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Fruit Notes

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Cornell Cooperative Extension
Lake Ontario Fruit Program

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Scientists, Extension Educators, and Ag-Tech Innovators are Working Together to Fine-Tune and Validate the Adoption of Digital Technologies for Precision Crop Load Management

Terence Robinson, Yu Jiang, Luis Gonzalez, Mario Miranda Sazo, and Craig Kahlke

In the last two growing seasons and in a few orchards in the Lake Ontario Fruit region and at Cornell AgriTech in Geneva, the testing of several digital technologies has been taking place to help improve the accuracy and labor efficiency of precision crop load management. Our final goal is to automate fruit, bud, and flower counting using computer vision technologies. We envision the use of autonomous or driven vehicles with computer vision capabilities to geo-reference each tree in a high-density orchard, either a 2-D or a 3-D canopy system, and then count/measure, very accurately:

- Trunk diameter
- Dormant flower buds
- Floral buds at green tip to pink
- Flowers at bloom
- Fruitlets at 10-20 mm size
- Fruits at 25-35mm size
- Fruits pre-harvest

Until recently, traditional manual methods to count/measure dormant buds, floral buds, flowers, or final crop load before harvest were tedious/expensive, and there were not enough trained/detail-oriented people in a farm, which often meant getting good tree data in a timely manner for accurate crop load management decisions, or yield estimations was not accomplished.

Now things have changed dramatically with the advent of new technologies that allow AG-tech companies to quickly process and make sense of vast amounts of tree data collected in a high-density orchard. Internet-connected sensors and cameras can now directly collect information on trees, including water needs, leaf temperature, flower counts, tree height/shape, GPS location, etc. After machine-learning algorithms analyze this 'digital tree', an Ag-Tech company's results can be automatically adjusted (by a calibration factor) to reflect the findings and even tailored to individual grower's needs or fruit company business goals.

These new developments make data-enabled management much more powerful than the old/slow/manual measurements in a few trees collected until recently. They don't, however, guarantee 100% accuracy and a significant amount of 'ground-truth' work or field validation is still needed by qualified horticultural teams. Within the SCRI Apple Crop Load Management project (led by Dr. Terence Robinson at Cornell), a team of researchers and extension educators began to conduct first validation trials 'ground-truthing' with a few Ag-tech companies in 2021. In February of 2022, we invited the most promising digital technologies from around the world and started a collaborative effort between our SCRI project and interested Ag-tech companies. In 2022, just in the Lake Ontario fruit region and as part of the extension activities of the SCRI nationwide project, CCE LOF carried out one pruning severity study on Honeycrisp at Orchard Dale Fruit Farm and validated two cell phone camera technologies to count and measure fruitlet diameter. Working with the Fruit Scout company, we used individual fruit



pictures to measure fruit growth rate and estimate fruit set after a thinning spray. We also worked with the Farm Vision company where we used a cell phone video of several trees to identify and measure fruitlet diameter and fruit set after a thinning spray (Figure 1). Both cell phone technologies gave us very accurate results when compared to our manual measurements. In addition, we are working with several companies who are developing rovers or drones to count (Moog from Buffalo, NY; Vivid from Ontario, Canada; Green Atlas from Australia and Outfield from England). We more recently began preliminary collaborations with AgerPix from Spain and Munckof/Aurea imaging from the Netherlands. This past summer, CCE LOF conducted a very successful fruit summer tour in Orleans County where several digital technologies were featured during the tour (Figure 2).

In the future fruit business operations (including small, medium, and large scale) will need to face (at different scales of adoption) the need to incorporate digital technologies into their operating models and respond to the new challenges and opportunities. Machine learning and digital technologies will transform the nature of many Ag-job (including those for precision crop load management/thinning). We hope the adoption and incorporation of these technologies will be made easier with the help of extension educators. They will develop and disseminate necessary literacy of digital agriculture concepts and technologies to relevant US stakeholders, growers, orchard managers, and orchard workers (including key H-2A employees).

Our current SCRI project is focusing on bringing digital technologies to precision pruning, precision chemical thinning and precision hand thinning. We hope that the information collected by drones, rovers or with digital cell phone cameras can be processed and the conveyed to human workers as actionable information to assist in crop load management during dormant pruning chemical thinning and hand thinning. With several companies working on this issue we feel confident that growers will have good options for incorporating digital technology into their businesses in the next 3-5 years.



Figure 1. In the picture, the Farm Vision technology uses a cell phone video of several trees to identify and measure fruitlet diameter and fruit set after a thinning spray.



Figure 2. The three rovers introduced at the CCE LOF summer tour on August 9, 2022: the Moog (left), the Green Atlas Cartographer (top right), and the Vivid Machine (bottom right).

Fall Pre-emergent Herbicide Timing: takeaways from our research

Janet van Zoeren and Mike Basedow

Although we are still in the thick of harvest season, it's always good to pay attention to what's on the horizon. Post-harvest can be a good time to get your pre-emergent materials on to get a leg up on your annual weeds heading into the next growing season. In the next few paragraphs, we'll discuss some results from our ARDP funded project comparing fall and spring pre-emergent herbicide applications, and some strategies you can use to get the most out of your fall pre-emergent herbicide applications.

Let's start with our takeaway messages

Based on the research study conducted by Mike and me, **post-harvest timing for pre-emergent herbicide applications can be as good or better than applications made the following spring.** This is especially effective for sites where the key weeds are annuals, rather than perennial species (want to talk more about the weeds growing on your farm? Please give me a call! I'd love to come take a look and help you tailor your weed management program to your weed species). Our [herbicide lookup table](#) can also help you select which material to use.

We recommend making fall applications of pre-emergent herbicides when your herbicide strips are clean enough and weather conditions are favorable, and including a post-emergent (burndown) herbicide in the tank. Previous work by Deborah Breth, Dan Donahue, and Anna Wallis found the following **pre-emergent** products/combinations of products to be effective for fall application.

- **Chateau (mostly annual broadleaves and some grasses) + Prowl (mostly annual grasses)**
- **Alion (annual broadleaves and grasses)**
- **Sandea (annual broadleaves and sedges)+ Prowl (mostly annual grasses)**
- **Goatender (annual broadleaves and some grasses)**
- **Simazine (mostly broadleaves) + Diuron (mostly broadleaves)**
- **Sinbar (annual broadleaves)**
- **Casoron (annual broadleaves and grasses)**
- **Matrix (annual broadleaves and grasses)**

Quick hints/reminders for if you would like to apply pre-emergent herbicides this fall:

Few products will cover everything you have, so tank mix materials to get the full spectrum of control that you need.

Pay close attention to weather requirements. Pre-emergent herbicides are finicky materials. For them to work well, they need to be applied under the right temperature/soil/tree conditions. Most need to go on prior to soil freeze up. Check the labels closely to make sure you are applying them under (as close to) ideal conditions as possible.

Apply to as clean of a strip as possible. Many pre-emergent materials need to be applied to bare soil to get maximum efficacy. The chemical needs to reach the soil surface to be taken up, so applying them on top of a weedy strip is going to greatly reduce your control. So, with that in mind....

Clean up the strip ahead of your application as much as possible – In Peru, they went through two weeks ahead of the Alion application with paraquat to burn down any vegetation, allowing the Alion to be applied to a clean strip. Seems annoying, but can make all the difference in pre-emergent efficacy.

Don't rely on one application to give season long control – Like any IPM program, the best control is going to be gained by using multiple tools from the tool box. Use a variety of tactics (pre-emergent materials, timely burndown applications, well-timed systemic materials) to manage your weeds.

Back to the beginning: what was our study?

For our ARDP-funded study, we compared fall versus spring timings of two pre-emergent herbicide combinations, each at two locations (ENY and WNY). In the fall of 2020, we applied Chateau and Prowl (along with glufosinate for burndown of existing vegetation) on a portion of a commercial herbicide strip in Peru and Albion, respectively. Another portion of the strip received that same combination of materials the following spring, while a third treatment received no pre-emergent application at all, just glufosinate to burn down existing vegetation. We scouted the weed plots throughout the growing season, paying close

attention to the plots during the critical weed free period of May through July. We made follow up applications with post-emergent materials to each plot as needed.

Here you can see the full list of applications that went on each treatment in Albion (Figure 1) and Peru (Figure 2) in 2021.

Figure 1. Applications made to the three treatments at our Albion field site in 2021.

2021 Albion Treatment Calendar			
Date	Treatment 1: Fall Applied	Treatment 2: Spring Applied	Treatment 3: Posts Only
10/23/2020	Prowl 4qt/Acre + Chateau 12oz /Acre + Interline 48 fl oz/Acre		
3/22/2021		Prowl 4qt/Acre + Chateau 12oz /Acre + Interline 48 fl oz/Acre	
5/6/2021			Interline 48 fl oz/Acre
7/11/2021	Mad Dog Plus 2.5qt/Acre	Mad Dog Plus 2.5qt/Acre	Mad Dog Plus 2.5qt/Acre
8/19/2021	Interline 80oz/Acre	Interline 80oz/Acre	Interline 80oz/Acre
10/22/2021	Alion 5oz/Acre + Interline 48 fl oz/Acre		

Figure 2. Applications made to the three treatments at our Peru field site in 2021.

2021 Peru Treatment Calendar			
Date	Treatment 1: Fall Applied	Treatment 2: Spring Applied	Treatment 3: Posts Only
11/6/2020	Prowl 4qt/Acre + Chateau 12oz/Acre + Forfeit 48 fl oz/Acre		
3/22/2021		Prowl 4qt/Acre + Chateau 12oz/Acre + Forfeit 48 fl oz/Acre	
4/27/2021	Poast at 1.5pt/Acre	Poast at 1.5pt/Acre	Poast at 1.5pt/Acre
5/14/2021			Rely 280 48 fl oz/Acre
5/24/2021	Milkweed hand cut	Milkweed hand cut	Milkweed hand cut
5/26/2021	Rely 280 48 fl oz/Acre	Rely 280 48 fl oz/Acre	
6/8/2021	Milkweed hand cut	Milkweed hand cut	Milkweed hand cut
6/16/2021	Poast at 1pt/Acre	Poast at 1pt/Acre	Poast at 1pt/Acre
6/22/2021	Milkweed and rootsucker hand cut	Milkweed and rootsucker hand cut	Milkweed and rootsucker hand cut
6/29/2021	Glystar Plus 2.5qt/Acre + Stinger at 1/3 pt/Acre	Glystar Plus 2.5qt/Acre + Stinger at 1/3 pt/Acre	Glystar Plus 2.5qt/Acre + Stinger at 1/3 pt/Acre
8/6/2021	Milkweed and rootsucker hand cut	Milkweed and rootsucker hand cut	Milkweed and rootsucker hand cut
8/10/2021	Rely 280 70 fl oz/Acre	Rely 280 70 fl oz/Acre	Rely 280 70 fl oz/Acre
10/12/2021	Hand cut	Hand cut	Hand cut
10/28/2021	Gramoxone 2.5pt/Acre	Gramoxone 2.5pt/Acre	Gramoxone 2.5pt/Acre
11/4/2021	Alion 5 fl oz/Acre + Rely 48 fl oz/Acre		

We repeated those methods in the fall of 2021, this time using Alion as our pre-emergent material. Here you can see the full list of treatments that have gone in Albion (figure 3) and Peru (figure 4) in 2022 to date.

Figure 3. Applications made to the three treatments at our Albion field site in 2022.

2022 Albion Treatment Calendar			
Date	Treatment 1: Fall Applied	Treatment 2: Spring Applied	Treatment 3: Posts Only
10/22/2021	Alion 5 fl oz /Acre + Interline 48 fl oz/Acre		
4/30/2022		Alion 5 fl oz /Acre + Interline 48 fl oz/Acre	
6/8/2022	Select Max 16 fl oz / Acre	Select Max 16 fl oz / Acre	Select Max 16 fl oz / Acre
6/25/2022			Interline 48 fl oz/Acre
7/29/2022		Interline 48 fl oz/Acre	
8/18/2022			Interline 48 fl oz/Acre

Figure 4. Applications made to the three treatments at our Peru field site in 2022.

2022 Peru Treatment Calendar			
Date	Treatment 1: Fall Applied	Treatment 2: Spring Applied	Treatment 3: Posts Only
11/4/2021	Alion 5 fl oz /Acre + Rely 280 48 fl oz/Acre		
4/26/2022	Select Max 16 fl oz / Acre	Select Max 16 fl oz / Acre	Select Max 16 fl oz / Acre
4/30/2022		Alion 5 fl oz /Acre + Rely 280 48 fl oz/Acre	
5/11/2022			Rely 280 48 fl oz/Acre
5/20/2022	Rely 280 48oz/Acre		
5/31/2022	Select Max 16 fl oz / Acre	Select Max 16 fl oz / Acre	Select Max 16 fl oz / Acre
6/3/2022	Milkweed hand cut	Milkweed hand cut	Milkweed hand cut
6/16/2022	Milkweed hand cut	Milkweed hand cut	Milkweed hand cut
6/28/2022	Milkweed hand cut	Milkweed hand cut	Milkweed hand cut
7/7/2022	Glystar Plus 3qt/Acre	Glystar Plus 3qt/Acre	Glystar Plus 3qt/Acre
8/12/2022	Milkweed and rootsucker hand cut	Milkweed and rootsucker hand cut	Milkweed and rootsucker hand cut
8/16/2022	Gramoxone 3pt/Acre	Gramoxone 3pt/Acre	Gramoxone 3pt/Acre

Below you can see the effects of those herbicide timings on the overall weed cover within the plots when Chateau and Prowl were used in both Albion (Figure 5) and Peru (6).

Figure 5. 2021 weed cover in Albion following fall applied Chateau + Prowl, spring applied Chateau + Prowl, and a post-emergent only program. Additional post-emergent applications were made on each plot as needed.

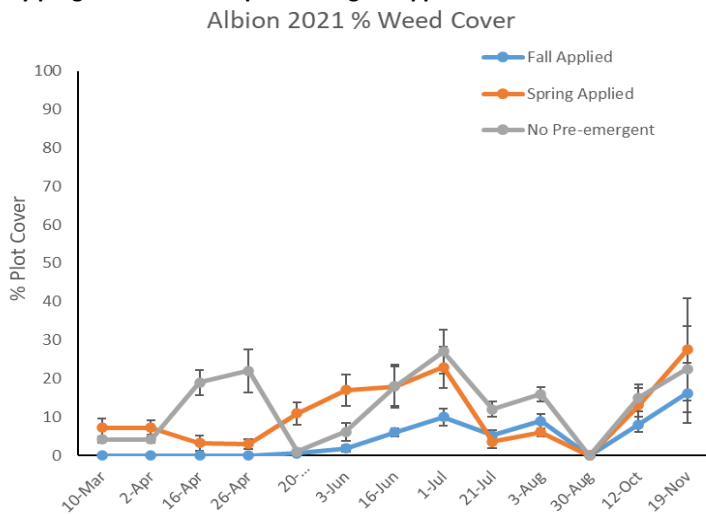
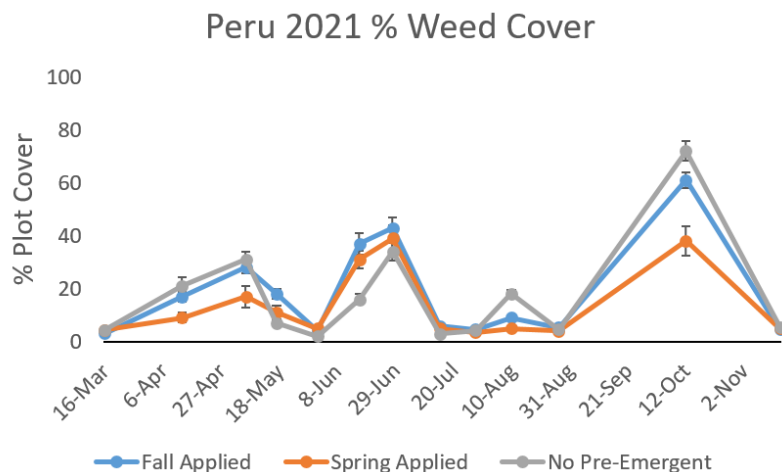


Figure 6. 2021 weed cover in Peru following fall applied Chateau + Prowl, spring applied Chateau + Prowl, and a post-emergent only program. Additional post-emergent applications were made on each plot as needed.



In Albion, the fall-applied Chateau and Prowl had the least weed cover during the weed free period relative to the spring and post-emergent only treatments. In Peru, there were no differences between any of the three treatments during the critical weed free period (May to July). This was likely due to needing to make multiple follow-up burndown applications on all three treatments to keep down the perennial weeds in these plots.

Now we will review the results of our Alion treatments in Albion (Figure 7) and Peru (Figure 8).

Figure 7. 2022 weed cover in Albion following fall applied Alion, spring applied Alion, and a post-emergent only program. Additional post-emergent applications were made on each plot as needed.

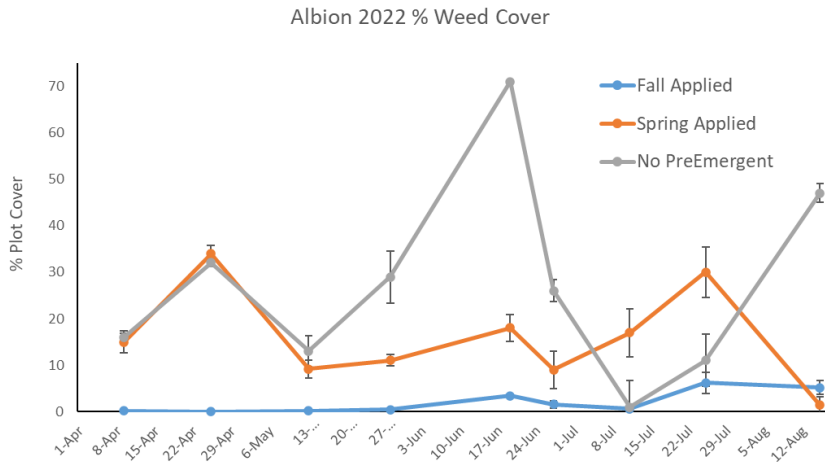
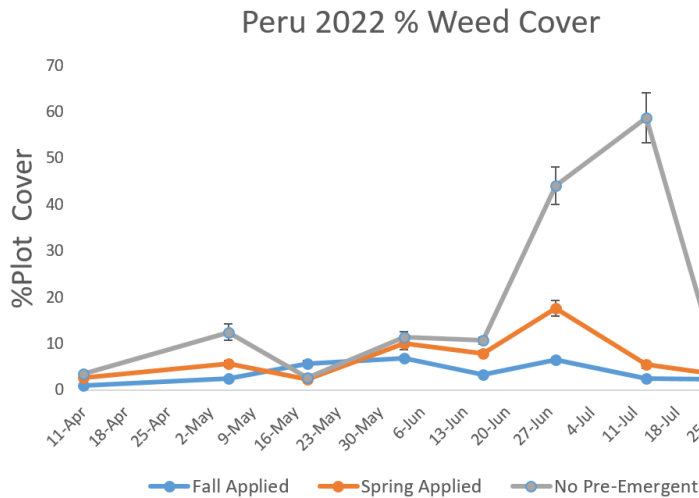


Figure 8. 2022 weed cover in Peru following fall applied Alion, spring applied Alion, and a post-emergent only program. Additional post-emergent applications were made on each plot as needed.



In Albion, the fall application of Alion kept weed cover below 5% through mid-July, and even by August weed pressure in the fall applied Alion plots was below 10% plot cover. No burndown herbicide was applied to those plots aside from the single application of the grass-specific Select Maxx. Weed control was also good in the spring applied Alion plots, although those required one burndown application in mid-summer. The post-emergent only plots required two burndown applications, and pressure still reached 70% plot cover in mid-June. In Peru, similar results were seen, with the fall Alion timing providing very good control, and spring timing also being effective. In Peru, all treatments once again required follow up post-emergent applications throughout the summer to keep perennial weeds in check.



Image 1. The Peru field site on August 12. The plot on the left is the post-emergent only treatment covered with amaranth, while the plot on the right is the fall-applied Alion treatment with only a few quackgrass present.

To reiterate our results, we conclude that a fall application of Chateau/Prowl or Alion (or likely any of the pre-emergent listed at the beginning of this article) is highly effective, and can control weeds throughout the following summer, when timed well and if weather permits. A spring application of a pre-emergent herbicide is also quite effective. Finally, we conclude that a program not using any pre-emergent herbicide is likely to be an uphill battle throughout the summer, and will require multiple burndown herbicide applications to maintain a clean herbicide strip.

If you would like to discuss weed management on your farm in more detail, or if you have ideas for future weed management research you would like to see in WNY, please call or email me: Janet van Zoeren; jev67@cornell.edu; 585 797 8368.

NY Herbicide Resistance Survey

With the recent documentation of evolved herbicide resistance in New York, including Palmer amaranth (glyphosate, ALS-inhibitors), waterhemp (glyphosate, ALS-inhibitors), horseweed (glyphosate, ALS-inhibitors, paraquat), lambsquarters (bentazon), Cornell wants to better understand the current “state of the state” with respect to herbicide performance and failure. Specifically, we are surveying growers/land managers/crop consultants/extension specialists/industry personnel, across cropped (e.g. agronomic, vegetable, fruit), ornamental/horticultural (e.g. Christmas tree farms, golf courses), and non-cropped (e.g. industrial, roadsides) systems in NY to describe the distribution of herbicide resistance in the state. This survey is VERY SHORT and should be QUICK to answer. It is also COMPLETELY ANONYMOUS. Your responses will help Cornell weed scientists plan future research and extension projects. Please access the survey using the link below:

https://cornell.ca1.qualtrics.com/jfe/form/SV_a2F9urYchJpl5Ay

Every effort has been made to provide correct, complete, and up-to-date pesticide recommendations. Nevertheless, changes in pesticide regulations occur constantly, and human errors are still possible. These recommendations are not a substitute for pesticide labeling. Please read the label before applying any pesticide. Copyright 2022. All rights reserved. No part of this material may be reproduced or redistributed by any means without permission. Cornell Cooperative Extension provides equal program and employment opportunities. The Lake Ontario Fruit Program is a Cornell Cooperative Extension partnership between Cornell University and the Cornell Cooperative Extension Associations in Monroe, Niagara, Orleans, Oswego and Wayne counties.

Cornell Cooperative Extension

Lake Ontario Fruit Program

12690 Rt. 31

Albion, NY 14411

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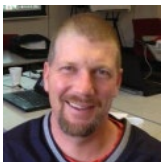
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Fruit Specialists



Craig Kahlke | 585-735-5448 | cjk37@cornell.edu
Team Leader, Fruit Quality Management

Areas of Interest: Fruit Quality and factors that affect fruit quality before, during, and after storage.

Crops: Blueberries, Raspberries / Blackberries, Strawberries, Apples, Apricots, Cherries, Nectarines, Peaches, Pears, Plums



Mario Miranda Sazo | 315-719-1318 | mrm67@cornell.edu
Cultural Practices

Crops: Blueberries, Raspberries / Blackberries, Strawberries, Apples, Apricots, Asian Pears, Cherries, Currants, Gooseberries, Nectarines, Peaches, Pears, Plums



Janet van Zoeren | 585-797-8368 | jev67@cornell.edu
Integrated Pest Management (IPM)

Areas of Interest: IPM of tree fruit and berry pests, biological control, pollinators.

Crops: Blueberries, Raspberries / Blackberries, Strawberries, Apples, Apricots, Asian Pears, Cherries, Currants, Nectarines, Peaches, Pears, Plums

For more information about our program visit us at lof.cce.cornell.edu