Evaluation of an AI-driven High-precision Spraying System (Ecorobotix ARA) for Targeted Weed Control in Onions

Precision Horticulture Lab
College of Agricultural & Environmental Sciences
UNIVERSITY OF GEORGIA

Dr. Regimar dos Santos
Ph.D. Student
Department of Horticulture
University of Georgia
regimar.garcia@uga.edu

Lucas Sales, M.S.
UGA Extension
ANR Agent
University of Georgia
lucas.sales@uga.edu

Dr. Marcelo Barbosa
Postdoctoral Associate
Department of Horticulture
University of Georgia
marcelo.Barbosa@uga.edu

Chris Tyson, M.S.
UGA Extension
ANR Agent
University of Georgia
tysonc@uga.edu

Dr. Luan Oliveira
Assistant Professor
Department of Horticulture
University of Georgia
luan@uga.edu

Introduction

Weeds remain one of the most persistent production challenges in the Vidalia Onion region, where sandy soils, rapid leaching, and environmental restrictions limit the availability of effective herbicide options. In this region, growers rely primarily on pendimethalin (Prowl® H20) and oxyfluorfen (Goal® 2XL), making timing, placement, and selectivity critical for protecting crop stands. Advances in computer vision now provide new opportunities for more efficient and sustainable weed control using these current or new herbicide options. High-precision sprayers that combine high-resolution imaging and artificial intelligence-(AI)-based crop recognition can be used for selective herbicide delivery. New systems like the Ecorobotix ARA uses advanced AI-driven systems to detect and differentiate weeds from crops of similar color and appearance, ensuring that only the weeds are targeted. Using this approach the herbicide is only applied to the weeds or to the surrounding non-crop areas. The system combines the AI-driven recognition with its 156 nozzles to deliver chemicals with high-accuracy. This targeted spraying strategy aims to reduce herbicide usage and to minimize crop injury risk. Therefore, the objective with this work is to compare the Ecorobotix ARA High-precision Sprayer (Figure 1) with a conventional broadcast application in regarding weed control and yield.

Materials and Methods

A field trial was carried out at the Vidalia Onion and Vegetable Research Center in Lyons, Georgia, USA. The "all-but-the-crop" without safety zone setting of the ARA sprayer was compared to a conventional broadcast treatment of Prowl® H20 and Goal® 2XL. The "all-but-the-crop" is an AI-based selective spraying mode that allow the sprayer to spray everything in the field besides the crop. The application was carried on January 6, 2025, 15 days after onion transplanting. Onion population was 90,000 plants per acre. After application, chemical usage, phytotoxicity, weed counts, bulb size, and yield were assessed. The target application rate was 26.7 gallons per acre (GPA) for both ARA and Broadcast treatments with 32 oz of Prowl® H20 and Goal® 2XL. Phytotoxicity and weed counts were measured at 14, 30, and 44 days after application (DAA) within a 10sqft area randomly selected three times within a 100ft plot. Yield was assessed by collecting the gross weight of onions on 15ft plots after onions "undercutting". Bulb size was assessed by measuring 30 random bulbs from inside of the plot. The experimental design was a RCBD with 3 replications.

Figure 1. Ecorobotix ARA System

Results

The Ecorobotix ARA achieved a 59% reduction in chemical use compared to broadcast application using the "all-but-the-crop" application mode.

The treatment applied with the Ecorobotix ARA presented lower phytotoxicity at 14 DAA compared to the broadcast application and maintained equivalent weed counts at all evaluation dates (Figure 2). As expected, the control treatment presented higher weed counts in all evaluation dates.

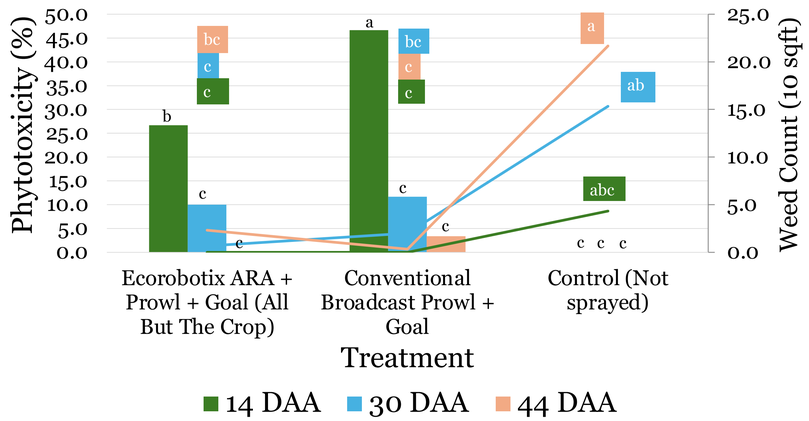

Figure 2. Phytotoxicity ratings and weed counts 14, 30, and 44 days after application (DAA).

No significant statistical differences were observed in the yield or bulb size among the Ecorobotix ARA versus the Broadcast (Figure 3). Both treatments (ARA and Broadcast) showed higher yields when compared to the control. Despite no statistical differences, data showed a difference of approximately 2,600 lbs per acre between the ARA and the conventional broadcast treatment. Average bulb size was also greater in the ARA and broadcast treatments than in the control.

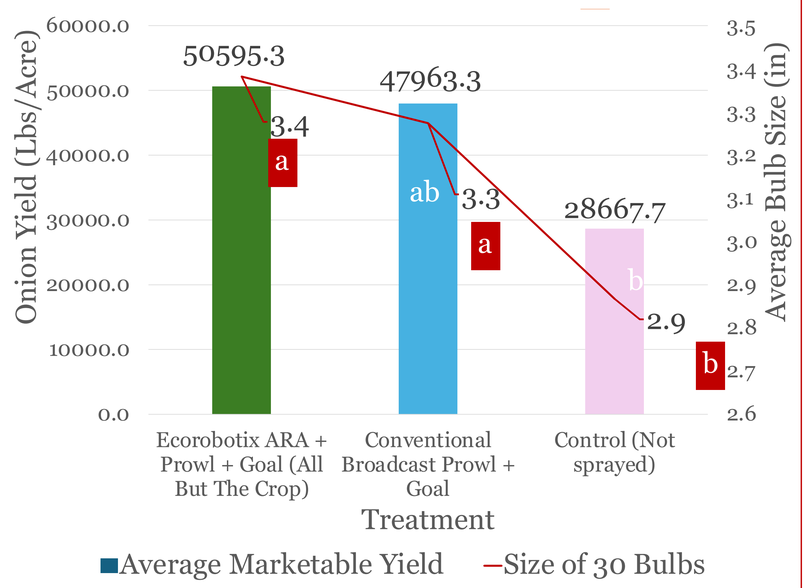

Figure 3. Onion Marketable Yield and Bulb Size

Conclusions

The study showed that the Ecorobotix ARA, operating in an "all-but-the-crop" mode, achieved weed control and crop phytotoxicity levels comparable to a full-rate broadcast application while using only 41% of the spray mixture in transplanted onions at a density of 90,000 plants per acre. The ARA treatment exhibited slightly lower phytotoxicity at 14 days after application and showed a trend toward increased yield. Further studies are needed to evaluate additional herbicide treatments, split-application strategies, and performance across different production environments, including direct-seeded onion systems. Further studies can also be valuable to determine the economic impact per acre between spot application and conventional spraying.

Acknowledgements

VIDALIA® ONIONS