Robotic Weed Management in Table Beet Grown in High Organic Matter and Mineral Soils

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Introduction

Vegetable growers are increasingly facing labor shortages and herbicide-resistant weeds in the Holland Marsh. Also, by 2025, no registered herbicides may be available for table beets (*Beta vulgaris* L.). Alternative technologies are needed for integrated weed management.

The performance of the electric Naio Orio robot (Fig. 1, 2) was evaluated for weed management and yield in table beet on both high organic matter soil (muck soil – Fig. 3) and mineral soil (Fig. 4), compared to conventional tractor-drawn methods.

Fig. 1. Naio Orio robot with rolling cultivator

Fig. 2. Naio Orio robot spraying

Fig. 3. Table beet on high organic matter soil

Fig. 4. Table beet on mineral soil

Objective

- To compare the Orio robot to conventional cultivation and spraying for weed management and yield in beets on muck and mineral soil.

Materials and Methods

- Fields were seeded between 16-23 May 2024, in muck (~62% organic matter) and mineral soil (~ 2% organic matter).
- The experiment was a completely randomized design with two replications in the muck field and six in the mineral field.
- Treatments were two weed management strategies: spraying (Fig. 2) and cultivating (Fig. 1, 6) by robot and tractor.
- Betamix β EC herbicide (1.5 L/ha) was applied three weeks after planting, followed by weekly cultivation.
- S-tine (Fig. 6) and roller cultivators (Fig. 1), were used on both the robot and tractor.
- Weed density and biomass were measured in 0.25m² quadrants pre- and post-treatment (Fig. 7, 8).
- Post-treatment weed density and yield were compared for each soil type (Table 1, Fig. 5).

Results

Table 1. Effect of robot and tractor weed management on table beet yield and weeds in different soils

Soil Type	Treatment	Weed Biomass (g/m²)	Marketable Yield (t/ha)	Number of harvested beets
Mineral	Robot	11.3 a[1]	14.3 a	91.5 ns
Mineral	Tractor	15.9 a	18.8 a	88.3
Muck	Robot	190.9 c	24.6 b	92.0
Muck	Tractor	37.6 b	40.4 c	100.2

Note: Means with the same letter are not significantly different P > 0.05, Tukey's test. ns=not significant.

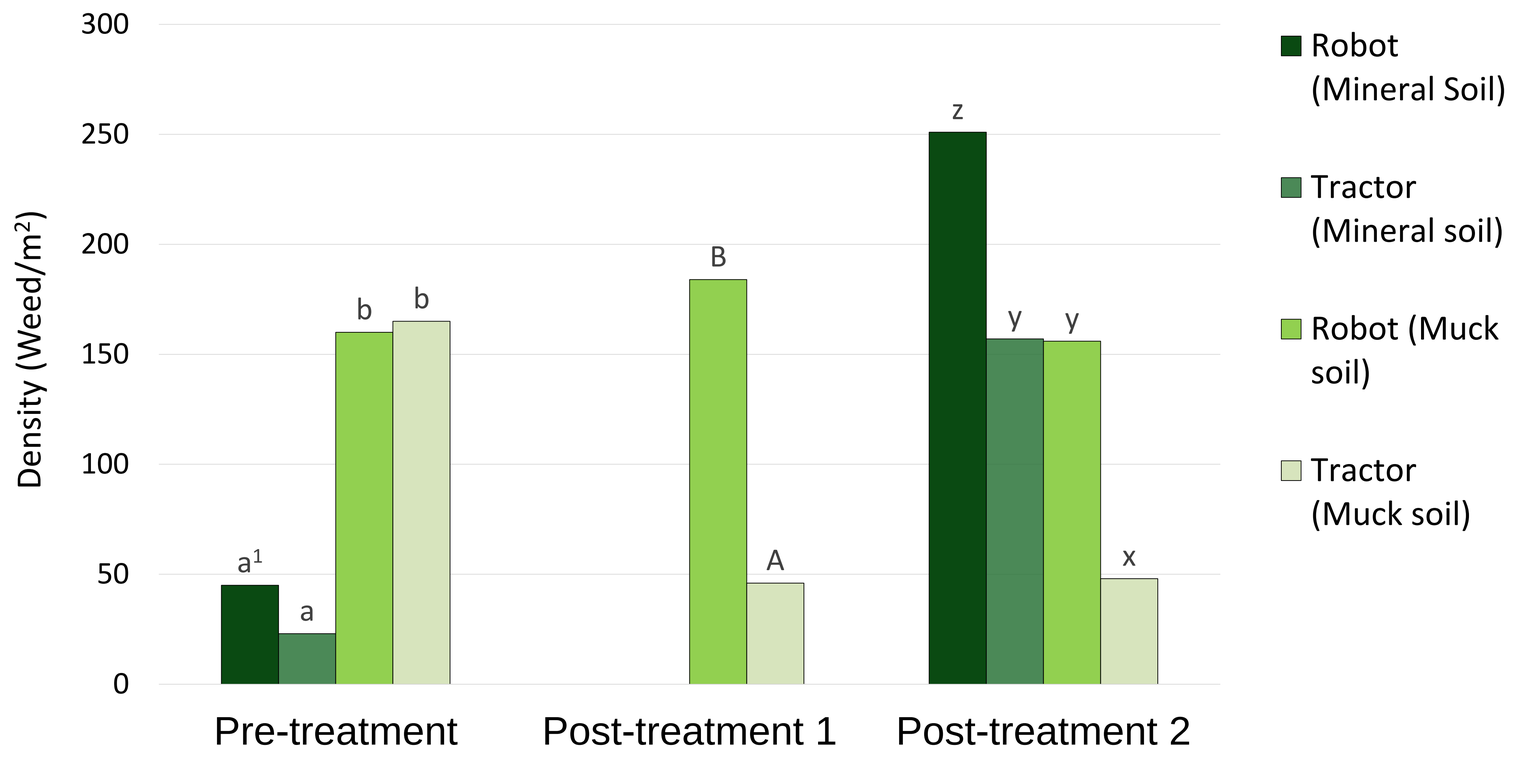

Fig. 5. Weed density pre- and post-treatment application

[1]Bars with the same letter and capitalization are not significantly different P > 0.05, Tukey's test.

Fig. 6. Naio Orio robot with an S-tine cultivator

Fig. 7. Beet plot cultivated by tractor-pulled S-tine cultivator

Fig. 8. Beet plot cultivated by robot-pulled S-tine cultivator

- Marketable yield was higher on muck soil, compared to mineral soil, as expected (Table 1).
- There were no differences in yield, weed density, or biomass on mineral soil.
- The lower yield in the robot treatment on muck soil was likely due to the higher weed biomass as a result of poorer weed control early in the season.

Conclusions

No differences in weed management or yield were found on mineral soil, but there were differences on muck soil for weed biomass and beet yield. The Naio Orio robot was effective for weed management, although the cultivator mount system needs improvement for better access to raised beds. Updates are ongoing to improve weed management using cultivation and between-row application of non-selective herbicides.

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