



DPR PMAC Meeting:

Dissemination and Training for Citrus Spray Application Expert System Adoption in California: Efforts and Outcomes

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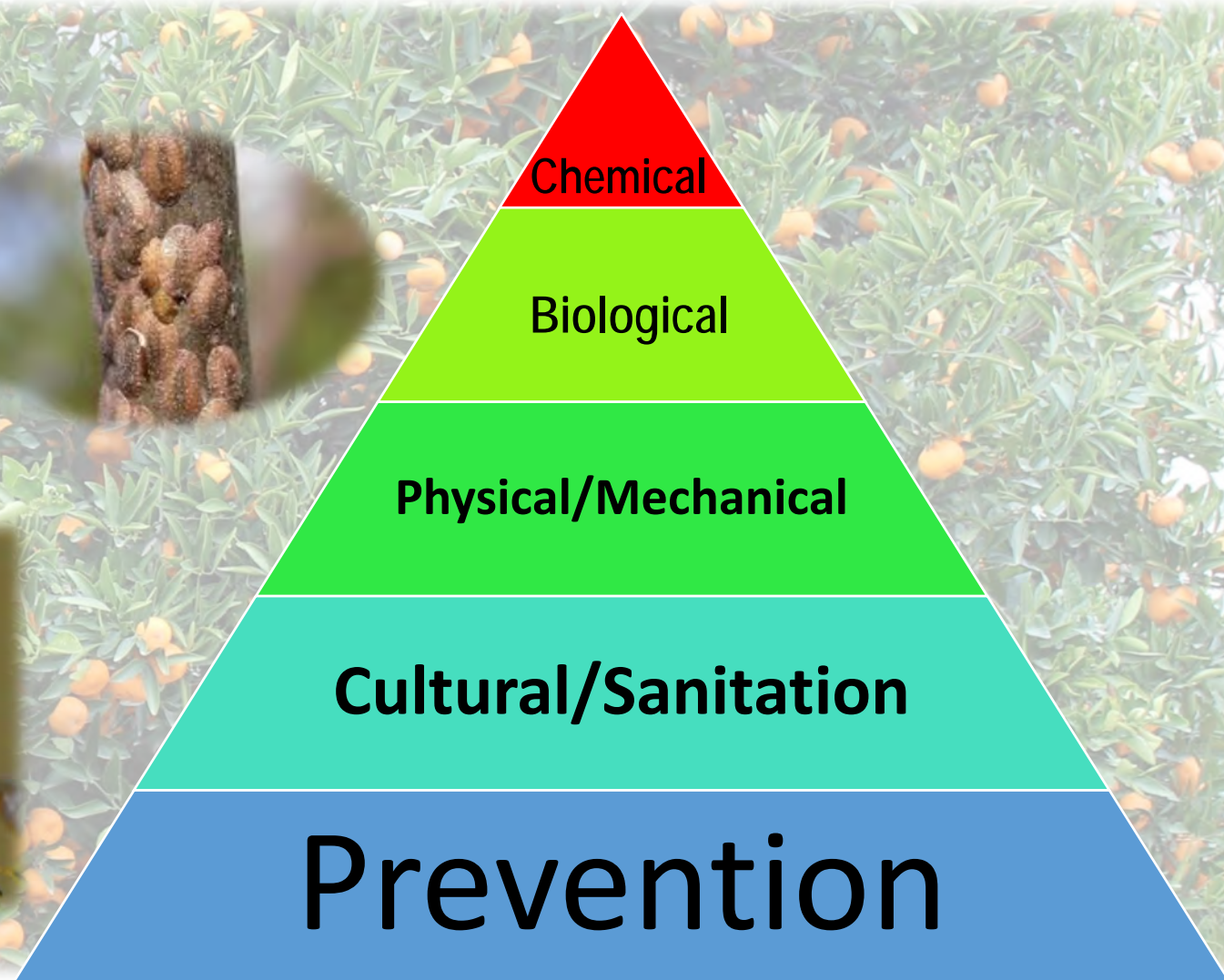
Date: August 11, 2022



Introduction

Need for general pesticide stewardship

Pesticide use remains inevitable in crop production, despite efforts to reduce their use via IPM.



Introduction

Spray Application in Trees and Vines

Airblast sprayers are most used sprayers in the San Joaquin Valley.



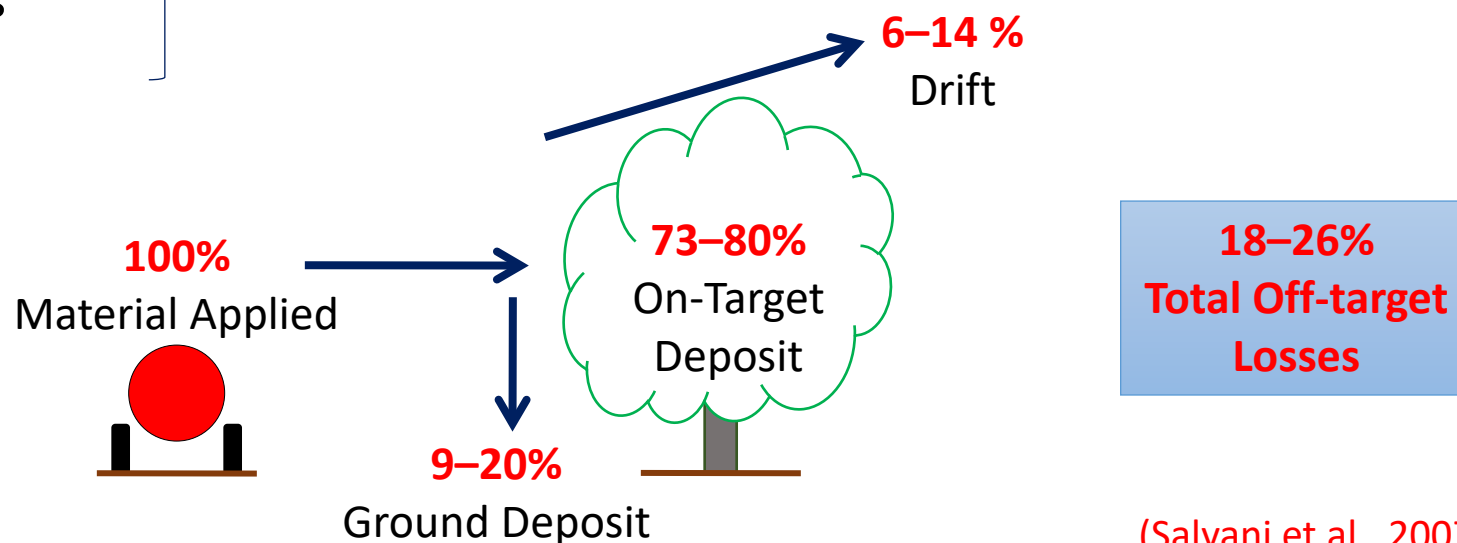
Introduction

Complex Nature of Spray Application

□ Lower than desired on-target spray deposition persistently occurs in citrus spray application due to several interacting factors

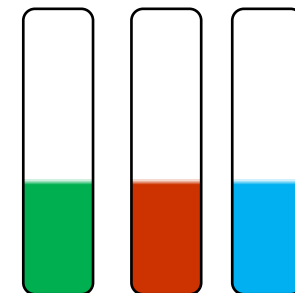
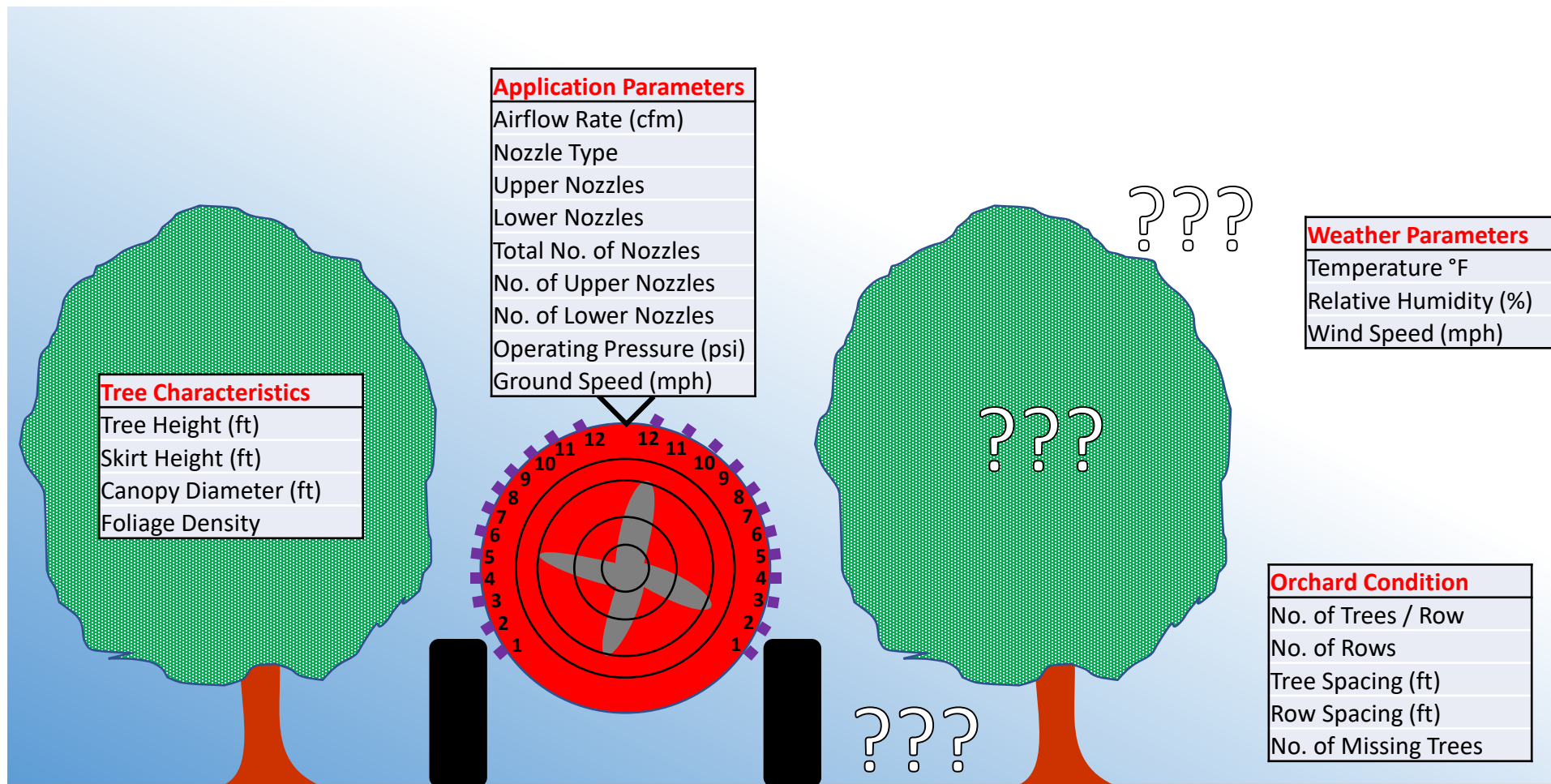
- equipment design
- application parameters
- spray physical properties
- tree characteristics
- weather condition

Complex interactions influence on-target spray deposition and off-target losses



Introduction

Daunting Task



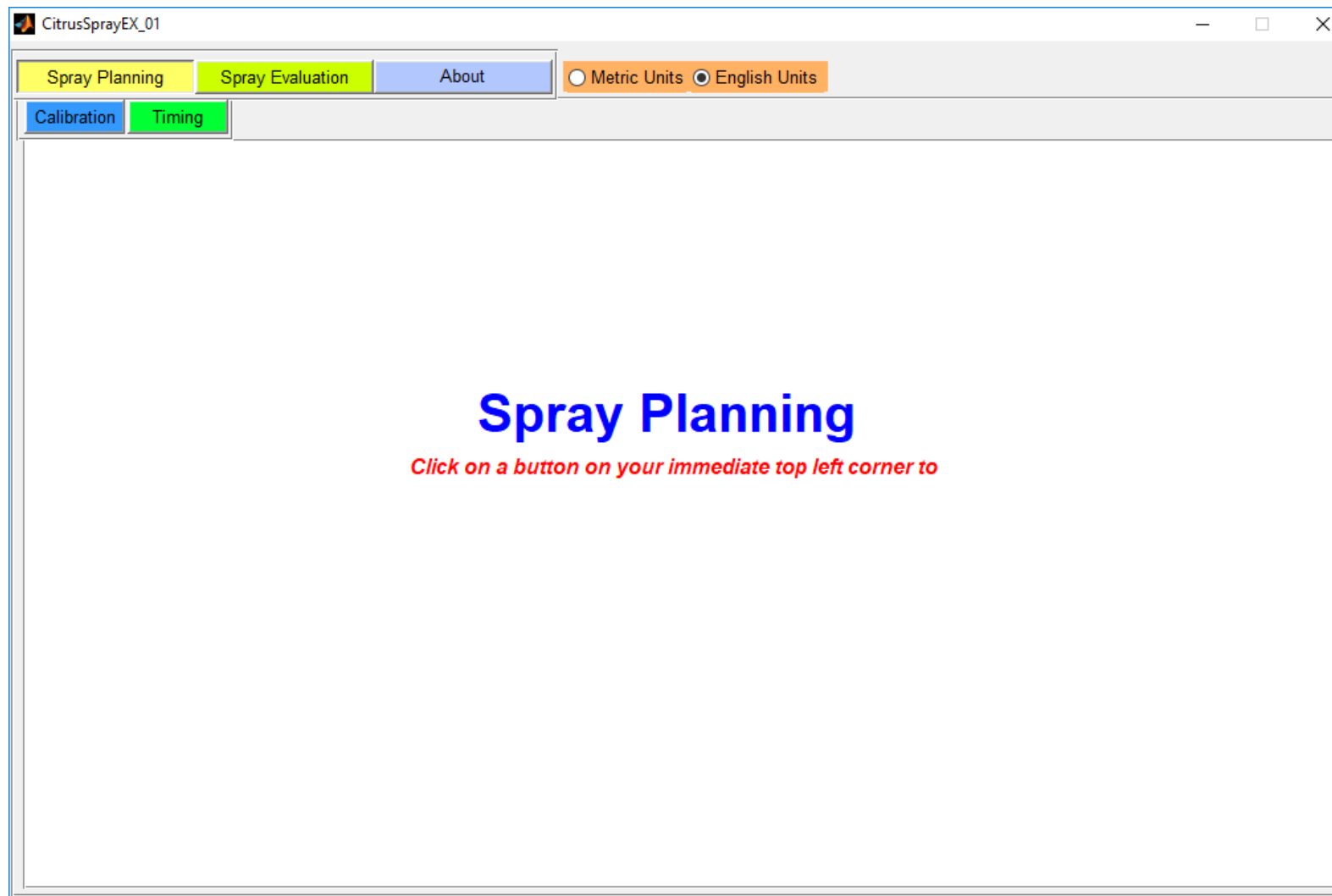
Introduction

Overview of CitrusSprayEx: Welcome Screen



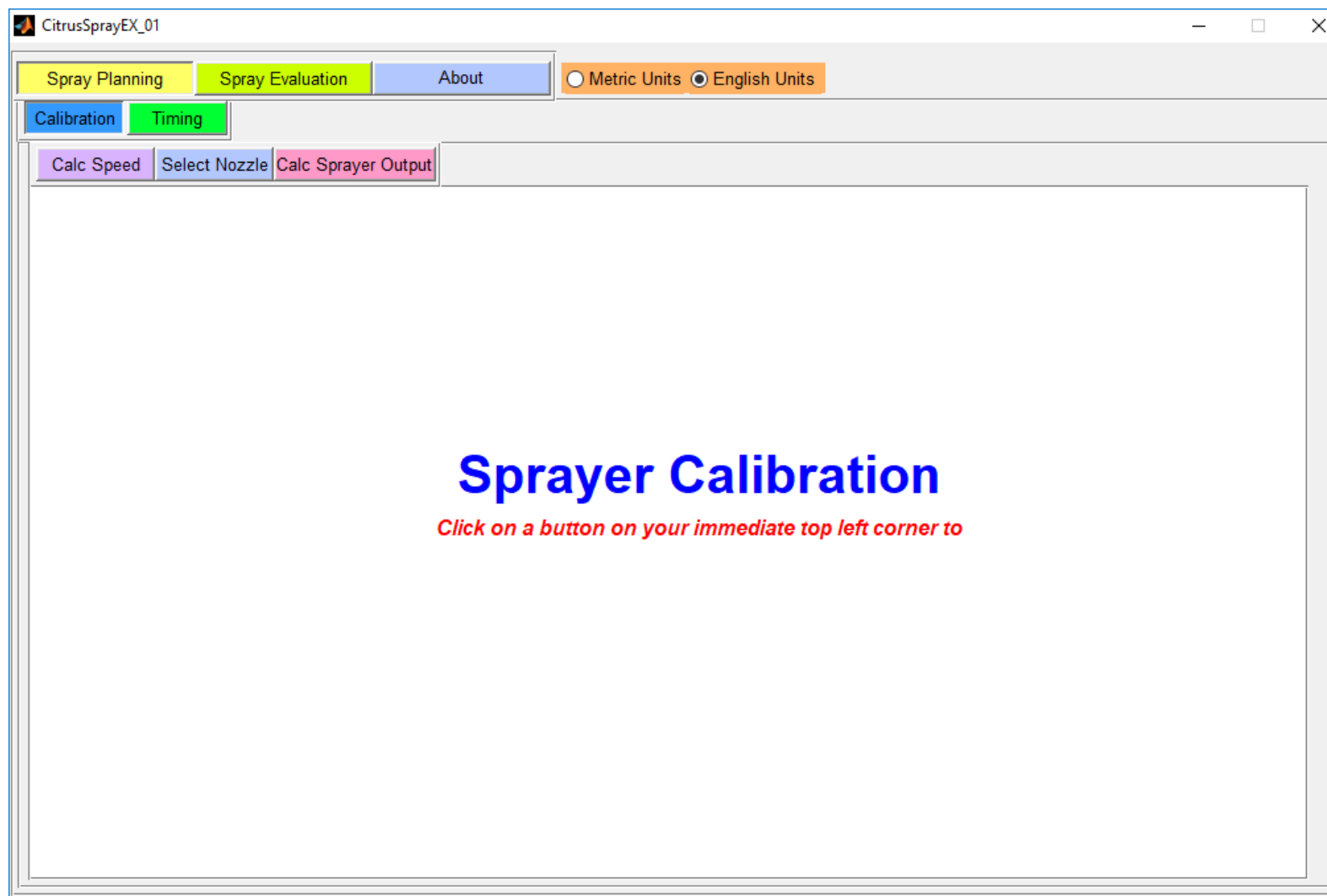
Introduction

Overview of CitrusSprayEx: **Spray Planning Front Screen**



Introduction

Overview of CitrusSprayEx: **Sprayer Calibration Front Screen**



Introduction

Overview of CitrusSprayEx: Speed Calculation Screen

CitrusSprayEX_01

Spray Planning | **Spray Evaluation** | About

Metric Units English Units

Calibration | **Timing**

Calc Speed | Select Nozzle | Calc Sprayer Output

Input

Select a method:

- Known Distance Method
- Trees Passed Method

Travel distance (ft):

Tree spacing (ft):

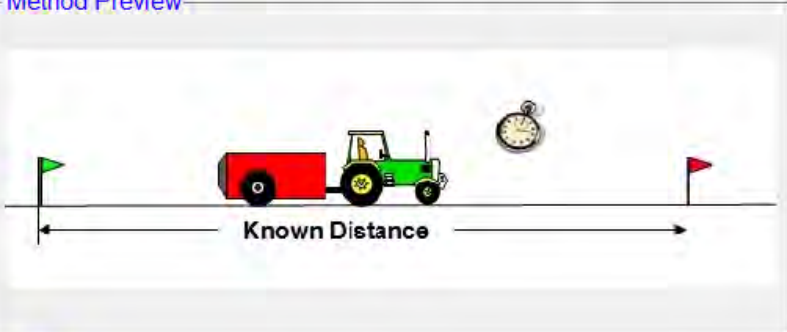
Number of trees passed:

Time spent (s):

Calculate

Note: It is important that the measurement be performed on a ground surface similar to the orchard condition. The sprayer should be hitched to the tractor and the sprayer tank should be about half full. If the sprayer is PTO-driven, then it must be run at the rated speed.

Method Preview



Output

Ground Speed = 1.5 mph

Introduction

Overview of CitrusSprayEx: Speed Calculation Screen

CitrusSprayEX_01

Spray Planning | **Spray Evaluation** | About

Metric Units English Units

Calibration | **Timing**

Calc Speed | Select Nozzle | Calc Sprayer Output

Input

Select a method:

- Known Distance Method
- Trees Passed Method

Travel distance (ft):

Tree spacing (ft):

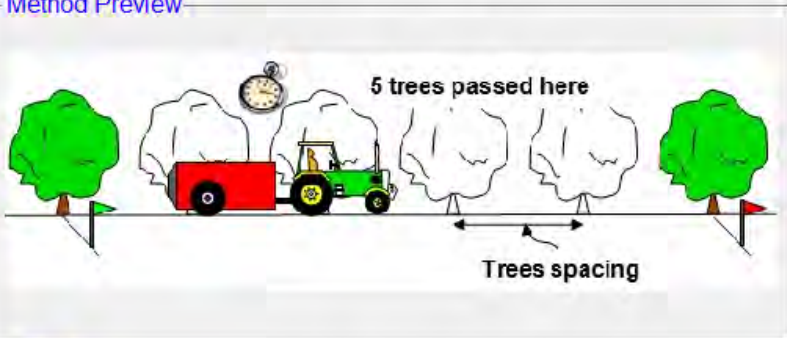
Number of trees passed:

Time spent (s):

Calculate

Note: It is important that the measurement be performed on a ground surface similar to the orchard condition. The sprayer should be hitched to the tractor and the sprayer tank should be about half full. If the sprayer is PTO-driven, then it must be run at the rated speed.

Method Preview



Output

Ground Speed = 2.0 mph

Introduction

Overview of CitrusSprayEx: Nozzle Selection Screen

CitrusSprayEX_01

Spray Planning | Spray Evaluation | About | Metric Units | English Units

Calibration | Timing

Calc Speed | Select Nozzle | Calc Sprayer Output

Input

Tank mix specific gravity:

Desired application rate (gpa):

Ground speed (mph):

Row spacing (ft):

Number of open nozzles per side:

Nozzle arrangement (Upper%-Lower%):

Uniform

Non-uniform (Ex. 65% - 35%)

Specify: Upper % - Lower %

Number of upper nozzles:

Number of lower nozzles:

Operating pressure (psi):

Output and Recommendation

>Desired sprayer tank mix output / side =4.0 gpm

>Required equivalent nozzle capacity (from nozzle chart) = 0.51 gpm

>Recommended TeeJet® nozzles = D2-46 (Use equivalent nozzles from other manufacturers)

Comparison

Desired sprayer tank mix flow rate / side = 4.0 gpm

Actual sprayer tank mix flow rate / side = 4.0 gpm

Maintain these settings since they give you the desired output.

Calculate | Compare | Report

Introduction

Overview of CitrusSprayEx: **Sprayer Output Calculation Screen**

The screenshot displays the CitrusSprayEX_01 application window. The interface includes a menu bar with 'Spray Planning', 'Spray Evaluation', and 'About'. Below this is a sub-menu with 'Calibration' and 'Timing'. The main area has three tabs: 'Calc Speed', 'Select Nozzle', and 'Calc Sprayer Output'. The 'Calc Sprayer Output' tab is active, showing an 'Input' section with radio buttons for 'Known area method' (sub-options: 'Actual area known', 'Row & tree spacing known') and 'Fixed position method' (selected). Below are input fields for 'Number of sides sprayed' (selected '2 Side'), 'Volume sprayed (gal):' (8.1), 'Spray time (s):' (60), 'Area covered (acre):', 'Tree spacing (ft):', 'Row spacing (ft):' (20), 'Number of Trees passed:', and 'Ground speed (mph):' (2). A 'Calculate' button is at the bottom. The 'Output' section shows 'Sprayer output per side = 4.0 gpm' and 'Application Rate = 100.2 gpa'. Explanatory text for 'Known Area Method' and 'Fixed Position Method' is also present.

Input

Select method: Known area method
 Actual area known
 Row & tree spacing known
 Fixed position method

Number of sides sprayed: 1 Side 2 Side

Volume sprayed (gal):

Spray time (s):

Area covered (acre):

Tree spacing (ft):

Row spacing (ft):

Number of Trees passed:

Ground speed (mph):

Output

Sprayer output per side = 4.0 gpm

Application Rate = 100.2 gpa

Known Area Method consists of determining the amount of the tank mix used to spray a known area.

Fixed Position Method consists of operating the sprayer in a fixed position and measuring the volume of the sprayed water for a specified time.

Calculate

Introduction

Overview of CitrusSprayEx: **Application Timing Screen**

The screenshot displays the CitrusSprayEX_01 application window. The interface includes a menu bar with 'Spray Planning', 'Spray Evaluation', and 'About' tabs. Below this, there are radio buttons for 'Metric Units' and 'English Units', with 'English Units' selected. A secondary menu bar contains 'Calibration' and 'Timing' tabs, with 'Timing' selected. The main content area is divided into three sections: 'Weather Conditions', 'Comments', and 'Explanation'. The 'Weather Conditions' section contains four input fields: Temperature (°F) with value 76, Relative Humidity (%) with value 62, Wind Speed with value 6, and Rain expected within 2 hours after spraying? [Y/N] with value 'y'. The 'Comments' section contains a text box with the message: 'Conditions are OK, but application is subject to rain washoff!!!'. The 'Explanation' section contains a text box with the message: 'Favourable condition to spray. However, rainfall within 2 hours of spray application might affect pesticide efficacy.'

Weather Conditions	
Temperature (°F):	76
Relative Humidity (%):	62
Wind Speed	6
Rain expected within 2 hours after spraying? [Y/N]	y

Comments

Conditions are OK, but application is subject to rain washoff!!!

Explanation

Favourable condition to spray. However, rainfall within 2 hours of spray application might affect pesticide efficacy.

Introduction

Overview of CitrusSprayEx: **Application Timing Screen**

The screenshot displays the CitrusSprayEX_01 application window. The interface includes a menu bar with 'Spray Planning', 'Spray Evaluation', and 'About' tabs. Below this, there are radio buttons for 'Metric Units' and 'English Units', with 'English Units' selected. A secondary menu bar contains 'Calibration' and 'Timing' tabs, with 'Timing' selected. The main content area is divided into three sections: 'Weather Conditions' with input fields for Temperature (85°F), Relative Humidity (48%), Wind Speed (4), and Rain expected within 2 hours after spraying? (n); 'Comments' with a text area containing 'Too dry!!!'; and 'Explanation' with a text area containing 'High potential for droplet evaporation.'

Weather Conditions	
Temperature (°F):	85
Relative Humidity (%):	48
Wind Speed	4
Rain expected within 2 hours after spraying? [Y/N]	n

Comments

Too dry!!!

Explanation

High potential for droplet evaporation.

Introduction

Overview of CitrusSprayEx: **Application Timing Screen**

The screenshot displays the CitrusSprayEX_01 application window. The interface includes a menu bar with 'Spray Planning', 'Spray Evaluation', and 'About'. Below this is a sub-menu with 'Calibration' and 'Timing'. The 'Timing' sub-menu is active, showing a 'Weather Conditions' section with input fields for Temperature (90°F), Relative Humidity (95%), Wind Speed (9), and Rain expected within 2 hours after spraying? (n). The 'Comments' section contains the text 'OK!!!'. The 'Explanation' section contains the text 'Favourable condition to spray.'

CitrusSprayEX_01

Spray Planning Spray Evaluation About Metric Units English Units

Calibration Timing

Weather Conditions

Temperature (°F): 90

Relative Humidity (%): 95

Wind Speed: 9

Rain expected within 2 hours after spraying? [Y/N]: n

Comments

OK!!!

Explanation

Favourable condition to spray.

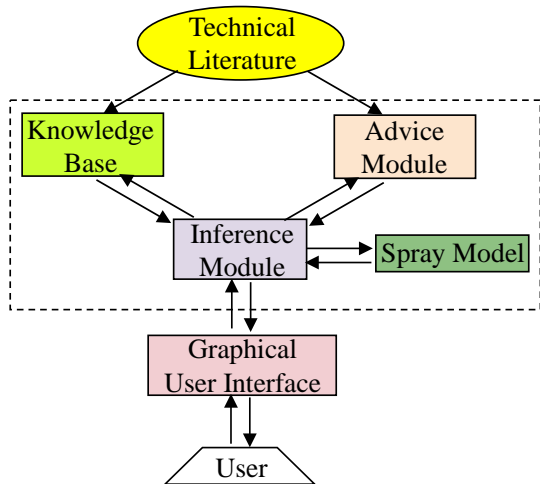
Introduction

Overview of CitrusSprayEx: **Spray Evaluation Screen**

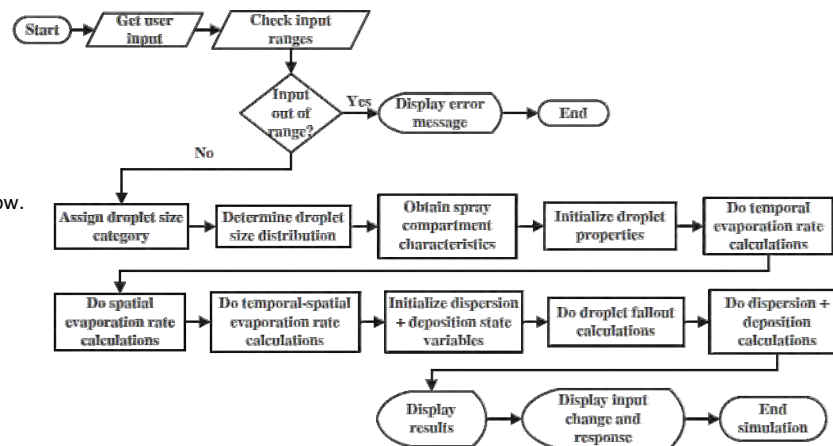
The screenshot shows the CitrusSprayEX_713 software interface. The 'Spray Evaluation' tab is active. The 'Simulation' section is divided into three sub-sections: 'Application Parameters', 'Orchard Condition', and 'Weather Parameters'. The 'Application Parameters' section includes fields for Sprayer make (a), Air outlet width (0.13), Air outlet length (1.45), Airflow Rate (20), Nozzle Type (Disc...), Upper/Lower nozzle (D3-25), No. of Open Nozzles/ Side (12), Upper/Lower (6), Operating Pressure (10), and Ground Speed (2.4). The 'Orchard Condition' section includes No. of Trees per Row (100), No. of Rows (20), Tree Spacing (4), Row Spacing (6), and No. of Missing Trees (0). The 'Weather Parameters' section is currently empty. The 'Tree Characteristics' section includes Mean Tree/Row Height (5), Skirt Height (0), Canopy Diameter (4), and Foliage Density (Med...). The 'Output' section shows 'Estimates: % Canopy Deposition', '% Ground Fallout', and '% Spray Drift'. The 'What-If Analysis' section displays results for a nozzle change from D4-45 to D2-23: Canopy deposition: 24 ---->> 62%, Ground deposition: 32 ---->> 2%, and Drift: 44 ---->> 36%. A 'Simulate' button is located at the bottom left. A progress dialog box is overlaid on the screen, displaying 'Spray deposition computations. Please wait...' and a red progress bar.

The basis of the spray evaluation section is the Larbi-Salyani airblast spray deposition model originally developed for citrus applications.

Model-based Expert System

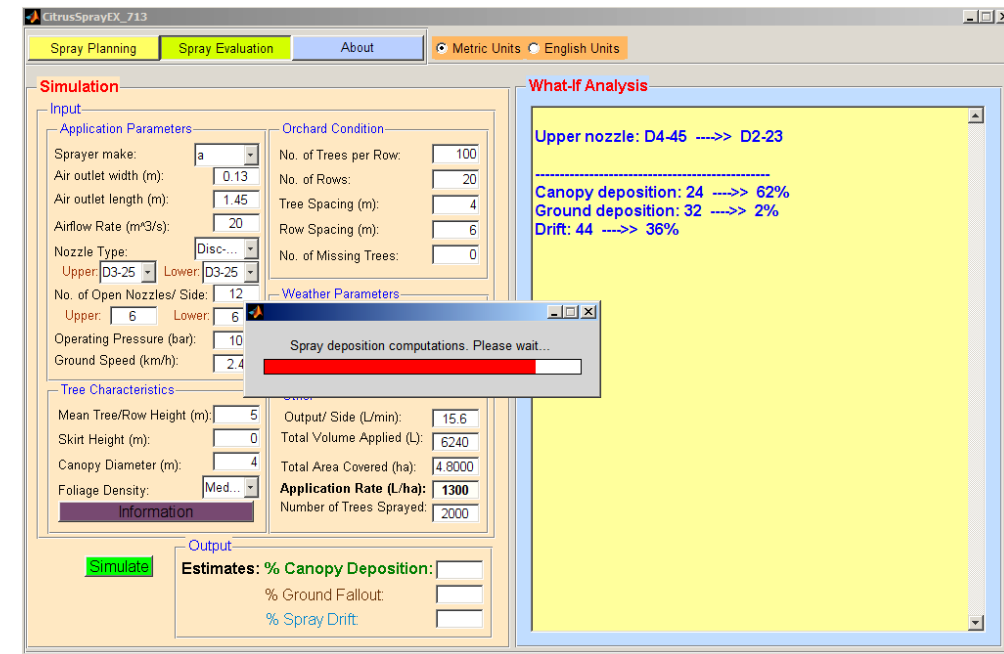


Structure of ES with arrows showing the direction of information flow.



Simplified flowchart for spray evaluation simulation

Source: Larbi, P.A. and M. Salyani. 2012c.



GUI for spray evaluation showing an ongoing simulation.

Table 6 Percentage of evaluation response for different ratings.^a

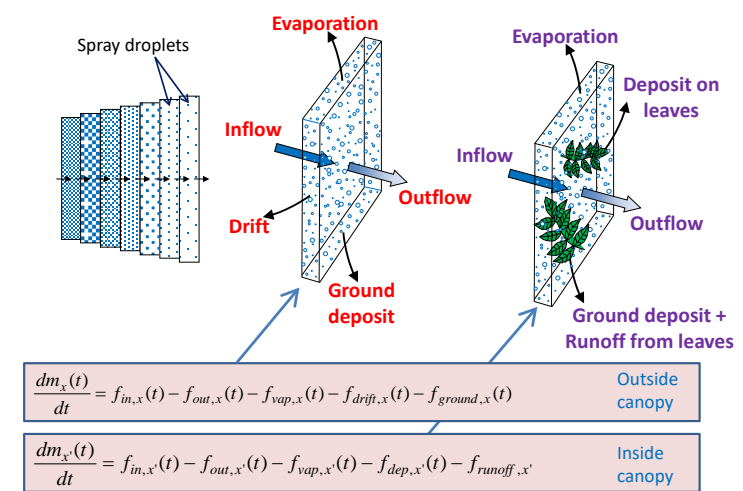
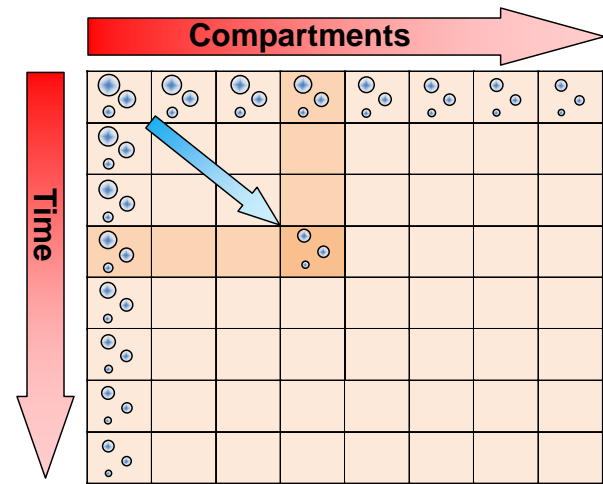
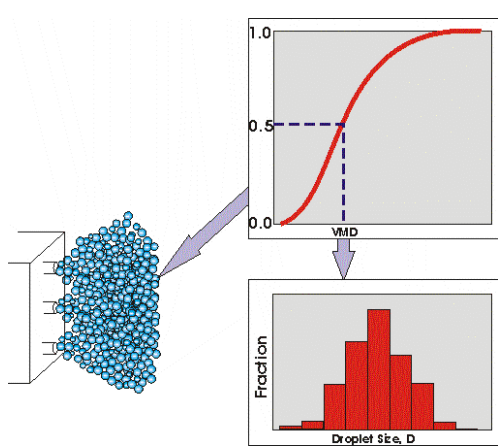
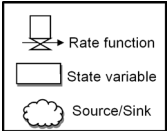
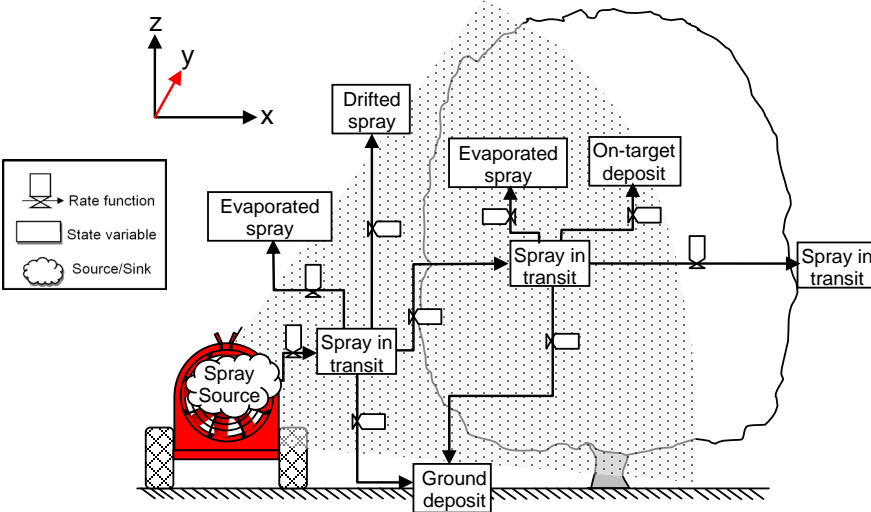
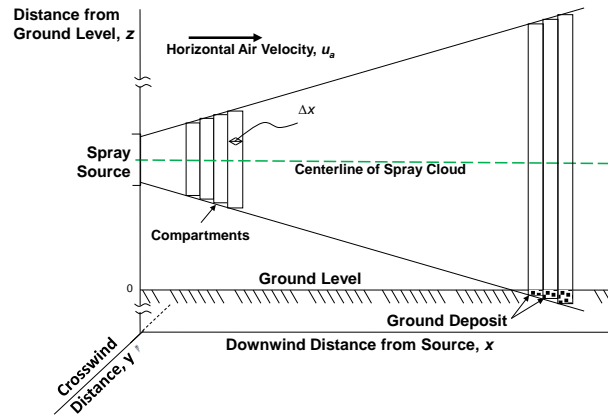
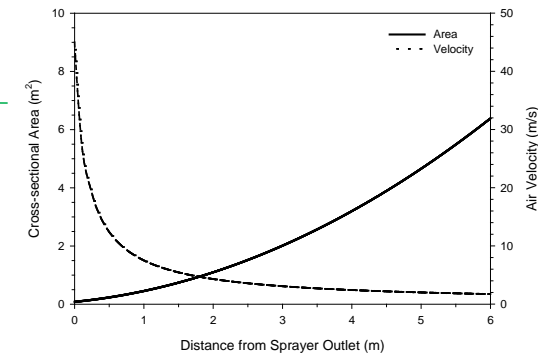
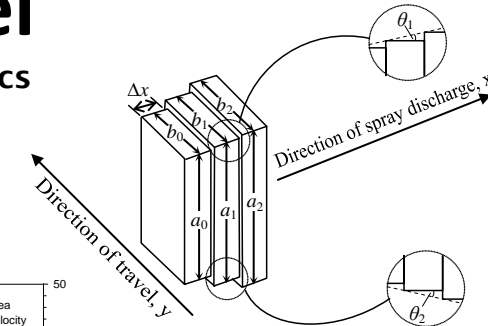
Category, %	Excellent, %	Very good, %	Good	Fair	Poor
ES content	80	20	0	0	0
Presentation	55	35	10	0	0
Effectiveness	30	70	0	0	0
User appeal & suitability	50	30	15	5	0
ES response	55	35	10	0	0
Ease of use	70	30	0	0	0
User interface and media quality	53	27	7	13	0

^a Based on all questions under each category.

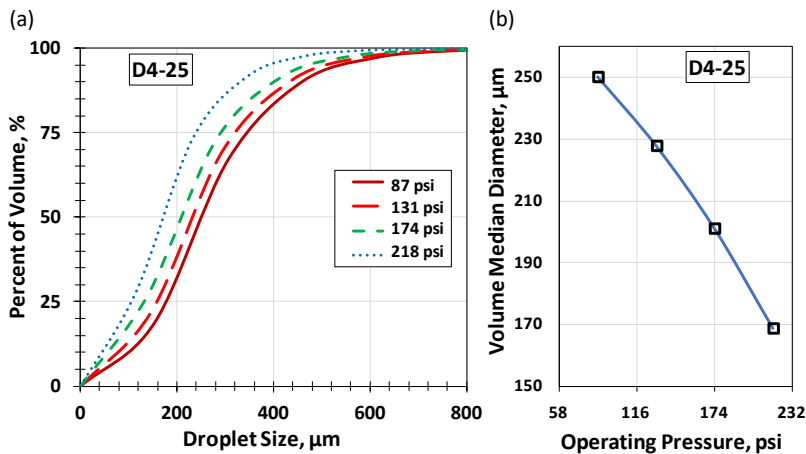
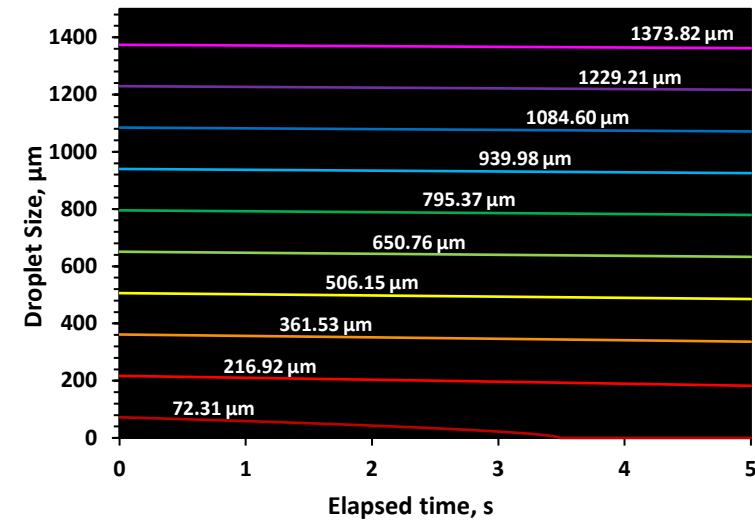
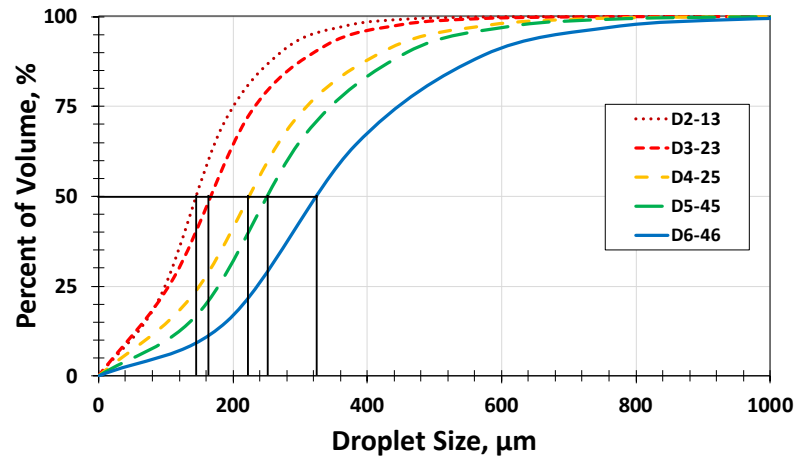
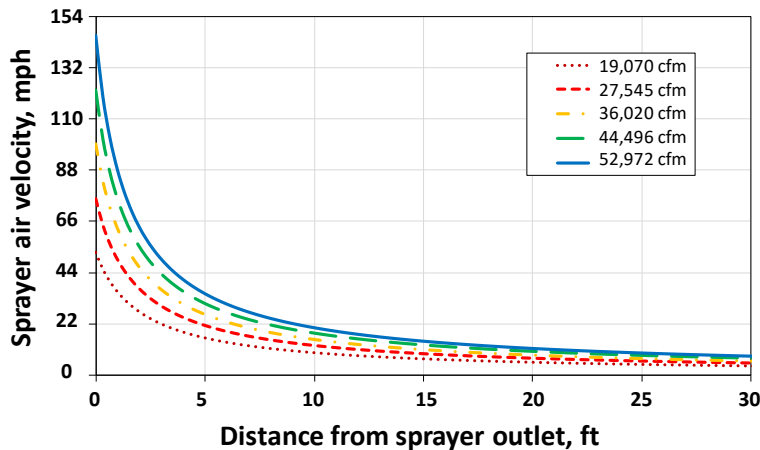
Larbi-Salyani Airblast Spray Deposition Model

Compartment Characteristics

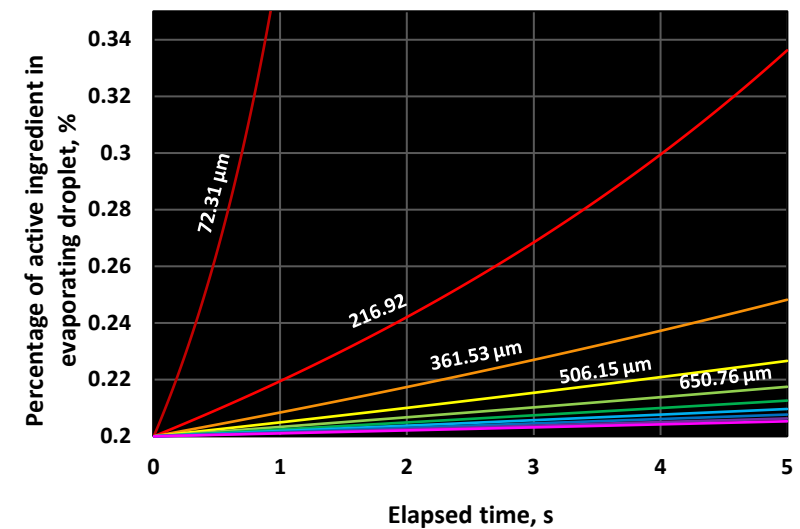
- Cross-sectional area
- Volume
- Air velocity



Spray Simulation



Nozzle	VMD (µm)	ASABE Droplet Category
D2-13	148.39	Very Fine to Fine
D3-23	166.33	Fine
D4-25	219.63	Fine to Medium
D5-45	252.32	Fine to Medium
D6-46	330.70	Medium to Coarse



Motivation

Need to increase agricultural sustainability
through improved productivity and environmental stewardship.

Opportunity to provide decision support to enable growers and pesticide applicators to recognize/use spray application best practices under normally complex field conditions.

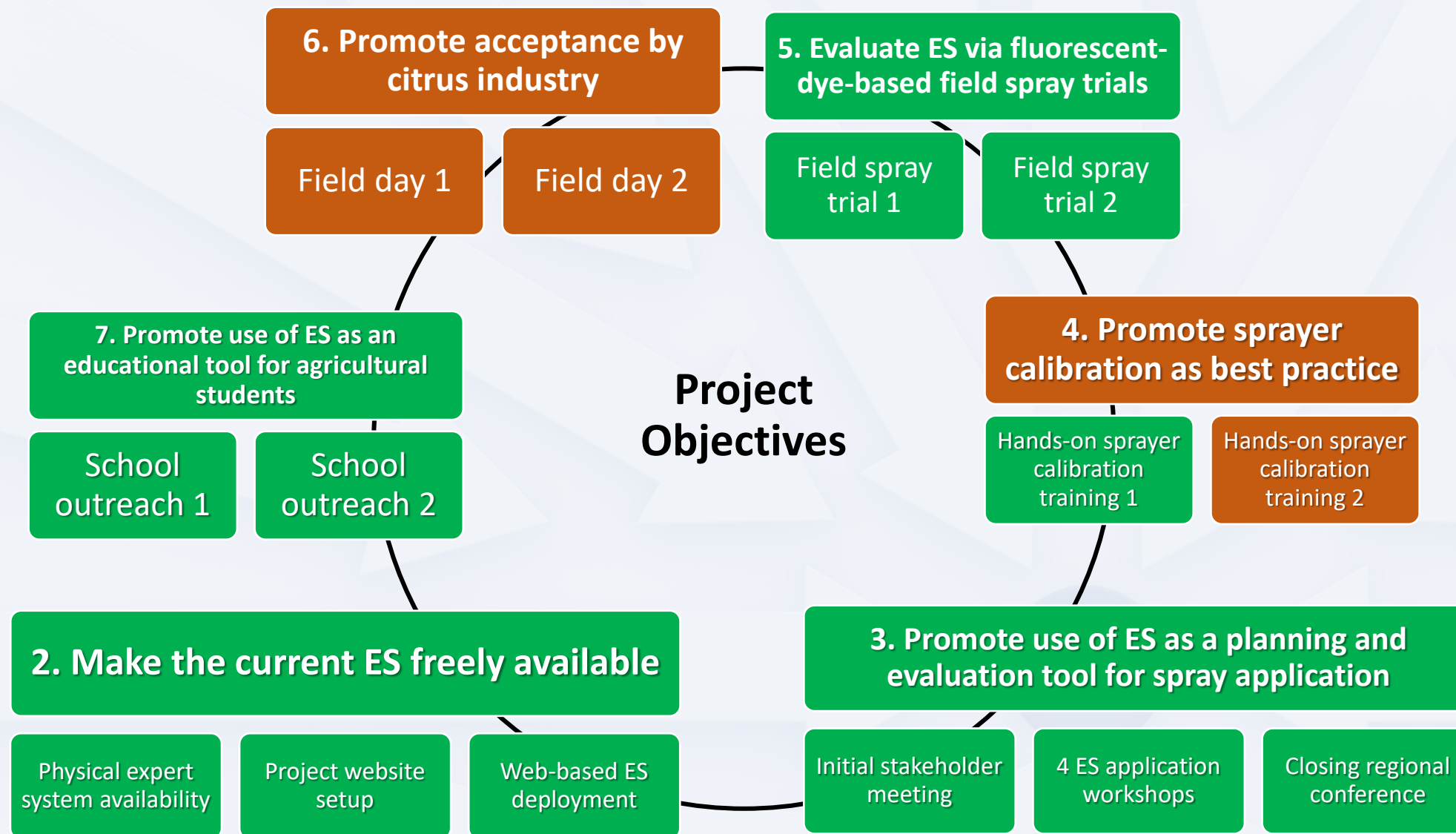
Goal

To improve pesticide spray application efficiency in citrus production and to reduce general pesticide use in the San Joaquin Valley region of California.

Specific and long term:

To cut the number of pesticide applications by ensuring effective pest control and reduced need for repeat applications through the adoption of the CitrusSprayEx expert system (ES) which guides growers and applicators in correct calibration, suitable application timing, and proper adaptation of application techniques in different situations.

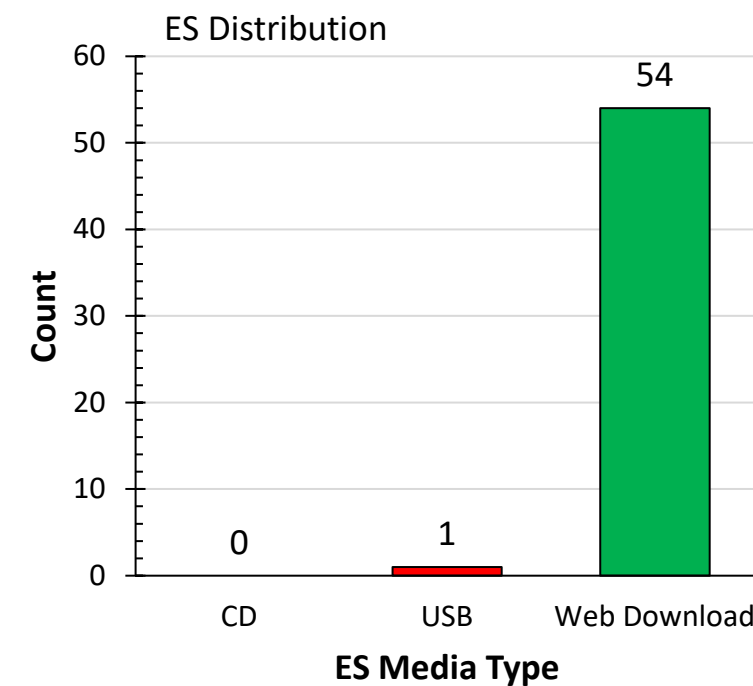
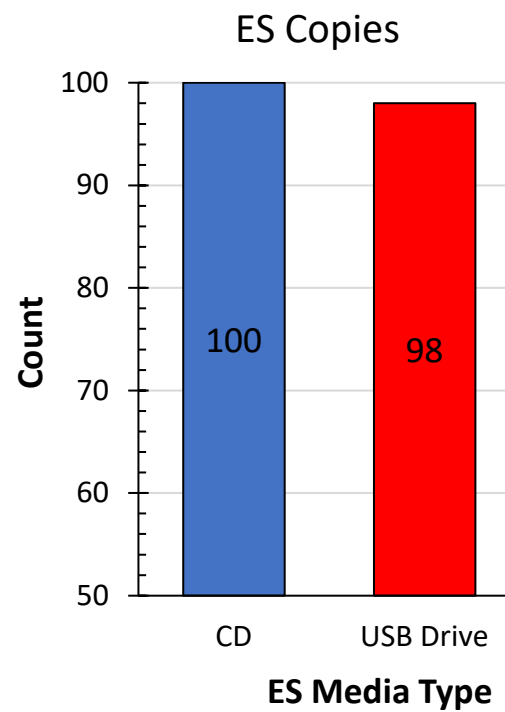
Measurable Project Objectives



Approach and Outcomes

2. Make the current ES freely available

Physical expert system
availability



Approach and Outcomes

2. Make the current ES freely available

Project website setup

The screenshot shows a web browser displaying the project website. The URL in the address bar is ucanr.edu/sites/CSEESDeploy/Project_Info/. The page header includes the University of California Agriculture and Natural Resources logo, a search bar, and a 'Give' button. The main heading is 'Dissemination and Training for Citrus Spray Application Expert System Adoption in California'. Below the heading is a banner image showing a citrus orchard, a tractor, and a large orange. A sidebar on the left contains links for 'Project Information', 'CitrusSprayEx Resources', 'Events', and 'Surveys'. The main content area is titled 'Project Information' and includes a 'Goal' section with text about improving pesticide spray application efficiency.

https://ucanr.edu/sites/CSEESDeploy/Project_Info/

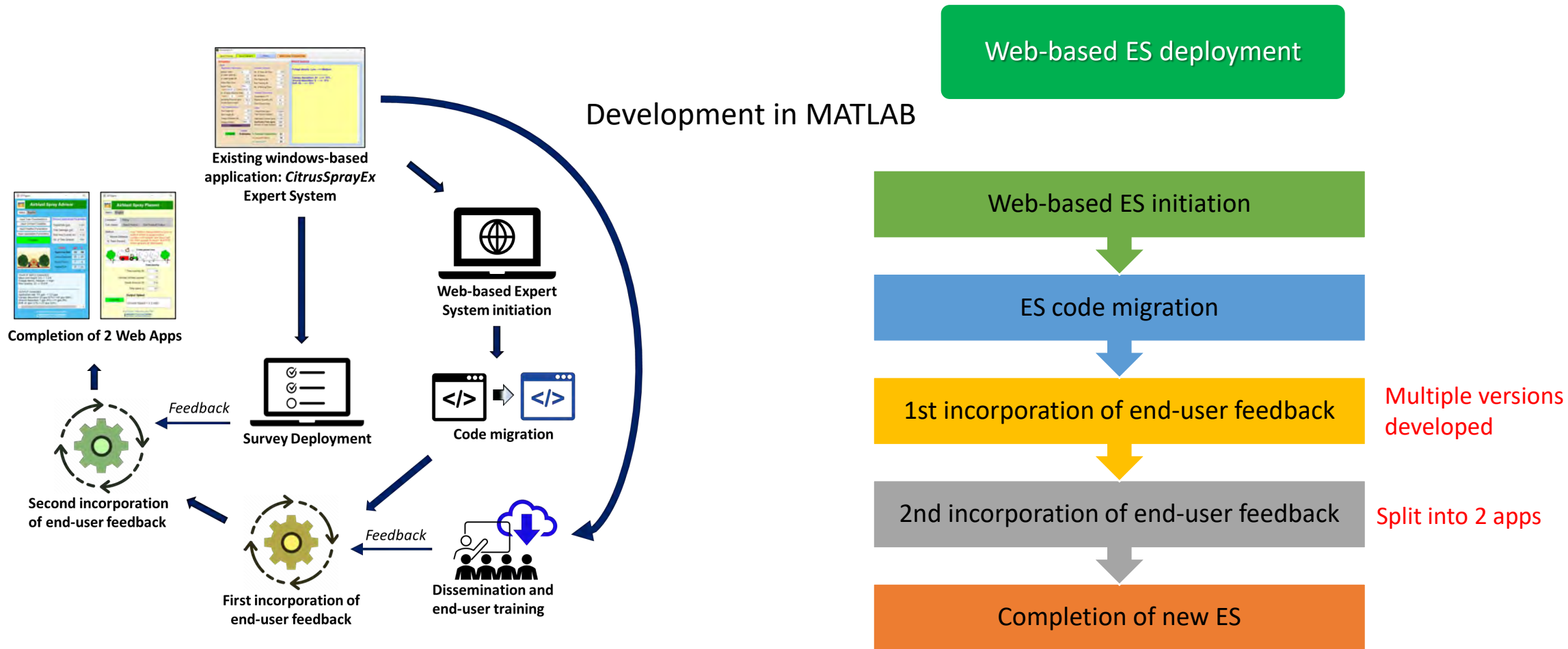
Or

<https://ucanr.edu/p/71771>



Approach and Outcomes

2. Make the current ES freely available



Flow diagram of airblast decision support web app development.

Approach and Outcomes

Web-based ES Deployment

CitrusSprayEX_01

Simulation

Input

Application Parameters

- Sprayer make: a
- Air outlet width (ft): 0.4
- Air outlet length (ft): 4.8
- Airflow Rate (cfm): 42378
- Nozzle Type: Disc...
- Upper: D5-23 Lower: D5-23
- No. of Open Nozzles/ Side: 12
- Upper: 6 Lower: 6
- Operating Pressure (psi): 145.0
- Ground Speed (mph): 1.5

Orchard Condition

- No. of Trees per Row: 100
- No. of Rows: 20
- Tree Spacing (ft): 13.1
- Row Spacing (ft): 19.7
- No. of Missing Trees: 0

Weather Parameters

- Temperature (°F): 77
- Relative Humidity (%): 60
- Wind Speed (mph): 2.2

Tree Characteristics

- Tree Height (ft): 16.4
- Skirt Height (ft): 0.0
- Canopy Diameter (ft): 13.1
- Foliage Density: Med...

Other

- Output/Side (gpm): 0.06684
- Total Volume Applied: 1592
- Total Area Covered (acre): 11.849
- Application Rate (gpa): 134
- Number of Trees Sprayed: 2000

Output

Estimates: % Canopy Deposition: 57
 % Ground Fallout: 10
 % Spray Drift: 33

What-If Analysis

Foliage density: Low ----> Medium

Canopy deposition: 41 ----> 57%
 Ground deposition: 9 ----> 10%
 Drift: 50 ----> 33%



Airblast Spray Advisor

Metric English

Input Tree Characteristics | Derived Application Parameters

Input Orchard Condition | Output/Side (gpm) 12.95

Input Weather Parameters | Total Gallonage (gal) 1475

Input Application Parameters | Total Area Covered (ac) 13.22

Simulate | No. of Trees Sprayed 1994

Output	gpa	%
Application Rate	111	100
Canopy Deposition	73	66
Ground Fallout	12	11
Potential Drift	26	23

WHAT-IF INPUT CHANGES:
 Mean skirt height: 0.0 --> 1.0 ft
 Foliage density: Medium --> High
 Row spacing: 19.7 --> 22.0 ft

OUTPUT CHANGES:
 Application rate: 124 gpa --> 111 gpa
 Canopy deposition: 69 gpa (56%) --> 73 gpa (66%)
 Ground deposition: 6 gpa (5%) --> 12 gpa (11%)
 Drift: 48 gpa (39%) --> 26 gpa (23%)

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Airblast Spray Planner

Metric English

Calibration | Timing

Calc Speed | Select Nozzle | Calc Sprayer Output

Method

Known Distance

Trees Passed

Note: Perform measurement on ground surface similar to target orchard condition with sprayer tank about half full. Hitch sprayer to tractor. Run PTO-driven sprayers at rated speed.

5 trees passed here

Trees spacing

Tree spacing (ft): 18

Number of trees passed: 12

Travel distance (ft): 216

Time spent (s): 67

Output Speed

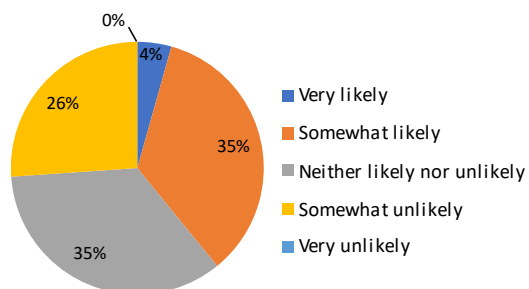
Ground Speed = 2.2 mph

Calculate

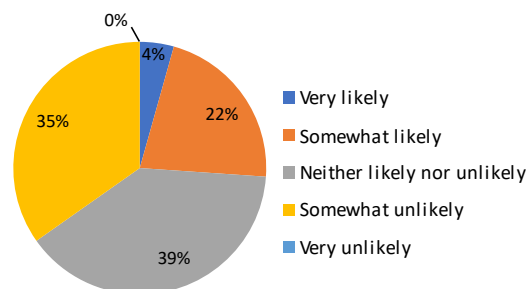
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Adoption Consideration

How likely are you to use the expert system (the current (CitrusSprayEx or an improved app) in your spray application planning and evaluation? (n=23)



How likely are you to recommend the use of the expert system (the current (CitrusSprayEx or an improved app) to others for their spray application planning and evaluation? (n=23)



<https://matlab.uckare.org/webapps/home/session.html?app=AirblastSprayAdvisor>
 Basic

<https://matlab.uckare.org/webapps/home/session.html?app=AirblastSprayPlanner>

Approach and Outcomes

Web-based ES Deployment

Input Tree Characteristics

Target Crop: Citrus

Mean Tree/Row Height (ft): 16.4

Skirt Height (ft): 0

Canopy Diameter (ft): 13.1

Foliage Density: Medium

Hide

Input Orchard Condition

Trees per Row: 100

Number of Rows: 20

Tree Spacing (ft): 13.1

Row spacing (ft): 19.7

Number of Missing Trees: 6

Hide

Input Weather Parameters

Air Temperature (°F): 77

Relative Humidity (%): 60

Wind Speed (mph): 2.2

Hide

Input Application Parameters

Sprayer: Rears Power Bla...

Rears Power Blast - PTO

Nozzle type/side: Dis... x 9

Upper: D4... x 5

Lower: D4... x 4

Operating pressure (psi): 145

Ground speed (mph): 2

Hide

UI Figure

Airblast Spray Advisor

Metric: English

Input Tree Characteristics

Input Orchard Condition

Input Weather Parameters

Input Application Parameters

Simulate

Derived Application Parameters

Output/Side (gpa)	0.041
Total Gallonage (gal)	1475
Total Area Covered (ac)	12.02
No. of Trees Sprayed	1994

Output

	gpa	%
Application Rate	123	100
Canopy Deposition	85	69
Ground Fallout	11	9
Potential Drift	27	22

WHAT-IF INPUT CHANGES:

Mean skirt height: 0.0 --> 1.0 ft

Foliage density: Medium --> High

Row spacing: 22 --> 20.0 ft

OUTPUT CHANGES

Application rate: 111 gpa --> 123 gpa

Canopy deposition: 63 gpa (57%) --> 85 gpa (69%)

Ground deposition: 7 gpa (6%) --> 11 gpa (9%)

Drift: 41 gpa (37%) --> 27 gpa (22%)

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Compatible with:

- PC
- Mac
- iPad
- iPhone
- Chromebook



Not Compatible with:

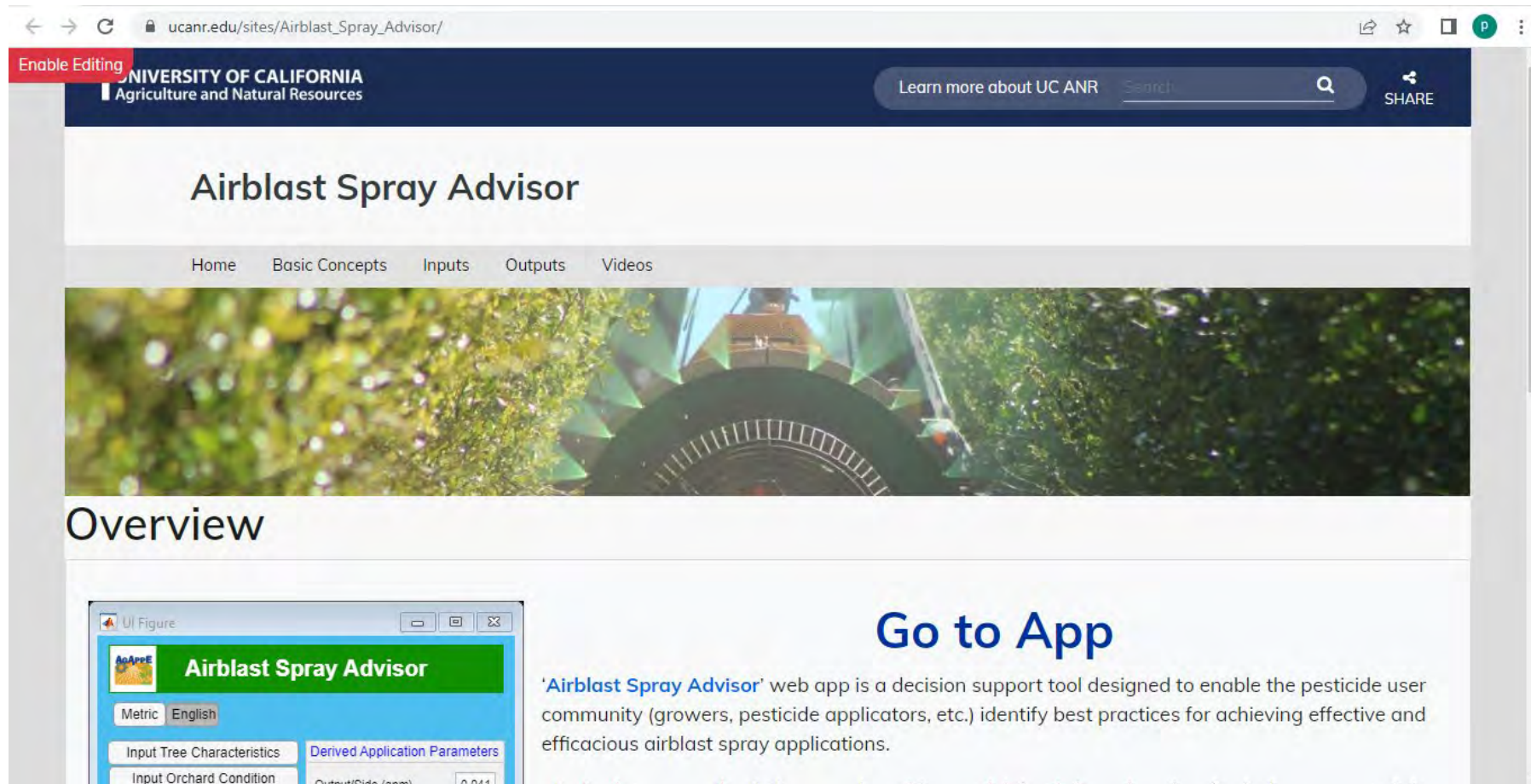
- Android



https://matlab.uckare.org/webapps/home/session.html?app=AirblastSprayAdvisor_Basic

Approach and Outcomes

Web-based ES Deployment



The screenshot shows a web browser window displaying the 'Airblast Spray Advisor' page. The browser address bar shows 'ucanr.edu/sites/Airblast_Spray_Advisor/'. The page header includes the University of California Agriculture and Natural Resources logo and a search bar. The main heading is 'Airblast Spray Advisor'. Below the heading is a navigation menu with links for 'Home', 'Basic Concepts', 'Inputs', 'Outputs', and 'Videos'. A large image of a green tractor with a spray boom is featured. Below the image is the 'Overview' section, which includes a 'Go to App' button and a description of the web app as a decision support tool for pesticide users. A small inset image shows the application's user interface with various input fields and a 'Go to App' button.



https://ucanr.edu/sites/Airblast_Spray_Advisor/ OR <https://ucanr.edu/p/71771>



University of California

Agriculture and Natural Resources

Agricultural Application Engineering Program



Approach and Outcomes

3. Promote use of ES as a planning and evaluation tool for spray application

Initial stakeholder meeting

A 2-hour information session on CitrusSprayEx Expert System and project overview.

Date: March 13, 2020

Format: Virtual via Zoom

Access: Open to Public

CEU Approved: 1.5 other CEU

Registered: 41

Attended: 19

Received CEU credits: 9

Discussion:

What other aspects do you think the project should have focused on? What other activities/tasks do you think the project should have included? Any other comments on how this project could better serve industry need?

Feedback:

1. Overall, project goals and tasks are reasonable and adequate.
2. Availability and application of the CitrusSprayEx expert system are practical and would be beneficial to the end users.
3. Number of inputs required is overwhelming and could be simplified or the expert system should be presented in a modular format tailored to different audiences. This feedback was considered in further development a new web-based, mobile-friendly expert system.

Approach and Outcomes

3. Promote use of ES as a planning and evaluation tool for spray application

4 ES application workshops

All events were virtual and open to the public.

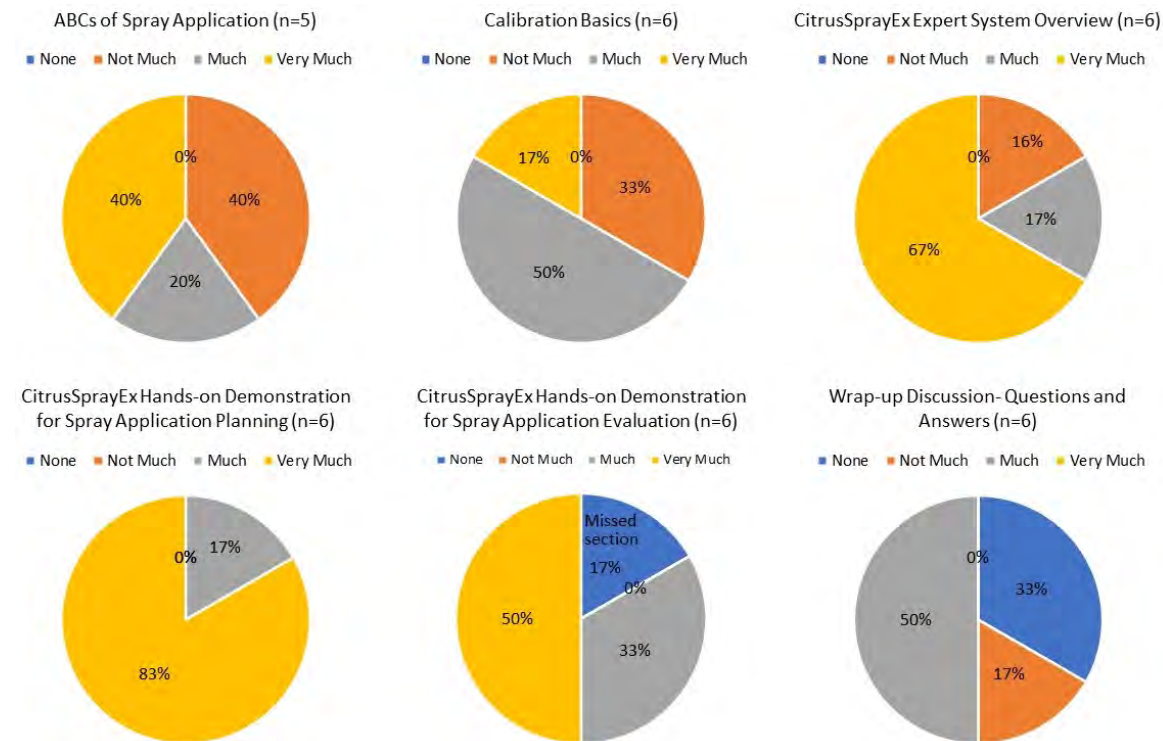
Date	CitrusSprayEx Application Workshop		Airblast Spray Application Web App Webinar	
	4/23-24, 2020	6/18-19, 2020	3/11/2021	3/11/2022
CEU Approved	5.5		2.0	
# Registered		7	77	24
# Attended:	11	3	52	6
# Receiv'g CEUs	12		15	1

Feedback (sample comments):

- “The application needs to be easier to use.”
- “It was very educational, simple and user friendly.”
- “We have been waiting for a program like this. Maybe one also for ground spraying.”
- “Very good coverage of the basics and the new program. Making it web based would be a good improvement”
- “Excellent exercise”

Question	Response		
Marketing (n=7)	Email (14%)	CDPR Website (14%)	Colleague (72%)
Expectations (n=6)	Learn all (33%)	Learn CitrusSprayEx (50%)	CEU (17%)

How much new information did you learn from these topics?



Approach and Outcomes

3. Promote use of ES as a planning and evaluation tool for spray application

Closing regional conference

A 3-day conference; May 16 to 18, 2022; Featured a welcome address by Dr. Glenda Humiston, Vice President, UCANR and Closing Remarks by Dr. Fadi Fathallah, Professor and Chair, Department of Biological and Agricultural Engineering, UC Davis:

- 10 sessions
- 10 moderators
- 3 keynote talks
- 25 technical talks
- 4 panels
- 21 technical speakers
- 15 panel speakers
- 3 concept videos: <https://ucanr.edu/sites/ASAM/Resources/>
- 17 DPR continuing education units
- 10 countries in participation (including United States)
- 75 registered
- 66 participants
- 20, 23, and 29 took final exam for days 1, 2, and 3, respectively

Approach and Outcomes

4. Promote sprayer calibration as a best practice

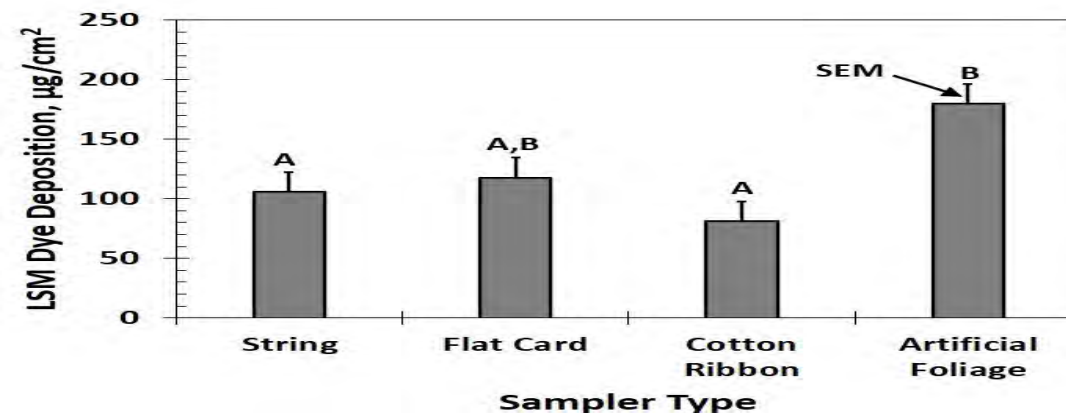
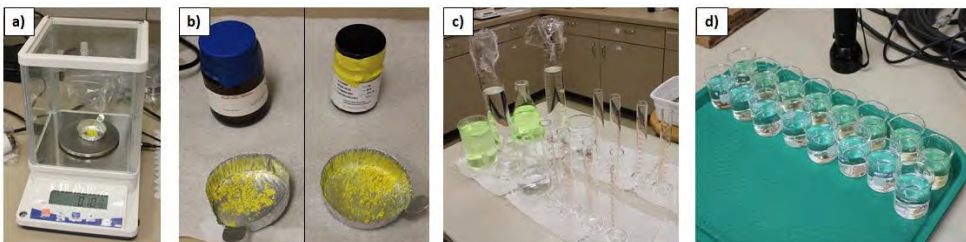
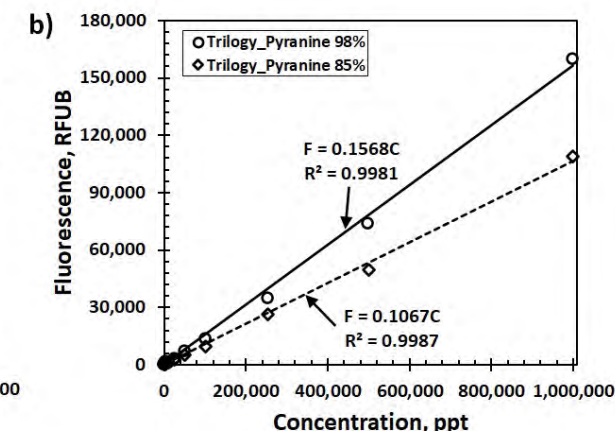
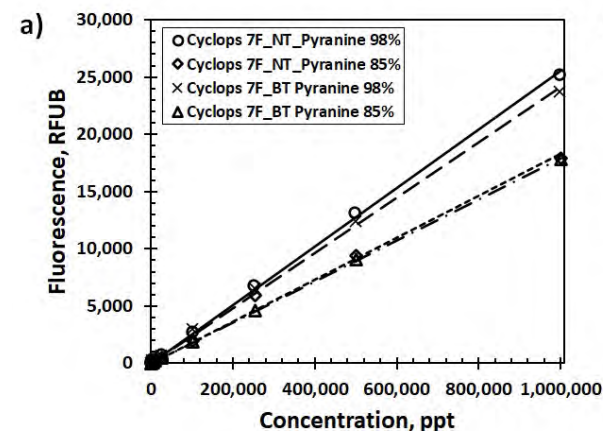
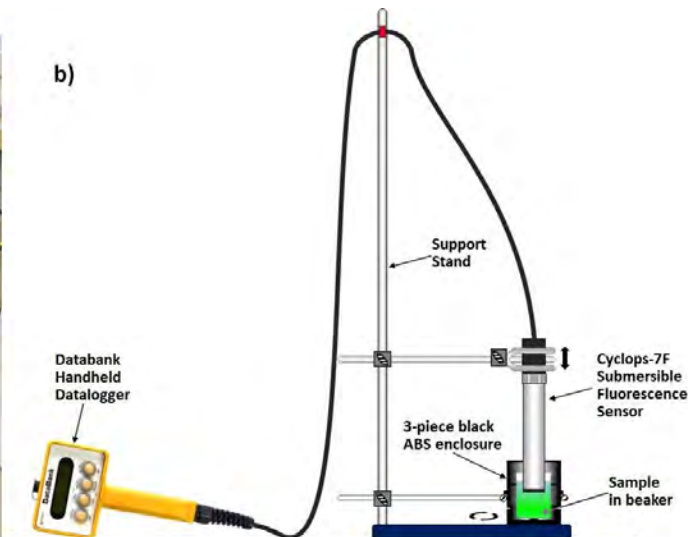
Hands-on sprayer calibration training 1

Hands-on sprayer calibration training 2

Sprayer calibration as a best practice was promoted in a hands-on calibration exercise that was recorded and presented virtually. A calibration training package is under development.

Approach and Outcomes

5. Evaluate ES via fluorescent-dye-based field spray trials



P. A. Larbi, "Configuration and Assessment of a Submersible Fluorometer for Evaluating Fluorescent Dye Deposition," Journal of Testing and Evaluation 50, no. 3 (May/June 2022): 1286–1298. <https://doi.org/10.1520/JTE20210617>

Approach and Outcomes

5. Evaluate ES via fluorescent-dye-based field spray trials

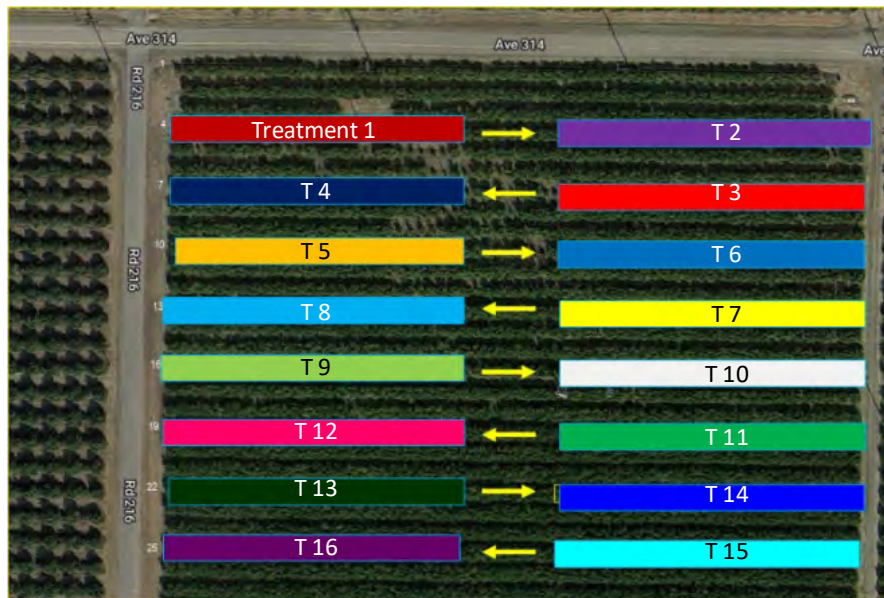
Field spray trial 1

Field spray trial 2

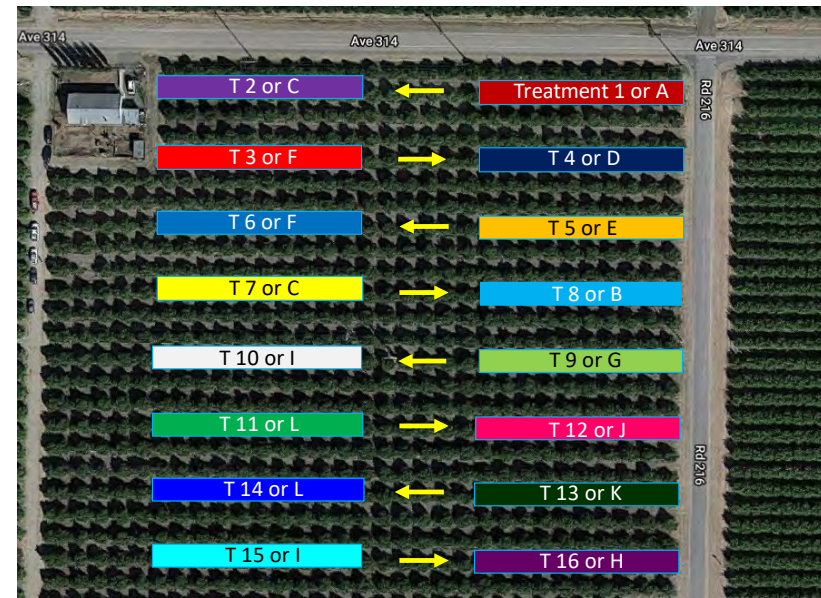
Settings	Fan Speed (F)	Travel Speed (S)	Nozzle Size (N)	Nozzle Row (NR)
Initial settings	1	1	1	1
Change Nozzle Row	1	1	1	2**
Change Travel Speed	1	2**	1	2
Change Nozzle Row	1	2	1	1**
Change Nozzle size	1	2	2**	1
Change Nozzle Row	1	2	2	2**
Change Travel Speed	1	1**	2	2
Change Nozzle Row	1	1	2	1**
Change Fan Speed	2**	1	1	1
Change Nozzle Row	2	1	1	2**
Change Travel Speed	2	2**	1	2
Change Nozzle Row	2	2	1	1**
Change Nozzle size	2	2	2**	1
Change Nozzle Row	2	2	2	2**
Change Travel Speed	2	1**	2	2
Change Nozzle Row	2	1	2	1**

** - Change

16 trials total



12 trials total

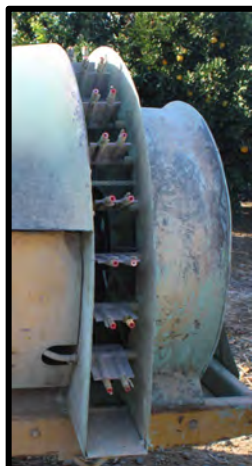


Approach and Outcomes

5. Evaluate ES via fluorescent-dye-based field spray trials

Field spray trial 1

& Field spray trial 2



Approach and Outcomes

5. Evaluate ES via fluorescent-dye-based field spray trials

Field spray trial 1

&

Field spray trial 2

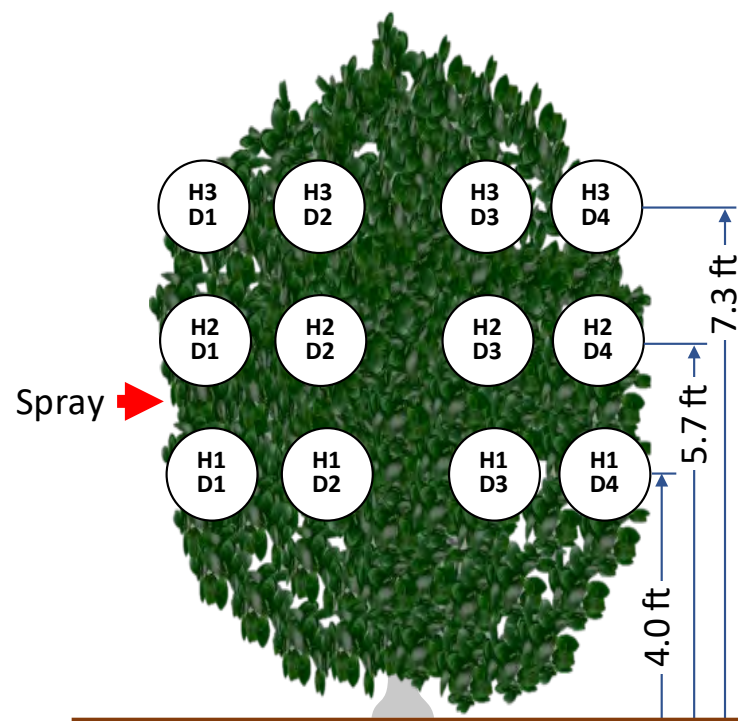


Fig 3. Schematic of sprayed leaf sampling locations (H – height; D – depth) in target canopy.

A total of 576 leaf samples (i.e., 3 canopy heights x 4 canopy depths x 16 treatments x 3 replications) were analyzed by fluorometry together with sprayer tank samples.

Following the fluorometric analysis, total area of each leaf sample was also obtained using a leaf area meter after the leaves were padded dry using paper towels.

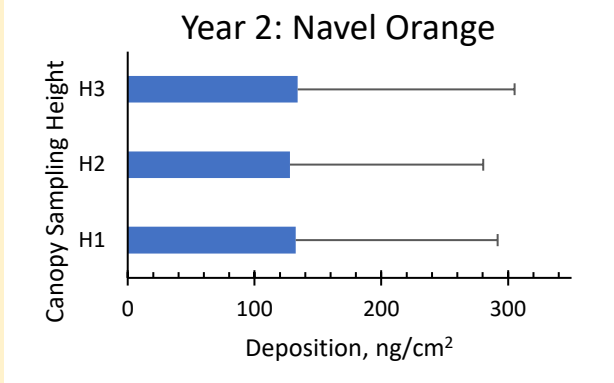
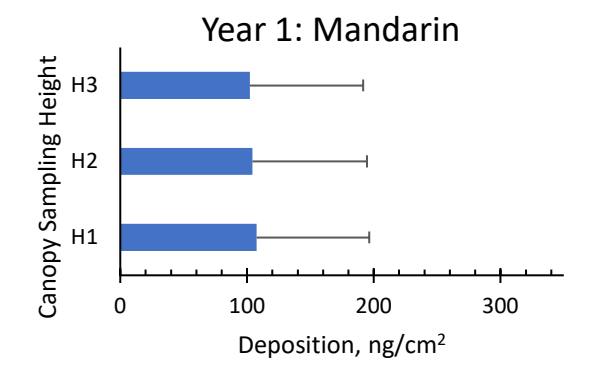
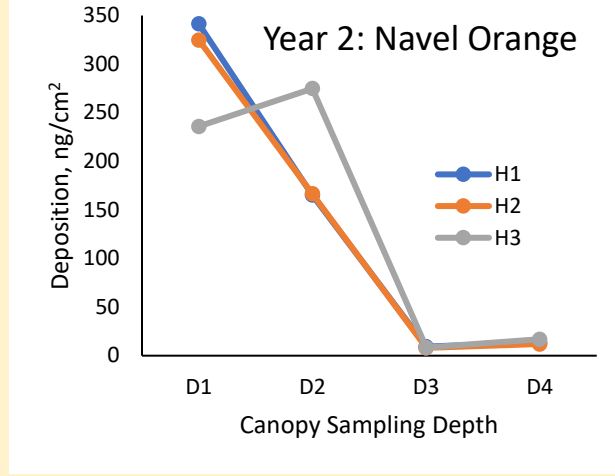
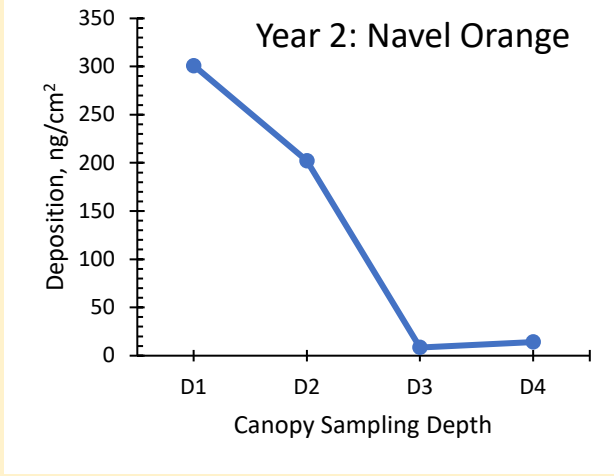
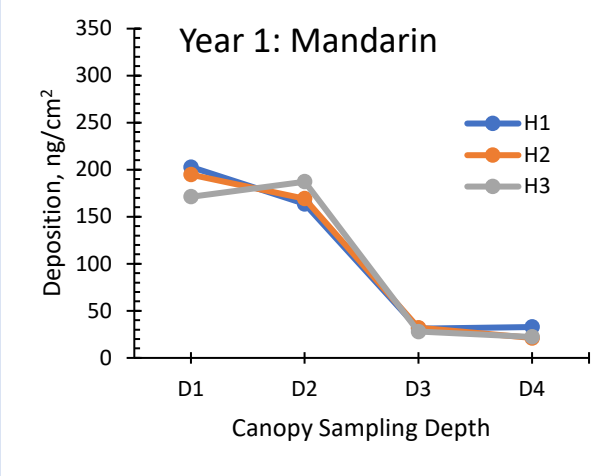
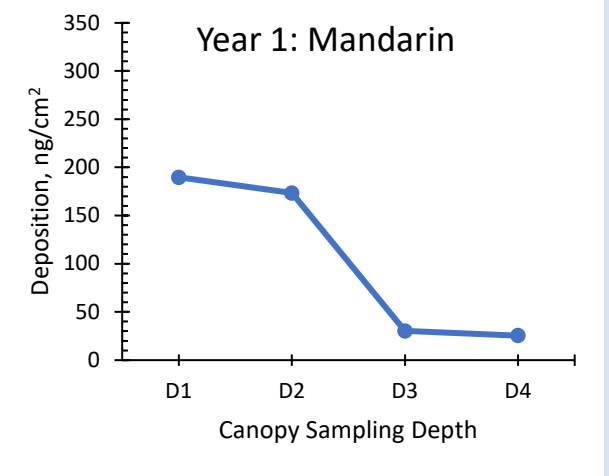


Approach and Outcomes

5. Evaluate ES via fluorescent-dye-based field spray trials

Field spray trial 1

Field spray trial 2

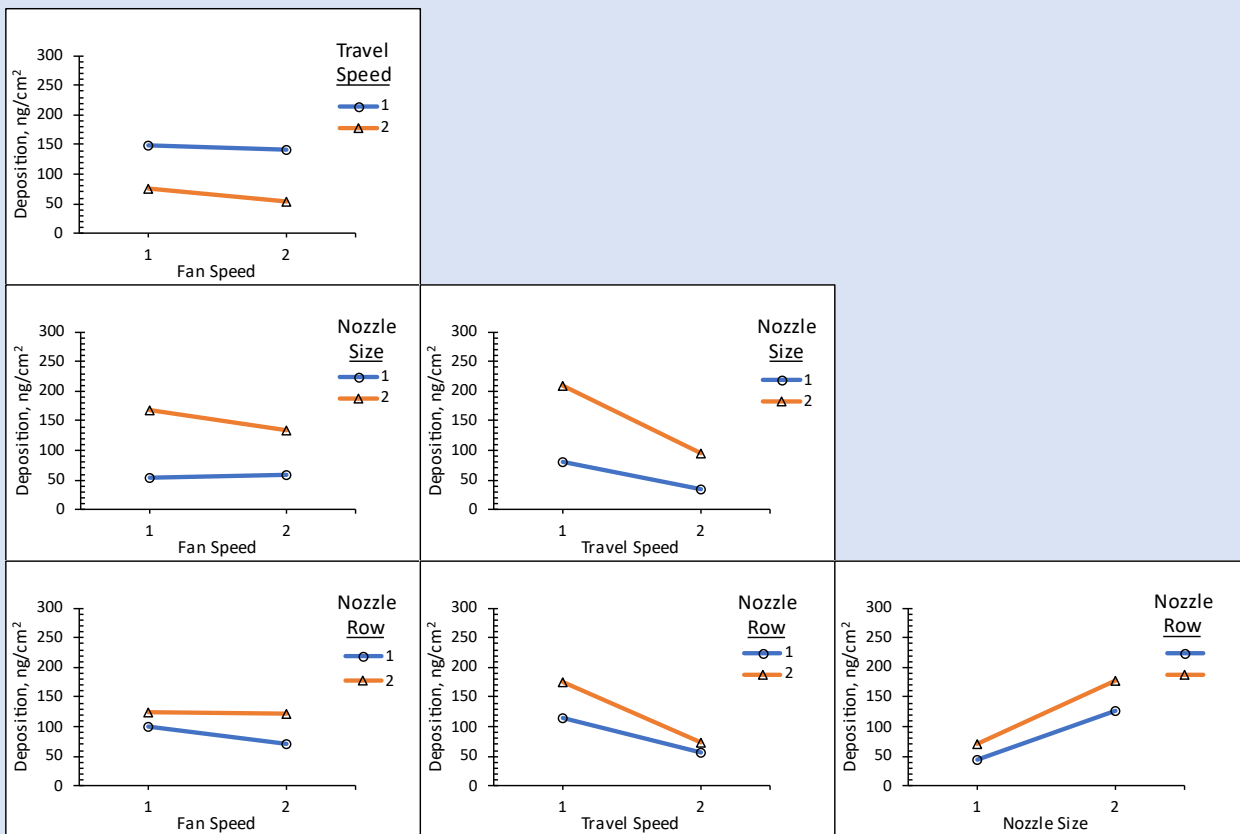


Approach and Outcomes

5. Evaluate ES via fluorescent-dye-based field spray trials

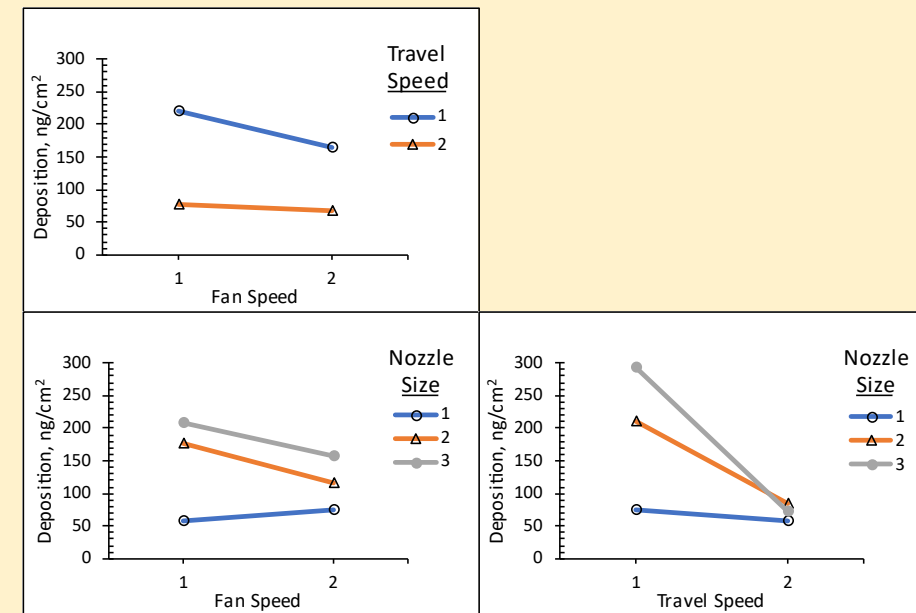
Field spray trial 1

Year 1: Mandarin Canopy Deposition



Field spray trial 2

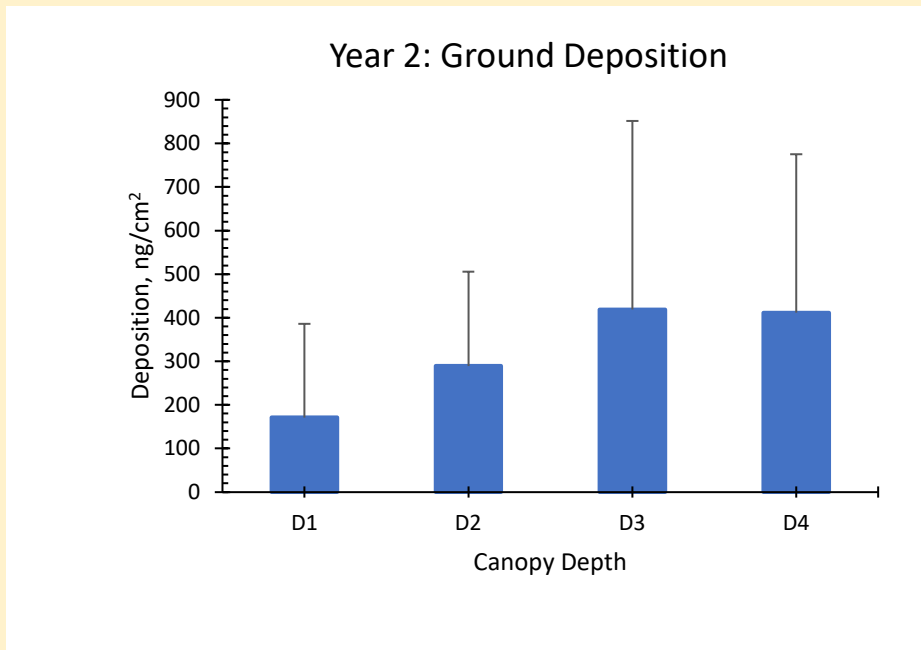
Year 2: Navel Orange Canopy Deposition



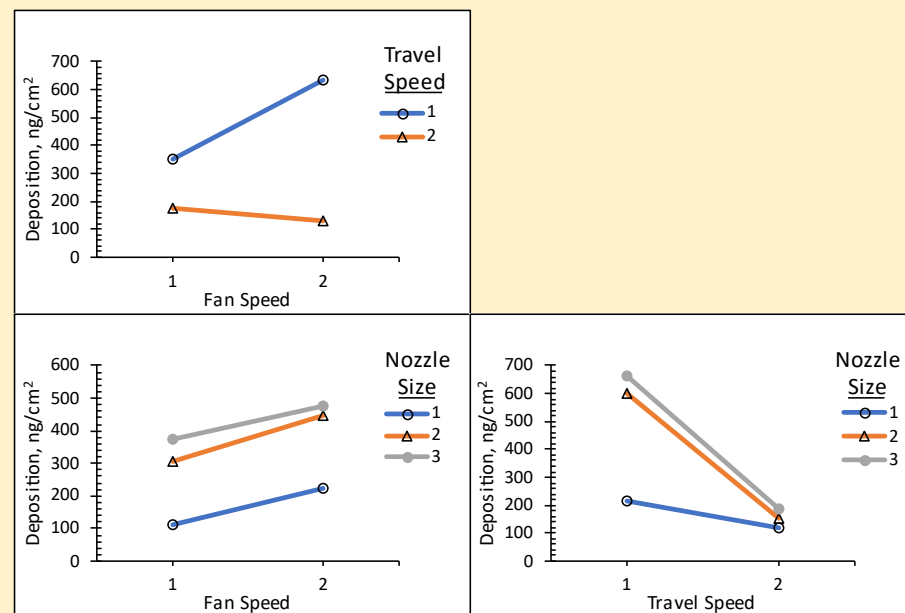
Approach and Outcomes

5. Evaluate ES via fluorescent-dye-based field spray trials

Field spray trial 2



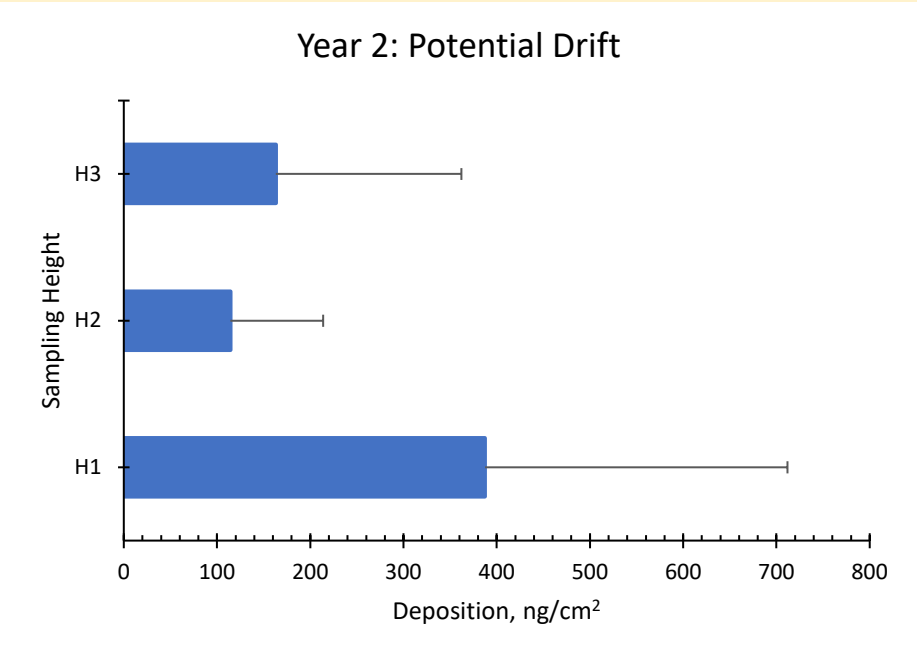
Year 2: Navel Orange Ground Deposition



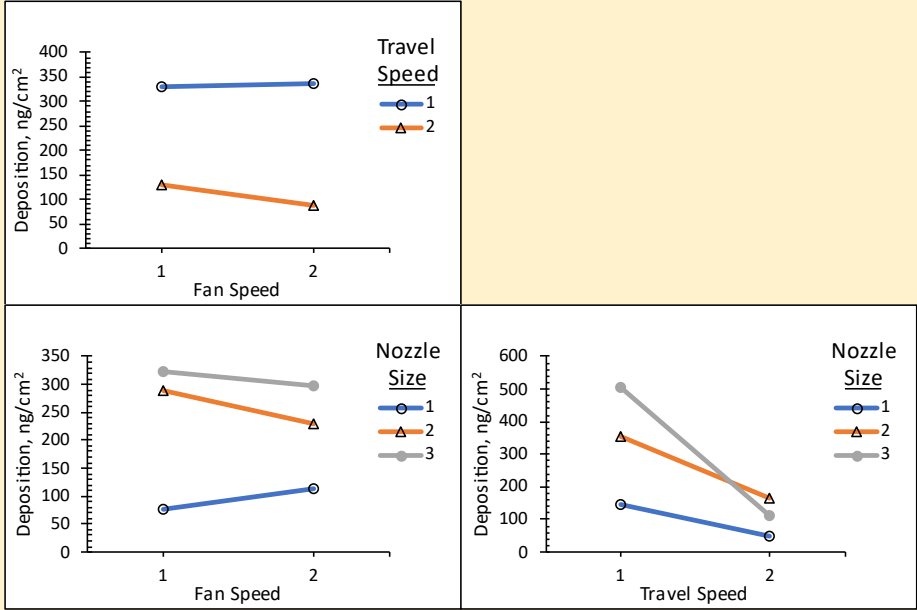
Approach and Outcomes

5. Evaluate ES via fluorescent-dye-based field spray trials

Field spray trial 2



Year 2: Navel Orange Potential Drift



Approach and Outcomes

6. Promote acceptance by citrus industry

Field day 1

Field day 2



Approach and Outcomes

7. Promote use of ES as an educational tool for agricultural students

School outreach 1

School outreach 2

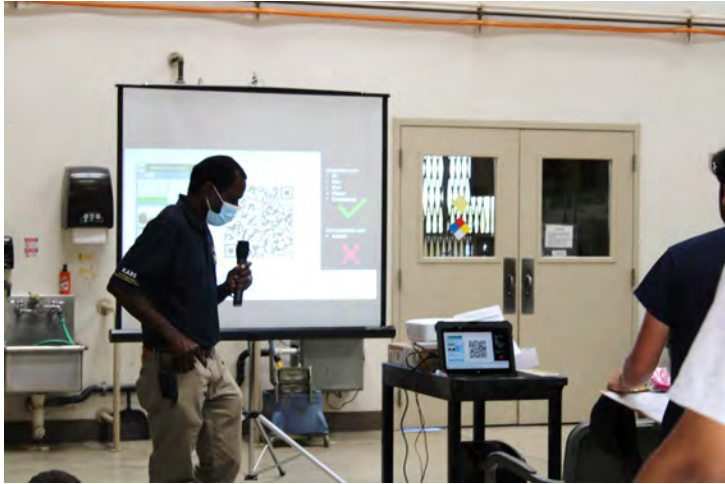


1. Guest lecture at California State University Viticulture and Enology class: **22 undergraduate students** and **1 instructor** in attendance.
2. School Outreach Hosting at the Agricultural Application Engineering (AgAppE) Laboratory at the Kearney Agricultural Research and Extension Center: **14 first-year and transfer undergraduate students, 1 graduate student,** and **2 instructors** in attendance

Approach and Outcomes

7. Promote use of ES as an educational tool for agricultural students

School outreach 2



Challenges and Setbacks

- **Major challenge was Covid-19 pandemic**
 - ✓ No/limited in-person engagement during project period
 - ✓ Uncertainty in webinar participation numbers



**Covid-19
pandemic**

Conclusions

1. General grant administration (meetings; quarterly, annual progress, and final reporting; and invoices) have been upheld and is ongoing as required.
2. Learning from and building on an existing expert system application, new airblast spray application decision support web apps were successfully developed and deployed.
3. Use of decision support tools for planning and evaluating spray application in trees and vines was promoted through a citrus industry engagement meeting, four application webinars, and a 3-day conference.
4. Sprayer calibration as a best practice was promoted in a hands-on calibration exercise that was recorded and presented virtually. A calibration training package is under development.



Conclusions

5. Conducted a fluorescent-dye-based spray lab study and two field studies for evaluating spray deposition model and expert system/web app.
6. Acceptance of spray application expert system/web apps by industry was promoted in several invited/organized presentations. A field day training package is under development.
7. The spray application expert system/web app was promoted as an educational tool for undergraduate agricultural students in an indoor guest lecture session and an indoor/outdoor hands-on session.



Thank You!

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Cardwell**, former director at Lindcove
Research and Extension Center



University of California

Agriculture and Natural Resources

■ Agricultural Application Engineering Program