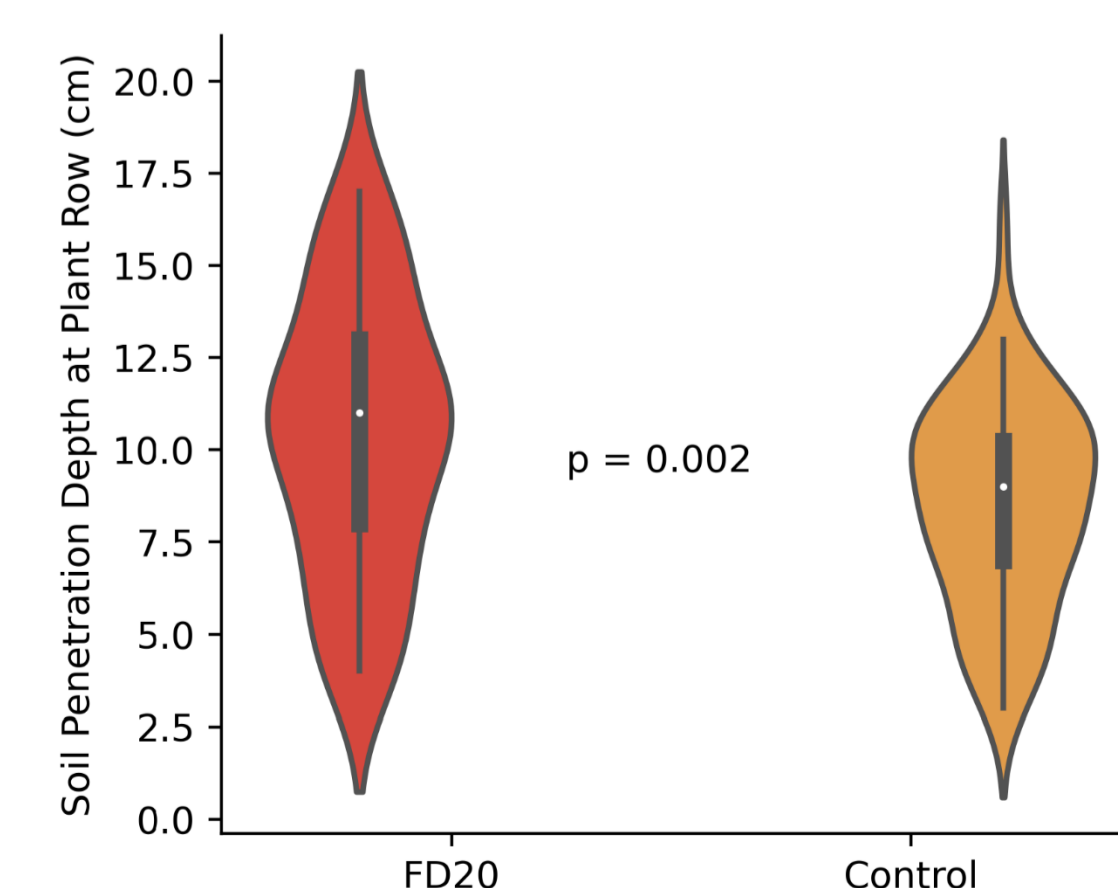
FarmDroid FD20

Sugar beets were seeded at a lower density with the FD20 than the conventional unit (45,000 seeds/acre vs 53,000 seeds/acre). Although the FD20 seeded at a lower density, there were more sugar beets in the FD20 field. The FD20 seeded sugar beets were consistent in size and shape, and had high sugar content. The producer commented that although the FD20 took longer to seed, it minimized seeding date risk, and the precision seeding benefited the crop with more consistent germination.

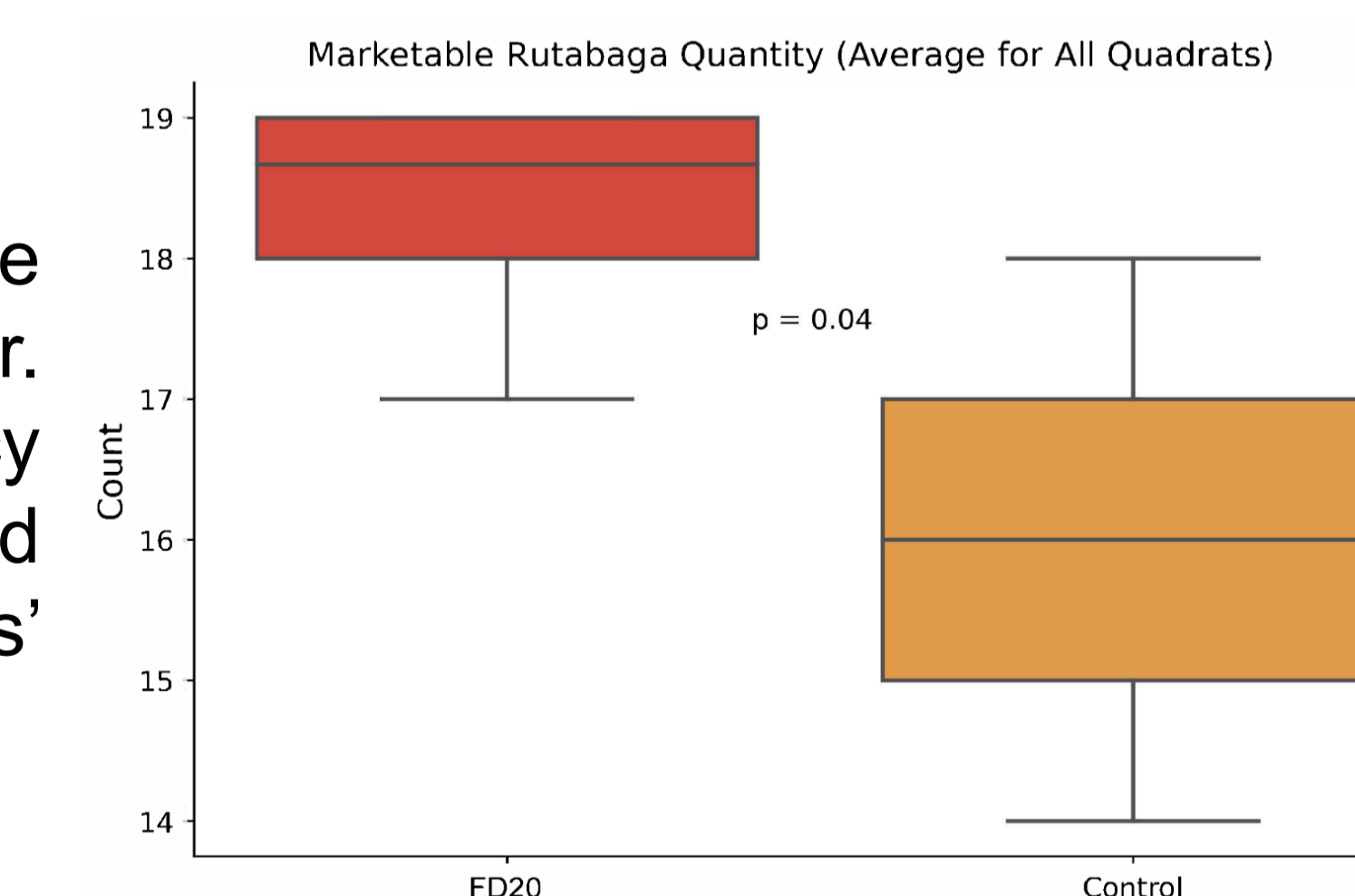
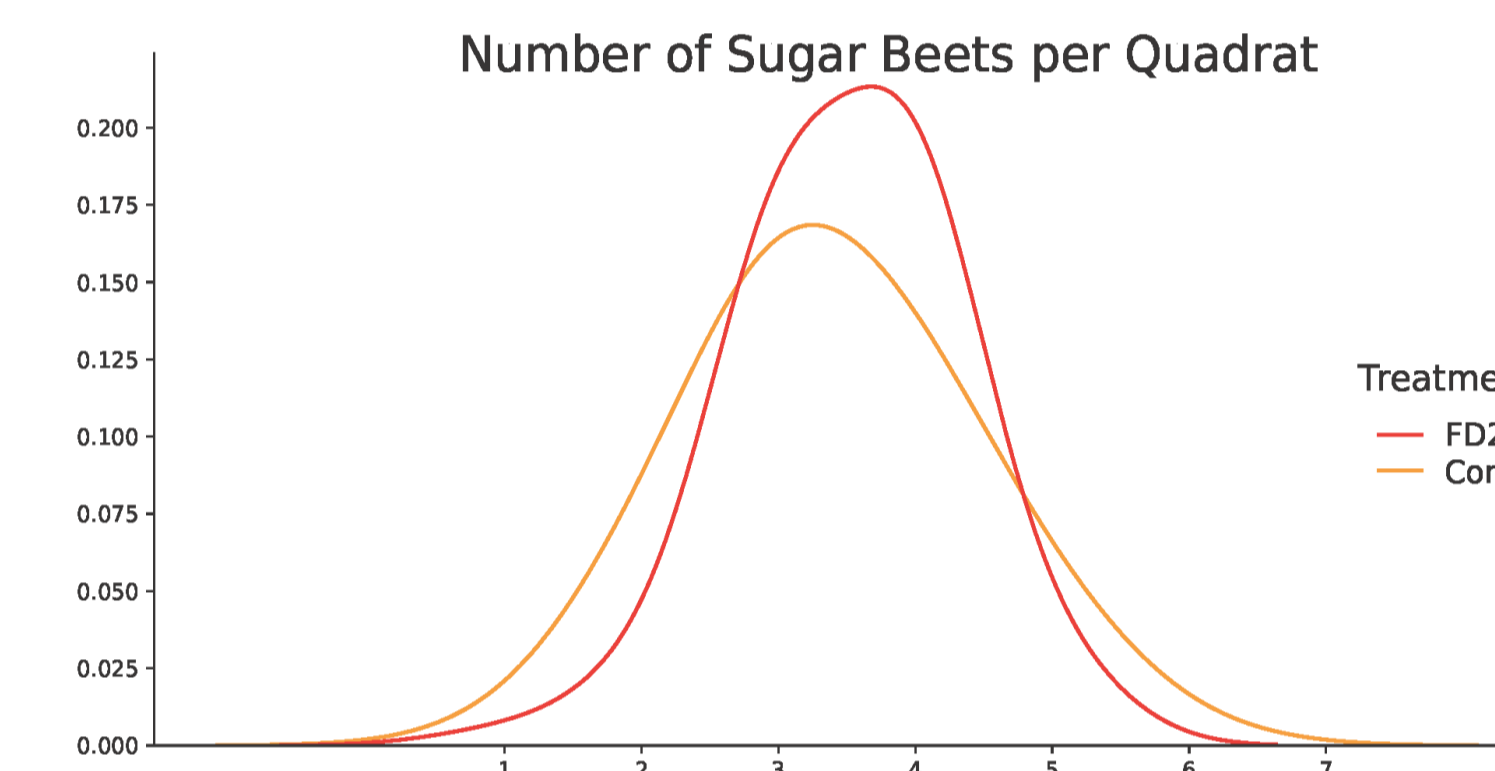


Both the FD20 and control treatments used herbicides; however, the FD20 treatment had fewer weeds throughout the season.

The FD20's consistency was also evident in the rutabaga trial that was conducted later in the year. The FD20's seeding and weeding proficiency provided improved crop development and marketable yield when compared to the producers' traditional management practice (control treatment).



At ~1,000 kg the FD20 weighs significantly less than traditional tractors. Although the robot operates continuously over the field, its relative impact on the soil is reduced.



Results and Discussion - Continued

Naïo Dino

The Naïo Dino worked reliably at cultivating in between rows of a 25 acre carrot field for one month. Historically, this plot had been minimally cultivated, and unfortunately due to the heavy cultivation of the Dino, the producer requested to remove the robot and continued with their conventional weed management practices.

Nexus La Chèvre

The teams at Haggerty AgRobotics, Nexus and the Ontario Crops Research Centre - Bradford worked closely to operate La Chèvre in onion and carrot plots. The most advanced prototype was able to remove ~90% of weeds, but the system did not move reliably through the field, and managed very few acres. The robot was removed after six weeks of operation because the onions were too large, and the carrot canopy had become too dense for the robot to operate without damaging the crop.

Conclusions

Conducting trials on commercial operations with high value crops was challenging. The Dino-carrot trial showed producer apprehension to new, autonomous solutions compared to their conventional management methods. The rutabaga producers' nervousness to plant at a lower density was another example of this. Their openness to adopting the system after seeing the results indicates that there is a curve to adoption and a strong need for producers to see these technologies locally in Ontario, Canada production systems.

Critical considerations for future work are the need for producer designated test plots, and adjusting assessments based on weed pressure, field conditions, and resistant weeds.

We are working together with collaborators and innovative producers to de-risk these technologies, which will enable producers to utilize these technologies with confidence in the future.

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