Comparison of Remote Sensing and Traditional Scouting for Estimating Colorado Potato Beetle Damage

Andrei Alyokhin and Aaron Buzza
School of Biology and Ecology
The University of Maine, USA
AndreiAlyokhin.com

Abstract

Sustainable potato protection requires integrated pest management, including reliable economic thresholds. We manipulated Colorado potato beetle densities in potato plots to create different levels of defoliation. We then correlated beetle numbers and foliage condition determined using traditional scouting and remote sensing techniques with potato yields. Both aerial photography and leaf indices calculated from foliar reflectance showed potential for estimating beetle damage. Potato plants could tolerate considerable defoliation without yield reduction.

Introduction

The Colorado potato beetle, *Leptinotarsa decemlineata*, is a highly damaging insect defoliator of potatoes, *Solanum tuberosum*. Indiscriminate applications of insecticides have repeatedly resulted in control failures due to the evolution of resistance in beetle populations. Therefore, sustainable potato protection requires integrated pest management, which is impossible without reliable monitoring techniques and economic thresholds.

Potato plants can tolerate considerable defoliation without reduction in tuber yield [*Ann. Appl. Biol. 166(2015): 208–217*]. Therefore, presence of Colorado potato beetles does not always require taking a control action. To reduce the number of unnecessary prophylactic applications of insecticides, farmers need to have feasible methods for determining damaging levels of beetle infestation and subsequent damage to potato plants.

Remote sensing techniques, including image recognition [*Proc. AIROV24(2024)*] and vegetation indices [*J. Appl. Remote Sens. 11(2017): 026013*], show a good potential for estimating Colorado potato beetle damage to potato fields. The goal of the present study was to correlate beetle numbers and foliage condition determined using traditional scouting and remote sensing techniques with potato yields.

Materials and Methods

Design:

- Small plots (30' by 6 rows in 2023 and 30' by 4 rows in 2024) planted to 'Reba' potatoes on Aroostook Research Farm, Presque Isle, Maine
- Four replications, randomized complete blocks

Colorado potato beetle populations:

- **Catastrophic**– untreated
- **High** – imidacloprid (Admire 75SG) at planting
- **Medium** – thiamethoxam (Platinum 75SG) at planting
- **Low** – in 2023, thiamethoxam (Platinum 75SG) at planting + a mix of cyantraniliprole and abamectin (Minecto Pro SC) twice foliar; in 2024, thiamethoxam at planting + a mix of cyantraniliprole and abamectin once foliar + spinosad (Blackhawk 36 WDG) once foliar

Sampling:

- Everything done within the middle two rows of each plot
- The number of beetle eggs, small larvae (1st and 2nd instars), large larvae (3d and 4th instars), and adults counted weekly on ten random plants
- Drone (Mavic Air 2) was flown weekly 6-8' above the ground and took pictures (Fig. 1)
- The number of visible Colorado potato beetles were counted on each picture
- Percent defoliation was visually estimated on each whole plot at the time of scouting
- In 2024, NDRE and NDVI were measured weekly using GreenSeeker handheld crop sensor
- Tubers were dug from two 10' sections and weighed

Fig. 1. Aerial photograph of the middle two rows of an experimental potato plot. (A) actual photo, 48 MP 8000x6000 px; (B) close-up with two arrows showing two adult Colorado potato beetles.

Results

Fig. 2. Drone detected fewer beetles of all life stages except large larvae.

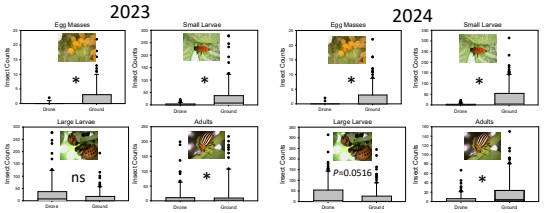


Fig. 3. However, there were significant correlations between observations made from the drone and on the ground.

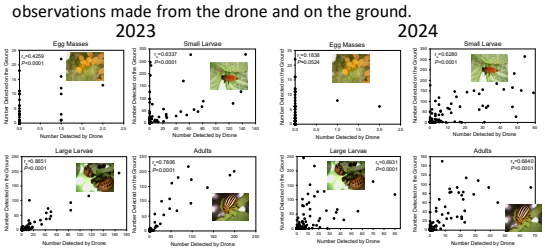
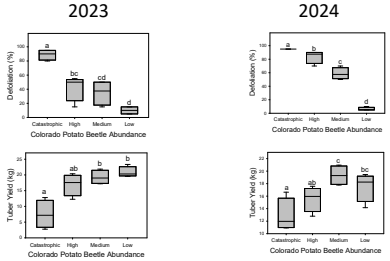


Table 1. Both leaf indices were significantly predictive of tuber yields but accounted for a relatively small portion of the observed variation.

Index	Week after Planting	Intercept	Parameter	*P*	R^2
NDRE	6	13.59	0.32	0.0557	0.18
	7	12.68	0.43	0.0064	0.38
	8	13.23	0.36	0.0271	0.25
	9	12.76	0.42	0.0082	0.36
	10	12.65	0.43	0.0059	0.39
	11	12.86	0.41	0.0109	0.34
	12	13.16	0.37	0.0228	0.27
NDVI	6	13.25	0.36	0.0283	0.25
	7	12.15	0.49	0.001	0.52
	8	11.83	0.53	0.0002	0.62
	9	12.91	0.40	0.0126	0.32
	10	12.76	0.42	0.0083	0.36
	11	13.12	0.38	0.0212	0.28
	12	13.39	0.35	0.0377	0.22

Fig. 4. Only the most severe defoliation resulted in a consistent decrease in tuber yields.



Discussion and Conclusions

- Remote sensing shows potential for scouting for Colorado potato beetle damage
- Potatoes could tolerate considerable defoliation without detectable decrease in tuber yields

Acknowledgements: Mia Arcott, Ben Beaulieu, Madelyn Buzza, Gage Dyer, Sophia Garcia, Savannah Guess, Joey Lippo, Ian McCray, Dakota Morrow, Riley Prince, and Chloe Sleeper provided technical assistance. This work is supported in part by the USDA/NIFA Multistate project award no. ME0-32125.