



PAUL R. LEPAGE
GOVERNOR

STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
BOARD OF PESTICIDES CONTROL
28 STATE HOUSE STATION
AUGUSTA, MAINE 04333

WALTER E. WHITCOMB
COMMISSIONER

BOARD OF PESTICIDES CONTROL

**October 5, 2018
9:00 AM**

Room 118 Marquardt Building
32 Blossom Lane, Augusta, Maine

AGENDA

1. Introductions of Board and Staff
2. Minutes of the August 15, 2018 Board Meeting

Presentation By: Megan Patterson, Director

Action Needed: Amend and/or Approve

3. Review of Budget

In early 2017, the Board reviewed the budget with a goal of identifying potential resources that could be allocated to Board priorities. At that time the Board requested ongoing annual updates on the status of the Pesticide Control Fund.

Presentation By: Megan Patterson, Director

Action Needed: None—Informational Only

4. Review of Pesticide Self-Service Sign

BPC Chapter 26 Section 7 required that pesticide self-service sales areas include a “Board approved sign informing the public where to obtain additional information.” The Board reviewed various drafts and discussed improvements at the May 18, 2018 and July 13, 2018 meetings. At the August 15, 2018 meeting the Board authorized the staff to hire a graphic designer to improve the layout. The Board will now review the first drafts provided by the graphic designer.

Presentation By: Amanda Couture,

Action Needed: Provide Input

5. Discussion of Board Priorities and Proposed Planning Session

In recent years, there has been considerable turnover in Board membership and Board staff. Staff is currently juggling the usual tasks of Board operation, but is also working toward full public implementation of the Maine Pesticide Enforcement, Registration and Licensing System (MEPERLS), conducting water quality testing, updating licensing exams, conducting training for the revised Worker Protection Standard, and preparing for adoption of new federal Certification and Training requirements. In addition, the new Certification and Training requirements make it necessary to revise the State Plan and conduct rulemaking. Staff would like input on which future projects are most important to the Board when discretionary staff time arises. It is proposed that a planning session may be an effective avenue for receiving constructive input.

Presentation By: Megan Patterson, Director

Action Needed: Provide guidance to the staff on Board priorities

6. Consideration of Consent Agreement with Wise Acres Farm, Kenduskeag

The Board’s Enforcement Protocol authorizes staff to work with the Attorney General and negotiate consent agreements in advance on matters not involving substantial threats to the environment or public health. This procedure was designed for cases where there is no dispute of material facts or law, and the violator admits to the violation and acknowledges a willingness to pay a fine to resolve the matter. This case involves using a pesticide in a manner inconsistent with the label, insufficient records, and lack of required information at central information display.

Presentation By: Raymond Connors, Manager of Compliance

Action Needed: Approve/Disapprove the Consent Agreement Negotiated by Staff

7. Correspondence

None received

8. Other Items of Interest

- a. Updated brochure *Licensing Requirements for Pesticide Applicators in the State of Maine*
- b. New BPC magnet
- c. Ninth Circuit Court Opinion On Petition for Review of an Order of the Environmental Protection Agency—Chlopyrifos Tolerances
- d. Article *Field Evaluation of Commercially Available Small Unmanned Aircraft Crop Spray Systems*

9. Schedule of Future Meetings

November 16, 2018 and January 16, 2019 are proposed meeting dates. The January meeting will be at the Agricultural Trades Show and will include a Public Listening Session.

Adjustments and/or Additional Dates?

10. Adjourn

NOTES

- The Board Meeting Agenda and most supporting documents are posted one week before the meeting on the Board website at www.thinkfirstspraylast.org.
- Any person wishing to receive notices and agendas for meetings of the Board, Medical Advisory Committee, or Environmental Risk Advisory Committee must submit a request in writing to the Board's office. Any person with technical expertise who would like to volunteer for service on either committee is invited to submit their resume for future consideration.
- On November 16, 2007, the Board adopted the following policy for submission and distribution of comments and information when conducting routine business (product registration, variances, enforcement actions, etc.):
 - *For regular, non-rulemaking business*, the Board will accept pesticide-related letters, reports, and articles. Reports and articles must be from peer-reviewed journals. E-mail, hard copy, or fax should be sent to the Board's office or pesticides@maine.gov. In order for the Board to receive this information in time for distribution and consideration at its next meeting, all communications must be received by 8:00 AM, three days prior to the Board meeting date (e.g., if the meeting is on a Friday, the deadline would be Tuesday at 8:00 AM). Any information received after the deadline will be held over for the next meeting.
- During rulemaking, when proposing new or amending old regulations, the Board is subject to the requirements of the APA (Administrative Procedures Act), and comments must be taken according to the rules established by the Legislature.



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WALTER E. WHITCOMB
COMMISSIONER

BOARD OF PESTICIDES CONTROL

**August 15, 2018
1:00 PM**

Mather Auditorium, Wells Reserve at Laudholm
342 Laudholm Farm Rd, Wells, Maine

DRAFT MINUTES

Present: Bohlen, Granger, Jemison, Morrill, Waterman

1. Introductions of Board and Staff

- The Board, and Staff introduced themselves
- Staff Present: Bryer, Chamberlain, Connors, Couture, Meserve, Patterson, Pietroski

2. Minutes of the July 13, 2018 Board Meeting

Presentation By: Megan Patterson, Director

Action Needed: Amend and/or Approve

- **Granger/Bohlen: Moved and seconded approval of minutes as amended**
- **In Favor: Unanimous**

3. Consideration of Consent Agreement with Mainely Ticks, Windham

The Board's Enforcement Protocol authorizes staff to work with the Attorney General and negotiate consent agreements in advance on matters not involving substantial threats to the environment or public health. This procedure was designed for cases where there is no dispute of material facts or law, and the violator admits to the violation and acknowledges a willingness to pay a fine to resolve the matter. This case involves an unauthorized application.

Presentation By: Raymond Connors, Manager of Compliance

Action Needed: Approve/Disapprove the Consent Agreement Negotiated by Staff

- Connors stated Mainely Ticks made an application to a property in Sanford. The company had a contract with the previous owner who had sold the house over the winter. Mainely Ticks was unaware the house had been sold. The applicator called the residence and left a message. No reply was received but the applicator came to the residence and made the application the following day anyway. Mainely Ticks did self-report the incident and the new owner called to report it as well. The consent agreement was for \$500 and Mainely Ticks has paid it.
- Bohlen asked if Connors took into consideration that the company self-reported.
- Connors stated it is a requirement of the company to report this type of incident as soon as they are aware, but he did take the self-reporting into consideration.
 - **Jemison/Waterman: Moved and seconded approval of consent agreement**
 - **In Favor: Unanimous**

4. Correspondence

- a. Email and attachments from Riley Titus, Responsible Industry for a Sound Environment (RISE) received July 10, 2018
- b. Email and attachments from Riley Titus, RISE, received August 2, 2018
 - Titus was present and told the Board he felt that integrated pest management (IPM) was lacking in many of the ordinances being passed. He asked the Board what they, the IPM Council, and UMaine Cooperative Extension were doing in regards to education and outreach throughout the state. Titus proposed a resolution to the Board that restates the Board's duty to IPM. He encouraged the Board to adopt this resolution.
 - Randlett told the Board that from a legal perspective he does not recommend the Board adopt the resolution. He added that IPM is a goal of the state, written in statute, not a policy. The state policy is to minimize reliance on pesticides.
 - Titus stated his main concern was the removal of the freedom of choice. He added that any homeowner or business that might service properties are now limited on how they can maintain those properties. Titus stated that he wants individuals to have all tools available to them once the steps of IPM have been conducted.
 - Jemison asked what percentage of those companies use the steps of IPM before they spray a lawn or a property. He added that it seems IPM is almost never used, applications are generally made on a calendar basis, and the whole concept of contract lawncare and IPM does not add up.
 - Granger stated he thought the issue was larger than contract lawncare. There are certain standards some property owners want their property kept to and they should have the ability to control and maintain their landscape how they wish.

- Morrill added that the issue also extends to hobby gardeners and florists and the ordinances are limiting what businesses can do.
 - Bohlen stated that the Board is not a legislative body and he is troubled at the thought that locally elected officials could have their decisions overturned by a Board like us. He added that he disagrees with Titus and does not feel the ordinances are undercutting IPM.
 - Randlett summarized a case in which Central Maine Power had challenged the town of Lebanon for creating an ordinance that put restrictions on the use of pesticides in their town. The Maine Supreme court sided with the town. Randlett submitted the case file as part of the Board packet for today's meeting. He added that the options for a person who wanted to challenge a town ordinance would be to do so in court or go to the legislature.
- c. Email and attachments from Karen Snyder, Portland

Break for public listening session (2:00pm) (see notes below)

5. Other Items of Interest

- a. Central Maine Power Co. v. Town of Lebanon, 1990 (submitted by Mark Randlett, Assistant Attorney General)
- b. Staff memo re pesticide self-service sign
 - **Morrill/Jemison: Moved and seconded to authorize staff to spend \$500 for graphic design work**
 - **In Favor: Unanimous**
- c. Worker Protection Standard updated brochures
 - Patterson presented three Worker Protection Standard, WPS, brochures that were created by staff for education and outreach. The brochures will be going to print within the next month.
- d. Variance permit issued to Mark Eaton for control of invasive phragmites in York
- e. Variance permit issued to Piscataqua Landscaping and Tree Service for control of invasive buckthorn, honeysuckle, and bittersweet in Shepard's Cove, Kittery

6. Schedule of Future Meetings

October 5, 2018, November 16, 2018 and January 16, 2019 are proposed meeting dates. The January meeting will be at the Agricultural Trades Show and will include a Public Listening Session.

- Chamberlain asked the Board about conducting an information gathering session to obtain public input regarding drones and staff outreach. She asked if they would like to do this at a fall meeting.

- Bohlen stated that there are currently rules in place that could function for drone applications. Patterson commented that the rules allowing applicators to do aerial applications are limited to commercial applicators only.
- Jemison added that this technology is quickly evolving.
- Bohlen stated it is not clear whether there is enough predictability to have a public information gathering session at this time.
- Morrill suggested holding an information gathering session at the Annual Agricultural Trade Show in January 2019.

7. Adjourn

- **Granger/Bohlen: Moved and seconded to adjourn at 3:11pm**
- **In Favor: Unanimous**

Notes from Public Listening Session

- Jody Spear told the Board she has followed the Portland ordinance through several stages and is impressed with the progress they have made. The committee recognized that IPM had come to be simply spraying without going through the first steps, so they voted to employ organic plant management. Spear added that pesticides have deleterious effects on humans and ecosystems, and this ordinance is a way of showing there is a preferred method for taking care of pest problems.
- Heather Spalding stated she was encouraged by the discussion today and that there are wonderful possibilities before us that are better for animal and human health. She added that she does not feel IPM and ordinances are mutually exclusive. Spalding told the Board that moving forward she would like the lines of communication to remain open and wants people to talk with each other.
- Spalding asked the Board three questions:
 1. How do submissions make it to the Board packet and how they are then taken up for business? She stated that it appeared as though a couple submissions received special attention.
 2. How is it determined which agricultural operations will receive unannounced visits from an inspector?
 3. Referencing Gary Fish's graphic about the increase in the use of pesticides, what are the Board's thoughts on gathering information on the volume of pesticides purchased and used in the state?
- Spalding closed by telling the Board that Maine Organic Farmers and Gardeners Association (MOFGA) wants to continue to be at the table and to be of assistance.

- Bohlen asked Randlett if it was appropriate to respond to the questions and was answered in the affirmative.
- On the issue of how correspondence is added to the packet, Chamberlain stated that all correspondence received before the deadline used to go into the agenda under “Other Old or New Business”, but now it is being added under “Correspondence” to keep it together and separate from other agenda items. The deadline to be added to the agenda is 8:00am three days before the meeting. Chamberlain explained that if anyone responds to the agenda once it is released then that goes out late so it is sent to the Board but not placed on the agenda. She added that staff do not make the decision when someone writes and asks to be on the agenda; staff forward it to the Board and they make that decision.
- Spalding replied that one specific incidence was regarding a few letters complaining about the ordinances. The authors of the letters did not come to the meeting but the letters were pulled out for fodder for discussion. Spalding asked the Board the process for that versus other submissions that are not discussed.
- Bohlen responded that it can be informal how they run their meetings and what they might be interested in and discuss. He added that the Board will try to be more mindful of that in the future.
- Connors explained the considerations for how non-complaint initiated inspections are conducted. He stated that each year Board staff must fill out a projection form detailing how many of each type of inspection will be done in the upcoming year. Connors stated the inspectors are afforded quite a bit of autonomy in where they conduct routine inspections. However, they do try to factor in inspections where environmental consequences may be greater.
- Jesse O’Brien is a member of the Pest Management Advisory Committee (PMAC) that assisted in drafting South Portland’s pesticide use ordinance. He told the Board that South Portland is having a kick-off party for the ordinance on September 29, 2018 at 9:00am. O’Brien asked if members of the Board or the IPM Council could have a table for outreach there.
- Morrill asked staff to attend.
- Patterson responded to Spalding’s question regarding tracking sales and use of pesticides in Maine. Patterson explained that there were inherent problems with the data that was used in the past and Fish gave a presentation on that topic at a past Board meeting. She suggested that anyone interested in the graphic read the minutes from the meeting with Fish’s explanation of the data collection process. Patterson added that staff is receiving annual use and sales reports, but is not currently compiling data as most annual reports received are hand printed and data correction/verificaiton is often required and difficult. Another challenge is that the approximately 12,000 Maine registered pesticides are not static, with approximately 1,000 products lost and gained annually. Any database designed to handle the data would need to be updated annually.

- There was discussion about a possible requirement stating applicators must submit their data digitally in a usable format.
- Morrill thanked all members of the audience who spoke during the public forum.

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Proposed Administrative Consent Agreement

Background Summary

Subject: Wise Acres Farm
424 Town House Road
Kenduskeag, Maine 04450

Date of Incident(s): June 7, 2017

Background Narrative: On June 15, 2017, a Board inspector completed an inspection with the owner of Wise Acres Farm in Kenduskeag.

The owner/applicator exceeded the maximum labeled application rate when applying Actinovate AG Biological Fungicide on June 7, 2017. The applicator did not wear the required respirator when mixing, loading, and applying the pesticide. Additionally, the owner did not have OSHA safety data sheets at a central information display as required by the federal Worker Protection Standard and the pesticide application records were incomplete.

Summary of Violation(s):

- Federal Worker Protection Standard, 40 CFR, Part 170. OSHA safety data sheets not provided at a central information display for workers.
- 7 U.S.C. § 136j (a)(2)(G), 7 M.R.S. § 606 (2)(B) and 22 M.R.S. § 1471 D (8)(F). Using a pesticide inconsistent with its label directions (exceeded maximum labeled application rate, lack of respirator).
- 01- 026 C.M.R. Ch. 50, § 1(A), The applicator's pesticide application records were insufficient. Information that was missing included: application method, applicator name, applicator license number, town of application, target pest, documentation of sensitive areas, and weather data.

Rationale for Settlement: Lack of personal protective equipment, did not post the required safety data sheets for workers, insufficient pesticide applicator records, and exceeded the maximum labeled application rate.

Attachments: Proposed Consent Agreement

**STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION, AND FORESTRY
BOARD OF PESTICIDES CONTROL**

In the Matter of:)	
Wise Acres Farm)	ADMINISTRATIVE CONSENT AGREEMENT
424 Town House Road)	AND
Kenduskeag, Maine 04450)	FINDINGS OF FACT

This Agreement by and between Wise Acres Farm, (hereinafter called the "Grower") and the State of Maine Board of Pesticides Control (hereinafter called the "Board") is entered into pursuant to 22 M.R.S. §1471-M (2)(D) and in accordance with the Enforcement Protocol amended by the Board on December 13, 2013.

The parties to this Agreement agree as follows:

1. That the Grower produces agricultural crops for commercial purposes at a business that utilizes pesticides bearing language requiring conformance with the federal Worker Protection Standard, 40 CFR, Part 170 (WPS).
2. That the Grower employs one or more workers as defined under 40 CFR, Part 170.3 to assist in the production of the crops described in paragraph one.
3. That a Board inspector conducted an inspection at the Grower's facility on June 15, 2017.
4. That from the inspection described in paragraph three, it was determined that on June 7, 2017, the Grower applied 2 ounces of Actinovate AG Biological Fungicide ("Actinovate AG") to 3,600 square feet of strawberries. The label maximum is 1 ounce of Actinovate AG to 3,600 square feet of strawberries.
5. That the circumstances described in paragraphs one through four constitute use of a pesticide inconsistent with the product labeling and in violation of 7 U.S.C. § 136j (a)(2)(G), 7 M.R.S § 606 (2)(B) and 22 M.R.S. § 1471 D (8)(F).
6. That, as a result of the inspection described in paragraph three, it was also determined that the Grower did not have OSHA safety data sheets at a central information display as required by the federal Worker Protection Standard, 40 CFR, Part 170.
7. That the circumstances in paragraphs one through four, and six, constitute a violation of the federal Worker Protection Standard, 40 CFR, Part 170.
8. That during the inspection described in paragraph three, the inspector reviewed the pesticide label for Actinovate AG and documented that the use of this product requires that mixers, loaders, applicators, and other handlers wear a respirator meeting NIOSH standards of at least N-95, R-95, or P-95.
9. That the inspection showed that no respirator was worn when the Actinovate AG was mixed, loaded or applied on June 7, 2017, as described in paragraph four.
10. That circumstances described in paragraphs one through four, eight, and nine, constitute use of a pesticide inconsistent with the product labeling and in violation of 7 U.S.C. § 136j (a)(2)(G), 7 M.R.S § 606 (2)(B) and 22 M.R.S. § 1471 D (8)(F).

11. That 01- 026 C.M.R. ch. 50, § 1(A), requires that commercial agricultural producers shall maintain pesticide application records.
12. That from the inspection described in paragraph three, it was determined that the Grower's records were insufficient under 01- 026 C.M.R. ch. 50, § 1(A). Information that was missing included: application method, applicator name, applicator license number, town of application, target pest, documentation of sensitive areas, and weather data.
13. That the circumstances described in paragraphs one, three, four, eleven, and twelve, constitute a violation of 01- 026 C.M.R. ch. 50, § 1(A).
14. That the Board has regulatory authority over the activities described herein.
15. That the Grower expressly waives:
 - a. Notice of or opportunity for hearing;
 - b. Any and all further procedural steps before the Board; and
 - c. The making of any further findings of fact before the Board.
16. That this Agreement shall not become effective unless and until the Board accepts it.
17. That in consideration for the release by the Board of the causes of action which the Board has against the Grower resulting from the violations referred to in paragraphs five, seven, ten, and thirteen, the Grower agrees to pay to the State of Maine the sum of \$175. (Please make checks payable to Treasurer, State of Maine).

IN WITNESS WHEREOF, the parties have executed this Agreement of two pages.

WISE ACRES FARM

By: _____ Date: _____

Type or Print Name: _____

BOARD OF PESTICIDES CONTROL

By: _____ Date: _____

Megan Patterson, Director

APPROVED:

By: _____ Date: _____

Mark Randlett, Assistant Attorney General

FOR PUBLICATION

**UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT**

LEAGUE OF UNITED LATIN
AMERICAN CITIZENS; PESTICIDE
ACTION NETWORK NORTH AMERICA;
NATURAL RESOURCES DEFENSE
COUNCIL; CALIFORNIA RURAL
LEGAL ASSISTANCE FOUNDATION;
FARMWORKERS ASSOCIATION OF
FLORIDA; FARMWORKER JUSTICE
GREENLATINOS; LABOR COUNCIL
FOR LATIN AMERICAN
ADVANCEMENT; LEARNING
DISABILITIES ASSOCIATION OF
AMERICA; NATIONAL HISPANIC
MEDICAL ASSOCIATION; PINEROS Y
CAMPELINOS UNIDOS DEL
NOROESTE; UNITED FARM WORKERS,
Petitioners,

STATE OF NEW YORK; STATE OF
MARYLAND; STATE OF VERMONT;
STATE OF WASHINGTON;
COMMONWEALTH OF
MASSACHUSETTS; DISTRICT OF
COLUMBIA; STATE OF CALIFORNIA;
STATE OF HAWAII,
Intervenors,

v.

No. 17-71636

OPINION

ANDREW WHEELER, Acting
Administrator of the U.S.
Environmental Protection Agency;
and U.S. ENVIRONMENTAL
PROTECTION AGENCY,
Respondents.

On Petition for Review of an Order of the
Environmental Protection Agency

Argued and Submitted July 9, 2018
Seattle, Washington

Filed August 9, 2018

Before: Ferdinand F. Fernandez and Jacqueline H.
Nguyen, Circuit Judges, and Jed S. Rakoff,* District Judge.

Opinion by Judge Rakoff;
Dissent by Judge Fernandez

* The Honorable Jed S. Rakoff, United States District Judge for the
Southern District of New York, sitting by designation.

SUMMARY**

Pesticides

The panel granted a petition for review, and vacated the Environmental Protection Agency's ("EPA") 2017 order maintaining a tolerance for the pesticide chlorpyrifos, and remanded to the EPA with directions to revoke all tolerances and cancel all registrations for chlorpyrifos within 60 days.

The Federal Food, Drug, and Cosmetic Act ("FFDCA") authorizes the EPA to regulate the use of pesticides on foods according to specific statutory standards, and grants the EPA a limited authority to establish tolerances for pesticides meeting statutory qualifications. The EPA is subject to safety standards in exercising its authority to register pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA").

The EPA argued that FFDCA's section 346a(g)(2)'s administrative process deprived this Court of jurisdiction until the EPA issues a response to petitioner's administrative objections under section 346a(g)(2)(C), which it has not done to date.

The panel held that section 346a(h)(1) of the FFDCA does not "clearly state" that obtaining a section (g)(2)(C) order in response to administrative objections is a jurisdictional requirement. The panel held that section 346a(h)(1) contains no jurisdictional label, is structured as a

** This summary constitutes no part of the opinion of the court. It has been prepared by court staff for the convenience of the reader.

limitation on the parties rather than the court, and only references an exhaustion process that is outlined in a separate section of the statute.

The panel held that in light of the strong individual interests against requiring exhaustion and weak institutional interests in favor of it, petitioners need not exhaust their administrative objections and were not precluded from raising issues on the merits.

Turning to the merits, the panel held that there was no justification for the EPA's decision in its 2017 order to maintain a tolerance for chlorpyrifos in the face of scientific evidence that its residue on food causes neurodevelopmental damage to children. The panel further held that the EPA cannot refuse to act because of possible contradiction in the future by evidence. The panel held that the EPA was in direct contravention of the FFDCA and FIFRA.

Judge Fernandez dissented. Judge Fernandez would hold that there is no jurisdiction over the petition for review under FFDCA and FIFRA, and dismiss the petition.

COUNSEL

Patti A. Goldman (argued), Marisa C. Ordonia, and Kristen L. Boyles, Earthjustice, Seattle, Washington, for Petitioners.

Frederick A. Brodie (argued), Assistant Solicitor General; Andrea Oser, Deputy Solicitor General; Barbara D. Underwood, Attorney General; Office of the Attorney General, Albany, New York; Brian E. Frosh, Attorney General; Steven M. Sullivan, Solicitor General; Office of the Attorney General, Baltimore, Maryland; Thomas J. Donovan Jr., Attorney General; Nicholas F. Persampieri, Assistant Attorney General; Office of the Attorney General, Montpelier, Vermont; Robert W. Ferguson, Attorney General; William R. Sherman, Counsel for Environmental Protection; Attorney General's Office, Seattle, Washington; Maura Healey, Attorney General; I. Andrew Goldberg, Assistant Attorney General; Environmental Protection Division, Office of the Attorney General, Boston, Massachusetts; Karl A. Racine, Attorney General; Brian R. Caldwell, Assistant Attorney General; Office of the Attorney General, Washington, D.C.; Xavier Becerra, Attorney General; Susan S. Fiering, Supervising Deputy Attorney General; Reed Sato, Deputy Attorney General; Office of the Attorney General, Sacramento, California; Russell A. Suzuki, Acting Attorney General; Wade H. Hargrove III, Deputy Attorney General; Health and Human Services Division, Department of the Attorney General, Honolulu, Hawaii; for Intervenors.

Phillip R. Dupré (argued) and Erica M. Zilioli, Attorneys, Environmental Defense Section; Jeffrey H. Wood, Acting Assistant Attorney General; Environment and Natural Resources Division, United States Department of Justice, Washington, D.C.; Mark Dyner, Office of the General

Counsel, United States Environmental Protection Agency, Washington, D.C.; for Respondents.

Donald C. McLean, Stanley H. Abramson, Kathleen R. Heilman, and Sylvia G. Costelloe, Arent Fox LLP, Washington, D.C., for Amicus Curiae Dow Agrosciences LLC.

Susan J. Kraham and Edward Lloyd, Columbia Environmental Clinic, Morningside Heights Legal Services, New York, New York, for Amicus Curiae Congressman Henry Waxman.

Shaun A. Goho, Emmett Environmental Law & Policy Clinic, Harvard Law School, Cambridge, Massachusetts, for Amici Curiae Health Professional Organizations.

OPINION

RAKOFF, District Judge:

Over nearly two decades, the U.S. Environmental Protection Agency (“EPA”) has documented the likely adverse effects of foods containing the residue of the pesticide chlorpyrifos on the physical and mental development of American infants and children, often lasting into adulthood. In such circumstances, federal law commands that the EPA ban such a pesticide from use on food products unless “there is a reasonable certainty that no harm will result from aggregate exposure to the pesticide.” 21 U.S.C. § 346a(b)(2)(A)(ii). Yet, over the past decade and more, the EPA has stalled on banning chlorpyrifos, first by largely ignoring a petition properly filed pursuant to law seeking such a ban, then by temporizing in response to repeated orders by this Court to respond to the petition, and, finally, in its latest tactic, by denying outright our jurisdiction to review the ultimate denial of the petition, even while offering no defense on the merits. If Congress’s statutory mandates are to mean anything, the time has come to put a stop to this patent evasion.

Petitioners seek review of an EPA order issued March 29, 2017 (the “2017 Order” or “Order”) that denied a 2007 petition to revoke “tolerances,” i.e. limited allowances, for the use of chlorpyrifos on food products. Petitioners argue that the EPA does not have the authority to maintain the tolerances for chlorpyrifos under the Federal Food, Drug, and Cosmetic Act (“FFDCA”), which authorizes the EPA to “leave in effect a tolerance for a pesticide chemical residue in or on a food only if the Administrator determines that the tolerance is safe”—with “safe,” in turn, defined to mean that the EPA “has determined that there is a reasonable certainty that no harm will result from aggregate exposure to the

pesticide chemical residue.” 21 U.S.C. § 346a(b)(2)(A)(i)–(ii). Respondent, the EPA, has never made any such determination and, indeed, has itself long questioned the safety of permitting chlorpyrifos to be used within the allowed tolerances. The EPA, therefore, does not defend the 2017 Order on the merits. Instead, the EPA argues that, despite petitioners having properly-filed administrative objections to the 2017 Order more than a year ago, and despite the statutory requirement that the EPA respond to such objections “as soon as practicable,” the EPA’s utter failure to respond to the objections deprives us of jurisdiction to adjudicate whether the EPA exceeded its statutory authority in refusing to ban use of chlorpyrifos on food products.

We hold that obtaining a response to objections before seeking review by this Court is a claim-processing rule that does not restrict federal jurisdiction, and that can, and here should, be excused. There being no other reason not to do so, we grant the petition on the merits.

BACKGROUND

A. *The Statutory Framework*

The FFDCA authorizes the EPA to regulate the use of pesticides on foods according to specific statutory criteria. 21 U.S.C. §§ 301–399i. The FFDCA prescribes that food with “any pesticide chemical residue . . . shall be deemed unsafe” and barred from movement in interstate commerce. *Id.* § 346a(a)(1). However, it grants the EPA a limited authority to establish tolerances for pesticides meeting statutory qualifications, enabling foods bearing residues of those pesticides within these tolerances to move in interstate commerce. *See id.* § 346a(a), (a)(4), (b)(1).

The EPA's ability to establish tolerances depends on a safety finding. "The Administrator may establish or leave in effect a tolerance . . . only if the Administrator determines that the tolerance is safe." *Id.* § 346a(b)(2)(A)(i). A tolerance qualifies as safe if "the Administrator has determined that there is a *reasonable certainty* that *no* harm will result from aggregate exposure to the pesticide chemical residue, including all anticipated dietary exposures and all other exposures for which there is reliable information." *Id.* § 346a(b)(2)(A)(ii) (emphasis added). To make such a determination, the EPA must perform a safety analysis to "ensure that there is a reasonable certainty that no harm will result to infants and children from aggregate exposure" and "publish a specific determination regarding the safety of the pesticide chemical residue for infants and children. *Id.* § 346(b)(2)(C)(ii)(I)–(II). Furthermore, even after establishing a tolerance, the EPA bears continuous responsibility to ensure that the tolerance continues to satisfy the FFDCA's safety standard; the FFDCA provides that the Administrator may "leave in effect a tolerance . . . only if the Administrator determines that the tolerance is safe" and "shall modify or revoke a tolerance if the Administrator determines it is not safe." *Id.* § 346a(b)(2)(A)(i).

The EPA is subject to these same safety standards in exercising its authority to register pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA"). *See* 7 U.S.C. § 136a(a). The EPA Administrator must register a pesticide—which is a requirement for pesticides to be distributed or sold—when, among other qualifications, the pesticide does not have "unreasonable adverse effects on the environment." *Id.* § 136a(c)(5) (D). FIFRA incorporates the FFDCA's safety standard into the definition of "unreasonable adverse effects" to include "a human dietary risk from residues that result from a use of a

pesticide in or on any food inconsistent with the standard under [the FFDCA].” *Id.* § 136(bb). FIFRA requires the EPA to reevaluate pesticides periodically after approval. *Id.*

While the EPA can act on its own initiative to establish, modify or revoke a tolerance under the FFDCA, 21 U.S.C. § 346a(e)(1), “[a]ny person may file . . . a petition proposing the issuance of [such] a regulation.” *Id.* § 346a(d)(1). After “due consideration,” the EPA Administrator must issue either a proposed or final regulation or an order denying the petition. *Id.* § 346a(d)(4)(A). After this response, “any person may file objections thereto with the Administrator.” *Id.* § 346a(g)(2)(A). The FFDCA directs that the Administrator “shall issue an order [known as a “g(2)(C) order”] stating the action taken upon each . . . objection” “[a]s soon as practicable.” *Id.* § 346a(g)(2)(C). “[A]ny person who will be adversely affected” by that order or the underlying regulation “may obtain judicial review by filing in the United States Court of Appeals” a petition for review. *Id.* § 346a(h)(1).

B. *The History of this Litigation*

This case arises from a 2007 petition filed under 21 U.S.C. § 346a(d) proposing that the EPA revoke tolerances for the pesticide chlorpyrifos (the “2007 Petition” or the “Petition”). Chlorpyrifos, an organophosphate pesticide initially developed as a nerve gas during World War II, was approved in 1965 in the United States as a pesticide for agricultural, residential, and commercial purposes. Chlorpyrifos kills insects by suppressing acetylcholinesterase, an enzyme that acts as a neurotransmitter in various organisms, including humans. The EPA has set chlorpyrifos residue tolerances for 80 food crops, including fruits, nuts, and vegetables. *See* 40 C.F.R. § 180.342. The 2007 Petition, filed by the Pesticide Action

Network North America (“PANNA”) and the Natural Resources Defense Council (“NRDC”), presented scientific studies showing that children and infants who had been exposed prenatally to low doses of chlorpyrifos suffer harms such as reduced IQ, attention deficit disorders, and delayed motor development, that last into adulthood.

Prior to the Petition’s filing, the EPA already had concerns about chlorpyrifos. After reviewing the registration for chlorpyrifos in 1998 under the amended FFDCA’s heightened safety standards that required considering cumulative exposure and the specific risks to children, the EPA cancelled all residential uses. Although the EPA continued to allow the use of chlorpyrifos as a pesticide on food crops, *see* 40 C.F.R. § 180.342, it required that “risk mitigation measures” be implemented while a full reassessment of chlorpyrifos was undertaken, as continued usage of chlorpyrifos without additional precautions “would present risks inconsistent with FIFRA.” EPA 738-R-01-007 “Interim Reregistration Eligibility Decision for Chlorpyrifos” (Feb. 2002)). This “interim reregistration” also announced future plans to reduce or revoke entirely chlorpyrifos tolerance levels for certain crops, citing “acute dietary risks” for “infants, all children, and nursing females.” *Id.*

Despite these earlier expressions of concern, the EPA failed to take any decisive action in response to the 2007 Petition, notwithstanding that the EPA’s own internal studies continued to document serious safety risks associated with chlorpyrifos use, particularly for children. A 2008 EPA Science Issue Paper, reviewing existing scientific studies, “preliminarily concluded that chlorpyrifos likely played a role” in low birth rate and delays in infant mental development observed in human cohort studies. A Science

Advisory Panel convened in 2008 concurred that chlorpyrifos exposures “can lead to neurochemical and behavioral alterations [in the young] that persist into adulthood.” A Science Advisory Panel convened in 2011 found “persuasive” evidence “that there are enduring effects on the Central Nervous System . . . from chlorpyrifos exposure at or above 1.0 mg/kg,” and that chlorpyrifos exposure is associated with adverse neurodevelopmental effects in children, including abnormal reflexes, pervasive development disorder, and attention and behavior problems.

Yet, even after all of these EPA studies, by 2012 the EPA still had not responded to the 2007 Petition. PANNA and NRDC thereupon petitioned this Court for a writ of mandamus to force the EPA to take action. We initially dismissed the mandamus petition, without prejudice to its renewal, based on the EPA’s representation that it had a “concrete timeline for final agency action” to be taken on the 2007 Petition by February 2014. *In re PANNA*, 532 F. App’x 649, 651 (9th Cir. 2013). When the EPA failed to respond to the 2007 Petition by September 2014, PANNA and NRDC again petitioned for mandamus, which we granted, ordering the EPA to issue a final response on the 2007 Petition by October 2015. *In re PANNA*, 798 F.3d 809, 815 (9th Cir. 2015).¹ We found the EPA’s delay in responding to the 2007 Petition “egregious,” especially “[i]n view of [the] EPA’s own assessment of the dangers to human health posed by this pesticide,” noting that the EPA had recently “reported that chlorpyrifos poses such a significant threat to water supplies that a nationwide ban on the pesticide may be justified.” *Id.* at 811, 814.

¹ Unless otherwise indicated, case quotations omit all internal quotation marks, alterations, footnotes, and citations.

Notwithstanding the deadline set by this Court, the EPA did not initially respond to the 2007 Petition until November 2015, when it issued a proposed rule revoking all tolerances for chlorpyrifos. Chlorpyrifos; Tolerance Revocations, 80 Fed. Reg. 69,080 (Nov. 6, 2015); *see* 21 U.S.C. § 346a(d)(4)(A)(ii). Describing the various scientific studies’ “consistency of finding neurodevelopmental effects” as “striking,” *id.* at 69,090, the EPA stated that it was “unable to conclude that the risk from aggregate exposure from the use of chlorpyrifos meets the safety standard of [21 U.S.C. § 346a(b)(2)(A)(i)]” *id.* at 69,080.

Yet the EPA still equivocated and delayed. Accordingly, in December 2015, we ordered the EPA “to take final action by December 30, 2016 on its proposed revocation rule.” *In re PANNA*, 808 F.3d 402, 402 (9th Cir. 2015). In June 2016, the EPA requested a six-month extension to continue scientific analysis, a request we characterized as “another variation on a theme of partial reports, missed deadlines, and vague promises of future action that has been repeated for the past nine years.” *In re PANNA*, 840 F.3d 1014, 1015 (9th Cir. 2016). We found that a six-month delay was “not justified” in light of the previous time extensions and the EPA’s “continued failure to respond to the pressing health concerns presented by chlorpyrifos,” but granted a three-month extension to March 2017. *Id.*

In the meantime, the EPA issued a 2016 Risk Assessment concluding that estimated dietary exposure to chlorpyrifos at existing tolerances exceeded what was acceptable for all population groups analyzed, with the highest risks for young children. The Risk Assessment found that scientific literature “as a whole provides evidence of long-lasting neurodevelopmental disorders” linked to chlorpyrifos exposure, with any remaining scientific

uncertainties insufficient to “undermine or reduce the confidence in the findings of the epidemiology studies.” The EPA concluded that its analysis of chlorpyrifos “continues to indicate that the risk from the potential aggregate exposure does not meet the FFDCSA safety standard” and that “expected residues of chlorpyrifos on most individual food crops exceed the ‘reasonable certainty of no harm’ safety standard.” Chlorpyrifos; Tolerance Revocations; Notice of Data Availability and Request for Comment, 81 Fed. Reg. 81,049, 81,050 (Nov. 17, 2016).

Then, in the Order at issue in this case, the EPA reversed its position and denied the 2007 Petition on the merits, leaving chlorpyrifos tolerances in effect. Chlorpyrifos; Order Denying PANNA and NRDC’s Petition To Revoke Tolerances, 82 Fed. Reg. 16,581 (Apr. 5, 2017). The Order did not refute the agency’s previous scientific findings on chlorpyrifos or its conclusion that chlorpyrifos violated the FFDCSA safety standard. Instead, the EPA stated that it would not revoke tolerances as “the science addressing neurodevelopmental effects remains unresolved.” *Id.* at 16,583. The EPA stated that it would not complete “any associated tolerance revocation of chlorpyrifos without first attempting to come to a clearer scientific resolution,” *id.*, and claimed to have “discretion to determine the schedule” for reviewing the existing chlorpyrifos tolerances as long as it completed the chlorpyrifos registration review by FIFRA’s deadline of October 1, 2022, *id.* at 16,590.

PANNA and NRDC moved for further mandamus relief in this Court, arguing that the 2017 Order failed to respond adequately to the 2007 Petition. We denied their motion as premature because the EPA had “done what we ordered it to do,” i.e. responded to the 2007 Petition, since the 2017 Order formally denied it. *In re PANNA*, 863 F.3d 1131, 1132 (9th

Cir. 2017). Petitioners then petitioned this Court for review of the 2017 Order. Petitioners concurrently filed objections in the EPA's administrative review process. Thereafter, we permitted several states that had also filed objections to the Order to intervene in this matter.

The EPA does not defend this suit on the merits, but argues that § 346a(g)(2)'s administrative process deprives this Court of jurisdiction until the EPA issues a response to petitioners' administrative objections, *see* § 346a(g)(2)(C), which it has not done to date.

DISCUSSION

A. *Jurisdiction*

The term “jurisdiction” refers specifically to “a court’s adjudicatory authority.” *Reed Elsevier, Inc. v. Muchnick*, 559 U.S. 154, 160 (2010). Therefore, “a rule should not be referred to as jurisdictional unless it governs a court’s adjudicatory capacity, that is, its subject-matter or personal jurisdiction.” *Henderson ex rel. Henderson v. Shinseki*, 562 U.S. 428, 435 (2011). In other words, “jurisdictional statutes speak to the power of the court rather than to the rights or obligations of the parties.” *Landgraf v. USI Film Prods.*, 511 U.S. 244, 274 (1994).

The Supreme Court has emphasized the necessity of observing “the important distinctions between jurisdictional prescriptions and claim-processing rules.” *Reed Elsevier*, 559 U.S. at 161. Claim-processing rules “seek to promote the orderly progress of litigation by requiring that the parties take certain procedural steps at certain specified times.” *Henderson*, 562 U.S. at 435. Claim-processing rules may be “important and mandatory,” but, as they do not “govern[] a

court's adjudicatory capacity," they can be waived by the parties or the court. *Id.*

The Supreme Court has adopted a "bright line" test for determining when to classify statutory restrictions as jurisdictional. *Arbaugh v. Y&H Corp.*, 546 U.S. 500, 516 (2006). A rule qualifies as jurisdictional only if "Congress has clearly stated that the rule is jurisdictional." *Sebelius v. Auburn Reg'l Med. Ctr.*, 568 U.S. 145, 153 (2013). "[A]bsent such a clear statement," the Supreme Court has cautioned, "courts should treat the restriction as nonjurisdictional in character," with the specific goal of "ward[ing] off profligate use of the term 'jurisdiction.'" *Id.* In considering whether Congress has spoken clearly, courts consider both the language of the statute and its "context, including . . . [past judicial] interpretation[s] of similar provisions." *Reed Elsevier*, 559 U.S. at 168.

"[T]hreshold requirements that claimants must complete, or exhaust, before filing a lawsuit" are typically "treated as nonjurisdictional." *Id.* at 166. Accordingly, "we have rarely found exhaustion statutes to be a jurisdictional bar." *McBride Cotton & Cattle Corp. v. Veneman*, 290 F.3d 973, 978 (9th Cir. 2002) (holding that requirement of "exhaust[ing] all administrative appeal procedures . . . before [a] person may bring an action in a court" was not jurisdictional); *see also Anderson v. Babbitt*, 230 F.3d 1158, 1162 (9th Cir. 2000) (same for provision that "[n]o decision which at the time of its rendition is subject to [administrative] appeal . . . shall be considered final so as to be agency action subject to judicial review"); *Rumbles v. Hill*, 182 F.3d 1064, 1067 (9th Cir. 1999) (same for provision that "[n]o action shall be brought . . . until such administrative remedies as are available are exhausted"),

overruled on other grounds by Booth v. Churner, 532 U.S. 731 (2001).

Section 346a(h)(1), the FFDCA's judicial review provision, provides:

In a case of actual controversy as to the validity of any regulation issued under subsection (e)(1)(C), or any order issued under subsection (f)(1)(C) or (g)(2)(C), or any regulation that is the subject of such an order, any person who will be adversely affected by such order or regulation may obtain judicial review by filing in the United States Court of Appeals for the circuit wherein that person resides or has its principal place of business, or in the United States Court of Appeals for the District of Columbia Circuit, within 60 days after publication of such order or regulation, a petition praying that the order or regulation be set aside in whole or in part.

The (g)(2)(C) order referenced above is the order “stating the action taken upon each such objection and setting forth any revision to the regulation or prior order that the Administrator has found to be warranted,” which the EPA must issue at the conclusion of the administrative objections process outlined in § 346a(g)(2). *Id.* § 346a(g)(2)(C).

We must consider whether § 346a(h)(1) “clearly states” that obtaining a (g)(2)(C) order in response to administrative objections is a jurisdictional requirement. It does not. Section 346a(h)(1) “is written as a restriction on the rights of plaintiffs to bring suit, rather than as a limitation on the power of the federal courts to hear the suit.” *Payne v.*

Peninsula Sch. Dist., 653 F.3d 863, 869 (9th Cir. 2011) (en banc). It delineates the process for a party to obtain judicial review, by filing suit in one of two venues within a specified time, not the adjudicatory capacity of those courts.

In *Henderson*, the Supreme Court evaluated a similarly structured provision, which provided that, “to obtain [judicial] review” of a final decision of the Board of Veterans’ Appeals, “a person adversely affected . . . shall file a notice of appeal with the Court.” 562 U.S. at 438. The Court found this language did “not suggest, much less provide clear evidence, that the provision was meant to carry jurisdictional consequences.” *Id.* Similarly, in *Payne*, we held that an exhaustion requirement providing that “before the filing of a civil action . . . , the [administrative] procedures . . . shall be exhausted” was not a jurisdictional limit on the courts, but a requirement for plaintiffs that could be waived. 653 F.3d at 867, 869. Like the provision evaluated in *Payne*, the focus of § 346a(h)(1) on the requirements for petitioners “strongly suggests that the restriction may be enforced by defendants but that the exhaustion requirement may be waived or forfeited.” *Id.* at 869.

Further, § 346a(h)(1) “does not speak in jurisdictional terms or refer in any way to the jurisdiction of the [federal] courts.” *Zipes v. Trans World Airlines, Inc.*, 455 U.S. 385, 394 (1982). The word “jurisdiction” never appears. The reference to the United States Courts of Appeals “simply clarifies that, when determining in which court of competent jurisdiction they will file their claim, . . . litigants have a choice of venue.” *Merritt v. Countrywide Fin. Corp.*, 759 F.3d 1023, 1038 (9th Cir. 2012) (classifying provision that an action “may be brought in any United States district court, or in any other court of competent jurisdiction” as

non-jurisdictional claim-processing rule despite its being labeled “Jurisdiction of courts; limitations on actions”).

Section 346a(h)(1) similarly lacks mandatory language with “jurisdictional import.” *Auburn Reg’l Med. Ctr.*, 568 U.S. at 154. It merely provides that a person “*may* obtain judicial review.” 21 U.S.C. § 346a(h)(1) (emphasis added). In *Auburn Regional Medical Center*, the Supreme Court evaluated a provision with similar language, which instructed that a health care provider “may obtain a hearing” by the Provider Reimbursement Review Board if “such provider files a request for a hearing within 180 days after notice of the intermediary’s final determination.” 568 U.S. at 154. The Court held that the provision did “not speak in jurisdictional terms” in part because it lacked “words with jurisdictional import” like “the mandatory word ‘shall.’” *Id.* Similarly, this Court has held that “permissive, non-mandatory language such as ‘may file’ . . . weighs considerably against a finding that [the provision] is jurisdictional.” *Merritt*, 759 F.3d at 1037.

Aside from listing a (g)(2)(C) order as one of the orders available for judicial review, § 346a(h)(1) provides no indication that the administrative process required to produce a (g)(2)(C) order is a condition of the courts’ jurisdiction. The objections process itself is detailed in Section 346a(g)(2), a separate provision focused entirely on administrative processes rather than on judicial review. The Supreme Court has repeatedly found that a requirement’s “appear[ance] as an entirely separate provision” from the one concerning judicial review is a significant indicator of lack of Congressional intent to make that requirement jurisdictional. *Zipes*, 455 U.S. at 393–94; *see also Reed Elsevier*, 559 U.S. at 164; *Arbaugh*, 546 U.S. at 515.

The fact that (g)(2)(C) orders issued at the conclusion of administrative objections appear on § 346a(h)(1)'s list of orders for judicial review, while (d)(4)(A) orders issued in response to petitions do not, is not in itself suggestive as to whether obtaining a (g)(2)(C) order is a jurisdictional limitation. In evaluating statutes that similarly list administrative actions available for judicial review, the Supreme Court has observed that “[t]he mere fact that some acts are made reviewable should not suffice to support an implication of exclusion as to others.” *Verizon Md., Inc. v. Pub. Serv. Comm’n*, 535 U.S. 635, 643 (2002). “The right to review is too important to be excluded on such slender and indeterminate evidence of legislative intent.” *Abbott Labs. v. Gardner*, 387 U.S. 136, 141 (1967), *abrogated on other grounds by Califano v. Sanders*, 430 U.S. 99, 105 (1977).

The Dissent finds the language of § 346a(h)(5) suggestive of a Congressional intent to “preclude[] possible bypassing of the § 346a(g)(2) provisions.” Dissent at 37. We disagree. Section 346a(h)(5) provides that “[a]ny issue as to which review is or was obtainable under this subsection shall not be the subject of judicial review under any other provision of law.” This is a limitation on the availability of judicial review under *other* statutory provisions, not a pronouncement as to the internal requirements of § 346a(h)(1) jurisdiction. Similarly, *NRDC v. Johnson*, 461 F.3d 164 (2006), the Second Circuit case cited by the Dissent to support its position that § 346a(h)(5) limits this Court’s jurisdiction, is inapposite. In that case, the Second Circuit held that “Section 346a(h) limits judicial review *to the courts of appeals*,” rejecting an attempt by plaintiffs to challenge a tolerance by filing directly in federal *district* court under the APA, rather than filing in a federal appellate court pursuant to § 346a(h)(1). *Id.* at 173 (emphasis added). While *Johnson* also stated that § 346a(h) “forecloses such

[appellate court] review prior to the exhaustion of administrative remedies,” *id.*, this was pure dictum and particularly inapposite here, since the question of whether such exhaustion was jurisdictional was not presented in that case, which expressly was concerned only with whether “decisions to leave tolerances in effect are reviewable in the district courts.” *Id.* at 167.

We are also mindful what it would mean for future review of EPA decisions if we were to find obtaining a (g)(2)(C) order to be a jurisdictional requirement. In seeking to “bring some discipline” to the classification of provisions as jurisdictional, the Supreme Court has repeatedly considered how the classification of the rule in question would impact future claims. *See Auburn Reg’l Med. Ctr.*, 568 U.S. at 153–54 (examining “what it would mean” for the review process if a provision were found jurisdictional); *see also Henderson*, 562 U.S. at 434 (addressing the “considerable practical importance” that attaches to the jurisdictional label, including how jurisdictional rules “may . . . result in the waste of judicial resources and may unfairly prejudice litigants”). The impact of a jurisdictional finding must be considered within the context of the administrative process Congress was establishing in the relevant statute, and the values that process was meant to protect. For example, in *Henderson*, the Supreme Court addressed the impact of a jurisdictional finding on the process established by Congress for adjudicating veterans’ benefits claims considering the “solicitude of Congress for veterans” reflected in the review scheme. *Id.*

Applying this analysis to the present case, a jurisdictional finding would mean that under no circumstances could persons obtain judicial review of a denial of a petition prior to an EPA response to an

administrative objection, even under exigent circumstances where the EPA was unwilling or unable to act. The EPA could evade judicial review simply by declining to issue a (g)(2)(c) order in response to an objection, requiring petitioners to seek writs of mandamus to order EPA action on objections. The history of this very case vividly illustrates this danger.

The language Congress used hardly suggests an intention to allow this scenario. Section 346a(g)(2) instructs the EPA to respond “as soon as practicable” to objections filed. Providing only a brief administrative review process makes sense. By the time an administrative objection is filed, the EPA has already fully considered the petition at issue and issued either a “final regulation” or, as here, “an order denying the petition.” 21 U.S.C. § 346a(d)(4)(A)(iii).

Furthermore, § 346a(h)(1) provides direct access to the Courts of Appeals to challenge such EPA determinations. Broad, efficient, and prompt access to judicial review is consistent with the other values expressed by the statutory scheme: prioritizing public involvement in monitoring tolerances, as evidenced by the § 346a(d) petition process; and requiring quick EPA responses to changing scientific evidence, as evidenced by the EPA’s continuing obligation to ensure that tolerances remain in compliance with the FFDCA’s safety standards. *See* § 346a(b)(2)(A)(i).

We have recognized that “determining what has and what has not been exhausted . . . may prove an inexact science” and that “questions about whether administrative proceedings would be futile, or whether dismissal of a suit would be consistent with the general purposes of exhaustion, are better addressed through a fact-specific assessment of the affirmative defense than through an inquiry about whether the court has the power to decide the case at all.” *Payne*,

653 F.3d at 870. Finding that a (g)(2)(C) order is a jurisdictional prerequisite would mean that courts would have no ability to analyze whether the administrative process was serving an important role in furthering the development of necessary evidence or was of little value for the issue in question, no matter the significance or the urgency of the question awaiting judicial review.

The EPA makes three main arguments that § 346a(g)(2)(C) is in fact jurisdictional. None are persuasive.

First, the EPA argues that a 1996 amendment to the language of the FFDCA's judicial review provision changing the reviewable orders listed in § 346a(h)(1), indicated a Congressional intent to condition jurisdiction over any orders not listed in Section 346a(h)(1) on their completion of the administrative appeals process. The EPA provides no support for this account of Congressional motivation, which it loosely suggests was a response to a D.C. Circuit decision from nearly a decade earlier finding that the language in the prior version did not require completing an administrative hearing process before filing for judicial review. In fact, the legislative history indicates that the amended statute "retain[ed] most of the existing provisions" regarding judicial review. H.R. Rep. No. 104-669(II), at 49 (1996). But even assuming that Congress's intent with this amendment was to have orders issued in response to petitions go through the § 346a(g)(2) administrative objections process prior to judicial review, that does not bear on the relevant question here, whether Congress intended the new rule as a claims-processing rule or a jurisdictional limitation on the courts.

Second, the EPA argues that the structure of the administrative objections process itself indicates that the process was intended as a jurisdictional requirement, rather

than a claims-processing rule. This argument relies almost entirely on the similarity between § 346a(g)(2)'s objections process and an administrative appeal process that we found jurisdictional in *Gallo Cattle Co. v. United States Department of Agriculture*, 159 F.3d 1194 (9th Cir. 1998). However, *Gallo* was premised on a view of statutory exhaustion that is inconsistent with subsequent Supreme Court precedent and later decisions in this circuit. Compare *id.* at 1197 (“[S]tatutorily-provided exhaustion requirements deprive the court of jurisdiction . . .”), with *McBride*, 290 F.3d at 980 (“[N]ot all statutory exhaustion requirements are created equal. Only statutory exhaustion requirements containing sweeping and direct language deprive a federal court of jurisdiction.”). We have specifically cautioned against reliance on prior cases like *Gallo*, “decided without the benefit of the Supreme Court’s recent admonitions against profligate use of the term jurisdictional.” *Merritt*, 759 F.3d at 1039. Moreover, even without this change in case law, *Gallo* would be inapposite. Unlike § 346a(h)(1), the provision evaluated in *Gallo* was explicitly jurisdictional, providing that “[t]he district courts of the United States . . . are hereby vested with jurisdiction to review [the administrative] ruling.” *Gallo*, 159 F.3d at 1197 (emphasis added).

Finally, the EPA argues that this Court’s statement in its most recent decision in the prior mandamus action forecloses this conclusion. It does not. That decision denied PANNA and the NRDC’s petition for further mandamus relief because it was premised on the ground that the 2017 Order failed to meet the requirements for a final order. Rejecting that view and finding that the 2017 Order was a final denial of the 2007 Petition, this Court instructed PANNA and the NRDC that “[f]iling objections and awaiting their resolution by the EPA Administrator is a prerequisite to obtaining

judicial review of [the] EPA's final response to the petition. Only at that point may we consider the merits of [the] EPA's final agency action." *In re PANNA*, 863 F.3d at 1133. Aside from the fact that none of this language spoke to the jurisdictional issue but only to the issue of exhaustion, the instant appeal is clearly in a different posture. In compliance with our prior ruling, petitioners filed their objections, but the EPA has failed to issue a timely (g)(2)(c) order in response.

In sum, we hold that § 346a(h)(1) is not jurisdictional. It contains no jurisdictional label, is structured as a limitation on the parties rather than the courts, and only references an exhaustion process that is outlined in a separate section of the statute.

B. *Exhaustion*

Where, as here, exhaustion of administrative remedies is not jurisdictional, we "must determine whether to excuse the faulty exhaustion and reach the merits, or require the petitioner to exhaust . . . administrative remedies before proceeding in court." *Rivera v. Ashcroft*, 394 F.3d 1129, 1139 (9th Cir. 2004), *superseded by statute on other grounds as stated in Iasu v. Smith*, 511 F.3d 881, 886 (9th Cir. 2007). "In determining whether exhaustion is required, federal courts must balance the interest of the individual in retaining prompt access to a federal judicial forum against countervailing institutional interests favoring exhaustion." *McCarthy v. Madigan*, 503 U.S. 140, 146 (1992), *superseded by statute on other grounds as stated in Booth*, 532 U.S. 731.

The Supreme Court has identified the two key institutional interests favoring exhaustion as "the twin purposes of protecting administrative agency authority and

promoting judicial efficiency.” *Id.* at 145. Not all cases implicate these interests to an equal degree. Exhaustion protects an agency’s authority “when the action under review involves exercise of the agency’s discretionary power or when the agency proceedings in question allow the agency to apply its special expertise.” *Id.* Exhaustion also protects an agency’s authority by providing the agency “an opportunity to correct its own mistakes with respect to the programs it administers.” *Woodford v. Ngo*, 548 U.S. 81, 89 (2006). “[E]xhaustion principles apply with special force when frequent and deliberate flouting of administrative processes could weaken an agency’s effectiveness by encouraging disregard of its procedures.” *McCarthy*, 503 U.S. at 145.

The institutional interest in requiring exhaustion to protect agency authority appears particularly weak in the present case. The challenged action, permitting the use of chlorpyrifos on food products, does not involve exercise of the EPA’s general discretion, but must take place in compliance with strict statutory directives. The questions presented in this appeal are in no way factual or procedural questions implicating the agency’s “special expertise.” This is not a situation, for example, where the EPA determined a pesticide was safe and the science underlying that determination is challenged. Rather, the purely legal questions here concern the statutory requirements of the FFDCA, and, accordingly, are suited to judicial determination. The crux of petitioners’ challenge is that the EPA has found that chlorpyrifos is not safe and therefore cannot maintain a tolerance for it.

Allowing the petition to proceed would not reward failure to properly exhaust administrative remedies. “Proper exhaustion demands compliance with an agency’s deadlines

and other critical procedural rules because no adjudicative system can function effectively without imposing some orderly structure on the course of its proceedings.” *Woodford*, 548 U.S. at 90–91.

Here, petitioners timely submitted objections to the order denying the 2007 petition to revoke tolerances, fulfilling all of their exhaustion obligations except for the one not within their control—obtaining the EPA’s response to the objections. Petitioners’ objections were filed 13 months ago, and the key issue therein—whether the EPA was statutorily obligated to revoke the tolerance for chlorpyrifos—was first raised to the EPA over a decade ago in the 2007 Petition. This timeline has provided the EPA more than ample opportunity to correct any mistakes on its own. But, despite the statutory requirement that the EPA respond to the objections “as soon as practicable,” it has failed to do so. The history of this litigation supports the inference that the EPA is engaging in yet more delay tactics to avoid our reaching the merits of the sole statutory issue raised here: whether chlorpyrifos must be banned from use on food products because the EPA has not determined that there is a “reasonable certainty” that no harm will result from its use, even under the established tolerances.

The second institutional interest identified by the Supreme Court as potentially favoring exhaustion, judicial economy, counsels against requiring further administrative exhaustion in this instance. Exhaustion offers the greatest support for judicial efficiency where it either permits the agency to “correct its own errors” such that the “judicial controversy may well be mooted, or at least piecemeal appeals may be avoided,” or where administrative review “may produce a useful record for subsequent judicial consideration, especially in a complex or technical factual

context.” *McCarthy*, 503 U.S. at 145. Here, it is just the opposite. Since 2012, we have issued five separate decisions related to the EPA’s inaction on the chlorpyrifos tolerances. Declining to waive exhaustion at this point would make this our sixth decision on the matter without once reaching the merits, setting the stage for yet another “piecemeal appeal[]” if the EPA should someday issue a response to the petitioners’ objection—something the EPA itself has strongly hinted may not come about until 2022, if then. Similarly, further development of the administrative record is of no use to judicial efficiency at this point in the proceedings; there are no factual questions, let alone “complex or technical” ones, at issue—only legal questions. And on the merits of these legal questions, the EPA offers no defense of its inaction, effectively conceding its lawlessness.

While both institutional interests favoring exhaustion are weak, this petition invokes two of the “three broad sets of circumstances in which the interests of the individual weigh heavily against requiring administrative exhaustion.” *McCarthy*, 503 U.S. at 146. First, the Supreme Court has recognized that exhaustion may be excused where “requiring resort to the administrative remedy may occasion undue prejudice to subsequent assertion of a court action. Such prejudice may result, for example, from an unreasonable or indefinite timeframe for administrative action.” *Id.* at 146–47. Most often, an administrative remedy is deemed inadequate “because of delay by the agency.” *Id.* Here, the EPA’s expressed intent to withhold action for years to come is “unreasonable” as applied here, especially as petitioners’ objections concern no factual issues that would require additional time to investigate. The EPA has had over a year to respond to the objections already, with no result.

In *Coit Independence Joint Venture v. Federal Savings & Loan Insurance*, 489 U.S. 561, 586–87 (1989), the Supreme Court held that a claimant was not required to wait for a decision on its administrative appeal before seeking judicial review where the administrative appeal had been pending for over 13 months as of the date of oral argument, and there was no “clear and reasonable time limit on [the agency’s] consideration of . . . claims.” *See also Smith v. Ill. Bell Tel. Co.*, 270 U.S. 587, 591–92 (1926) (holding that a claimant “is not required indefinitely to await a decision of the [administrative] tribunal before applying to a federal court for equitable relief”). Like the regulation evaluated in *Coit*, the EPA’s interpretation of the FFDCA’s administrative review provision as providing limitless time to respond to objections would give the agency “virtually unlimited discretion to bury large claims like [petitioners’] in the administrative process, and to stay judicial proceedings for an unconscionably long period of time.” *Coit*, 489 U.S. at 586. The delay is particularly prejudicial here where the continued use of chlorpyrifos is associated with severe and irreversible health effects. *See Bowen v. City of New York*, 476 U.S. 467, 483 (1986) (concluding that disability-benefit claimants “would be irreparably injured were the exhaustion requirement now enforced against them”); *Aircraft & Diesel Equip. Corp. v. Hirsch*, 331 U.S. 752, 773 (1947) (directing consideration of “irreparable injury flowing from delay incident to following the prescribed procedure” in determining whether to require exhaustion). Petitioners have been waiting over a year for EPA action on their objections, and over eleven years for an EPA decision on chlorpyrifos tolerances, while being

continually exposed to the chemical's effects. This is a sufficient basis to waive or otherwise excuse exhaustion.²

In light of the strong individual interests against requiring exhaustion and weak institutional interests in favor of it, we conclude that petitioners need not exhaust their administrative objections and are not precluded from raising before us the issues at hand on the merits.³

C. The Merits

We now turn to the merits. Petitioners argue that the EPA's decision in its 2017 order to maintain a tolerance for chlorpyrifos in the face of scientific evidence that its residue on food causes neurodevelopmental damage to children is flatly inconsistent with the FFDCFA. Specifically, petitioners argue that a need for additional scientific research is not a valid ground for maintaining a tolerance that, after nearly two decades of studies, has not been determined safe to "a reasonable certainty," and that the EPA cannot delay a decision on tolerances to coordinate that decision with registration review under FIFRA.

The EPA presents no arguments in defense of its decision. Accordingly, the EPA has forfeited any merits-

² Exhaustion may also be excused where "the administrative body is shown to be biased or has otherwise predetermined the issue before it." *McCarthy*, 503 U.S. at 148. The history detailed above strongly suggests that the EPA, for whatever reason, has decided not to ban chlorpyrifos under any circumstances, even when its own internal studies show that it could not possibly make the factual findings necessary to avoid a ban.

³ Because we find judicial review available under § 346a(h)(1), we will not address petitioners' alternative argument that judicial review is available under FIFRA, 7 U.S.C. § 136n(b).

based argument. *See Martinez v. Sessions*, 873 F.3d 655, 660 (9th Cir. 2017).

The FFDCA states unequivocally that the Administrator “shall modify or revoke a tolerance if the Administrator determines it is not safe.” § 346a(b)(2)(A)(i). A tolerance is safe when “the Administrator has determined that there is a *reasonable certainty* that *no* harm will result from aggregate exposure to the pesticide, including all anticipated dietary exposures and all other exposures for which there is reliable information.” § 346a(b)(2)(A)(ii) (emphasis added). Accordingly, the EPA bears a continuing obligation to revoke tolerances that it can no longer find with a “reasonable certainty” are safe.

The EPA’s 2016 risk assessment concluded that its analysis of chlorpyrifos “continues to indicate that the risk from potential aggregate exposure does not meet the FFDCA safety standard” and that “expected residues of chlorpyrifos on most individual food crops exceed the ‘reasonable certainty of no harm’ safety standard.” This finding was the EPA’s final safety determination before the 2017 EPA Order. The 2017 Order declined to revoke chlorpyrifos tolerances but did not make a finding of reasonable certainty that the tolerances were safe. Instead, it found “significant uncertainty” as to the health effects of chlorpyrifos, which is at odds with a finding of “reasonable certainty” of safety under § 346a(b)(2)(A)(ii) and therefore mandates revoking the tolerance under § 346a(b)(2)(A)(i).

“[H]owever desirable it may be for [the] EPA to consult [a Scientific Advisory Board] and even to revise its conclusion in the future, that is no reason for acting against its own science findings in the meantime.” *Chlorine Chemistry Council v. EPA*, 206 F.3d 1286, 1290 (D.C. Cir. 2000). The EPA cannot refuse to act “because of the

possibility of contradiction in the future by evidence unavailable at the time of action – a possibility that will *always* be present.” *Id.* at 1290–91 (emphasis in original). Chlorpyrifos similarly does not meet the statutory requirement for registration under FIFRA, which incorporates the FFDCA’s safety standard. As we have previously counseled, “evidence may be imperfect [and] the feasibility inquiry is formidable,” but there remains no justification for the “EPA’s continued failure to respond to the pressing health concerns presented by chlorpyrifos,” which has now placed the agency in direct contravention of the FFDCA and FIFRA. *In re PANNA*, 840 F.3d at 105.

Accordingly, we **GRANT** the petition for review. The EPA’s 2017 Order maintaining chlorpyrifos is **VACATED**, and the case is remanded to the EPA with directions to revoke all tolerances and cancel all registrations for chlorpyrifos within 60 days.

FERNANDEZ, Circuit Judge, dissenting:

League of United Latin American Citizens, Pesticide Action Network North America (PANNA), Natural Resources Defense Council (NRDC), California Rural Legal Assistance Foundation, Farmworkers Association of Florida, Farmworker Justice GreenLatinos, Labor Council for Latin American Advancement, Learning Disabilities Association of America, National Hispanic Medical Association, Pineros Y Campesinos Unidos del Noroeste, and United Farm Workers (collectively, “LULAC”) petition for review of the Environmental Protection Agency’s (EPA) 2017 order denying a 2007 petition to revoke all tolerances for the pesticide chlorpyrifos (hereafter “the Pesticide”). *See* Chlorpyrifos; Order Denying PANNA and NRDC’s Petition

to Revoke Tolerances, 82 Fed. Reg. 16,581, 16,583 (Apr. 5, 2017) (the “2017 Order”).¹ In the briefs (not in the petition for review), LULAC and the States ask for a writ of mandamus ordering EPA to respond to the objections they filed to the 2017 Order. In their brief, the States also ask for a writ of mandamus compelling the EPA to issue a final rule revoking chlorpyrifos tolerances.

The EPA regulates the use of pesticides on food pursuant to the Federal Food, Drug, and Cosmetic Act² (FFDCA) and the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).³ At present, the Pesticide is registered as an insecticide for food crops and non-food settings. In the view of LULAC and the States, the Pesticide is unsafe⁴ and the EPA should modify or revoke the tolerances it has established for the Pesticide pursuant to FFDCA. *See* 21 U.S.C. § 346a(a)(1)(A), (b)(1). For that matter, they believe that the EPA should cancel the Pesticide’s registration for food crops under FIFRA. *See* 7 U.S.C. § 136a(g)(1)(A)(v). In September 2007, PANNA and NRDC filed an administrative petition with the EPA seeking revocation of the Pesticide’s FFDCA food tolerances and cancellation of its FIFRA registrations (the 2007 Petition). On April 5, 2017, the EPA issued the 2017 Order in which it denied the 2007 Petition. *See* 82 Fed. Reg. at 16,581.

¹ The States of New York, Maryland, Vermont, Washington, California, and Hawaii, as well as the Commonwealth of Massachusetts and the District of Columbia (collectively, “the States”), are Intervenor in support of LULAC’s petition.

² 21 U.S.C. §§ 301–399g.

³ 7 U.S.C. §§ 136–136y.

⁴ *See* 21 U.S.C. § 346a(a)(1).

LULAC and certain states filed objections to the 2017 Order on June 5, 2017, and on that same date, LULAC filed the instant petition for review of the merits of the 2017 Order.

JURISDICTION

The majority holds that we have jurisdiction over the petition for review. I disagree. Of course, we do have jurisdiction to determine whether we have jurisdiction over the petition for review. *See Special Invs. Inc. v. Aero Air Inc.*, 360 F.3d 989, 992 (9th Cir. 2004). Nonetheless, “[w]e presume that federal courts lack jurisdiction unless the contrary appears affirmatively from the record.” *DaimlerChrysler Corp. v. Cuno*, 547 U.S. 332, 342 n.3, 126 S. Ct. 1854, 1861 n.3, 164 L. Ed. 2d 589 (2006). Thus, “the party asserting federal jurisdiction . . . has the burden of establishing it.” *Id.* Here LULAC⁵ attempts to meet that burden by pointing to the judicial review provisions of FFDCFA. *See* 21 U.S.C. § 346a(h).⁶ It also relies on FIFRA. *See* 7 U.S.C. § 136n(b). The States also point to 5 U.S.C. §§ 704, 706 as a possible source of jurisdiction. In my view, all of those attempts fail. Hence I would dismiss the petition.

A. Jurisdiction Under FFDCFA

The 2017 Order was issued pursuant to § 346a(d)(4)(A)(iii). In seeking to obtain FFDCFA jurisdiction, LULAC relies upon § 346a(h)(1) which, as pertinent here, provides that:

⁵ What I determine hereafter regarding LULAC also applies to the States unless otherwise indicated.

⁶ Hereafter, all references to § 346a are to 21 U.S.C. § 346a.

In a case of actual controversy as to the validity of . . . any order issued under subsection . . . (g)(2)(C) [of this section], . . . any person who will be adversely affected by such order . . . may obtain judicial review by filing in the United States Court of Appeals for the circuit wherein that person resides or has its principal place of business . . . a petition praying that the order . . . be set aside in whole or in part.

Unfortunately for LULAC's argument, the subsection referred to in the above quotation from § 346a(h)(1) is the subsection that provides for the EPA to issue an order following objections to a previous order of the EPA and that agency's processing of those objections. *See* § 346a(g)(2). That, by the way, is the process to which we pointed the parties in our earlier consideration of the EPA's proceedings regarding the Pesticide and stated that only after the review was completed "may we consider the merits of EPA's 'final agency action.'" *Nat. Res. Def. Council, Inc. v. U.S. EPA (In re PANNA)*, 863 F.3d 1131, 1133 (9th Cir. 2017). Specifically, § 346a(g)(2)(A) provides that a person may file objections to an order issued under § 346a(d)(4), as the 2017 Order was. The EPA may then hold a public evidentiary hearing upon request or upon its own initiative. *See* § 346a(g)(2)(B). An appropriate "order stating the action taken upon each such objection and setting forth any revision to the . . . prior order" must then be issued. *Id.* at (C). Pursuant to the plain reading of the above subsection taken

as a whole,⁷ then, and only then, can judicial review in this court be sought pursuant to § 346a(h)(1).

But, says LULAC, the requirement is no more than a claim-processing rule⁸ rather than a true jurisdictional rule.⁹ The majority agrees; I am not convinced. Here Congress was very careful and very specific about the class of cases—the limited kind of orders—over which it wished to give the courts of appeals direct review. It made it plain that we could not review the EPA’s actions in this specific area until the agency had developed and considered a full record regarding objections and the like. Before that occurred, judicial review was not available; we had no authority whatsoever to consider the issue. As the Second Circuit Court of Appeals has pointed out, § 346a(h)(1) is “unique in that it only commits certain specific agency actions to appellate court review.” *Nat. Res. Def. Council v. Johnson*, 461 F.3d 164, 172 (2d Cir. 2006). In light of that careful restriction on judicial review, it is not at all likely that Congress would

⁷ See *Nuclear Info. & Res. Serv. v. U.S. Dep’t of Transp. Research & Special Programs Admin.*, 457 F.3d 956, 960 (9th Cir. 2006).

⁸ See *Henderson ex rel. Henderson v. Shinseki*, 562 U.S. 428, 435, 131 S. Ct. 1197, 1203, 179 L. Ed. 2d 159 (2011) (claim-processing rules merely “seek to promote the orderly progress of litigation by requiring that the parties take certain procedural steps at certain specified times”).

⁹ “‘Jurisdiction’ refers to ‘a court’s adjudicatory authority.’” *Reed Elsevier, Inc. v. Muchnick*, 559 U.S. 154, 160, 130 S. Ct. 1237, 1243, 176 L. Ed. 2d 18 (2010). “Accordingly, the term ‘jurisdictional’ properly applies only to ‘prescriptions delineating the classes of cases (subject-matter jurisdiction) . . .’ implicating that authority.” *Id.* at 160–61, 13 S. Ct. at 1243; see also *Payne v. Peninsula Sch. Dist.*, 653 F.3d 863, 868 (9th Cir. 2011) (en banc), *overruled on other grounds by Albino v. Baca*, 747 F.3d 1162, 1171 (9th Cir. 2014) (en banc).

have authorized our seizing jurisdiction before the specific agency action was concluded. Lest there be any doubt, Congress also precluded possible bypassing of the § 346a(g)(2) provisions when it directed that no “judicial review under any other provision of law” would be permitted. Section 346a(h)(5); *see also Johnson*, 461 F.3d at 172–74. And that is further emphasized by the fact that the section does not speak in general language of finality or exhaustion;¹⁰ it, rather, states specifically when we can assume review authority over the particular matters. Had Congress contemplated appellate court review before the EPA completed the process required by § 346a(g)(2)(C), it could easily have inserted orders under § 346a(d)(4), or, more specifically, § 346a(d)(4)(A)(iii) into the judicial review provisions of § 346a(h)(1), which, of course, it did not do. Rather, it expressly allowed judicial review only over the agency’s ruling on objections that had to be filed with the agency, and not before. *See Gallo Cattle Co. v. U.S. Dep’t of Agric.*, 159 F.3d 1194, 1197–98 (9th Cir. 1998); *see also McBride Cotton & Cattle Corp. v. Veneman*, 290 F.3d 973, 979–80 (9th Cir. 2002) (discussing *Gallo Cattle*). That is particularly telling because earlier iterations of the review provisions contained no such jurisdictional limitations. *See Nat’l Coal. Against the Misuse of Pesticides v. Thomas*, 809 F.2d 875, 878–79 (D.C. Cir. 1987).

In short, I see no basis for deconstructing that carefully constructed jurisdictional scheme and thereby inviting

¹⁰ *Cf. Anderson v. Babbitt*, 230 F.3d 1158, 1162 (9th Cir. 2000); *Rumbles v. Hill*, 182 F.3d 1064, 1067 (9th Cir. 1999).

premature attacks on matters committed to the expertise of the agency in the first instance.¹¹

B. Jurisdiction under FIFRA

LULAC then argues that because it not only asked for the EPA to revoke all tolerances for the Pesticide but also asked the EPA to cancel all registrations for the Pesticide, the 2007 Petition to the EPA arose under both the FFDCA and FIFRA. Thus, it argues, it need not abide by the FFDCA review provisions, but can rely on the jurisdictional provisions of the FIFRA to establish our jurisdiction. *See* 7 U.S.C. § 136n(b). I do not agree.

Rather, I am persuaded by the cogent reasoning of the Second Circuit Court of Appeals in a strongly similar situation. *See Johnson*, 461 F.3d at 176. In that case, pursuant to the FFDCA provisions, NRDC also challenged the EPA's setting of tolerances for residues on food of five pesticides (not including the Pesticide). *Id.* at 169–70. NRDC added that their registration should be cancelled pursuant to FIFRA. *Id.* at 176. NRDC had brought its action in the district court, and on appeal the Second Circuit determined that the district court did not have jurisdiction to review the EPA determination under the FFDCA because, as § 346(a)(h)(1), (5) provide, jurisdiction over those claims was limited to the courts of appeals. *Id.* at 172–76. NRDC

¹¹ Because the completion of the administrative process is jurisdictional, I do not consider LULAC's fallback argument that it would be futile to pursue the prescribed process. *See Sun v. Ashcroft*, 370 F.3d 932, 941 (9th Cir. 2004); *see also Ross v. Blake*, ___ U.S. ___, ___, 136 S. Ct. 1850, 1857, 195 L. Ed. 2d 117 (2016); *Gallo Cattle*, 159 F.3d at 1197.

then argued that the district court still had jurisdiction pursuant to FIFRA. The court replied:

However, FIFRA's grant of jurisdiction to the district courts is irrelevant. The NRDC Appellants "challenge the registration of pesticides under FIFRA only through their challenge to the tolerances set under the [F]FDCA." Essentially, therefore, the violations of FIFRA alleged by the NRDC Appellants "amount to challenges to the methodologies used in reaching the reassessment determinations at issue" in this case. As such, these challenges represent an "issue as to which review is or was obtainable under Section 346a(h). Section 346a(h)(5) precludes judicial review of these issues "under any other provision of law." The NRDC Appellants' attempt to find independent jurisdiction for their claims under FIFRA is thus precluded by the express language of § 346a(h)(5). The NRDC Appellants' claims are reviewable only in the courts of appeals, and only after they have exhausted the statutory provisions for administrative review.

Id. at 176 (citations omitted).

I accept that reasoning and the same reasoning should apply here. It would foreclose LULAC's argument. LULAC essentially argues that the EPA has erred in maintaining tolerances for the Pesticide, which is an unsafe insecticide, and for that same reason it argues that the EPA must forthwith revoke registration of the Pesticide. It argues

that it should not have to wait for the EPA to rule on its registration claim, but that is just an allotrope of its central arguments against waiting for relief under the FFDCAs tolerances provision with which its FIFRA argument is “inextricably intertwined.” *See Ctr. for Biological Diversity v. U.S. EPA*, 847 F.3d 1075, 1089 (9th Cir. 2017). Therefore, the FIFRA provision does not offer a way to avoid the judicial review provisions of the FFDCAs in this instance.

Thus, I would dismiss the petition for review for lack of jurisdiction.¹²

WRIT OF MANDAMUS

In its briefs, LULAC asks us to issue a writ of mandamus¹³ directing that the EPA respond to its objections within sixty days. However, LULAC did not file a petition for issuance of that writ and, therefore, made no attempt to comply with the Federal Rules of Appellate Procedure when it filed its petition for review of the merits of the 2017 Order. *See Fed. R. App. P. 21(a), (c); see also Fed. R. App. P. 20*. I see no reason to treat LULAC’s petition for review as, in fact, one for a writ of mandamus. It was not, and could not have been, a mere instance of mislabeling a request for relief that was sought. Had LULAC intended to seek a writ of

¹² I do not overlook the States’ argument regarding 5 U.S.C. §§ 704, 706 (the Administrative Procedure Act provisions). But those provisions do not confer direct review jurisdiction upon this court. *See Gallo Cattle*, 159 F.3d at 1198; *see also Califano v. Sanders*, 430 U.S. 99, 106–07, 97 S. Ct. 980, 985, 51 L. Ed. 2d 192 (1977). Therefore, they add nothing of substance to the petition for review issues now before us.

¹³ *See* 28 U.S.C. § 1651(a); *see also Cal. Cmty. Against Toxics v. U.S. EPA (In re A Cmty. Voice)*, 878 F.3d 779, 783 (9th Cir. 2017).

mandamus, rather than a merits review, that would have been most peculiar because on that same day LULAC had just filed its objections to the 2017 Order. It could not honestly complain about delay in considering its objections at that point. Were I to decide otherwise, I would essentially ignore our holding, which was handed down after this petition for review was filed, but before the briefs were filed, and which declared that PANNA and NRDC must file their objections and await resolution of those objections by the EPA before we would consider the merits of the EPA's actions regarding the Pesticide. *See Nat. Res. Def. Council*, 863 F.3d at 1133.

Thus, this case is quite unlike cases where we decided that a party improperly sought to appeal an interim procedural order rather than a decision on the merits of a case, but we also considered whether we should construe the appeal as a petition for a writ of mandamus. *See Kum Tat Ltd. v. Linden Ox Pasture, LLC*, 845 F.3d 979, 983 (9th Cir. 2017) (discussing order denying arbitration request); *Johnson v. Consumerinfo.com, Inc.*, 745 F.3d 1019, 1023 & n.2 (9th Cir. 2014) (discussing order compelling arbitration and staying judicial proceedings); *see also United States v. Davis*, 953 F.2d 1482, 1497–98 (10th Cir. 1992) (dismissing request for mandamus by defense counsel in criminal conviction appeal where no petition had been filed); *EEOC v. Neches Butane Prods. Co.*, 704 F.2d 144, 146, 151–52 (5th Cir. 1983) (denying request that an appeal from a stay of proceedings pending compliance with discovery orders be treated as a mandamus petition where requesting party was represented by competent counsel and should have filed a petition therefor); *Jones & Guerrero Co., Inc. v. Sealift Pac.*, 650 F.2d 1072, 1073–74 (9th Cir. 1981) (per curiam) (refusing to construe appeal from order remanding case to

Guam Superior Court as a petition for mandamus where no mandamus petition filed).

In short, I would decline to treat LULAC's petition as one for a writ of mandamus. Of course, I express no opinion on whether or when LULAC can or should file a petition for a writ of mandamus because LULAC deems the EPA's consideration of the objections to have been unduly delayed. *See PANNA v. U.S. EPA (In re PANNA)*, 798 F.3d 809, 813 (9th Cir. 2015); *Telecomms. Research & Action Ctr. v. FCC*, 750 F.2d 70, 80 (D.C. Cir. 1984).

Thus, I respectfully dissent from parts A and B of the Discussion in the majority opinion. As a result, I do not decide the issue in part C although I do find the discussion therein does have some persuasive value.



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Field Evaluation of Commercially Available Small Unmanned Aircraft Crop Spray Systems

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ABSTRACT. *Agricultural research and development on small unmanned aircraft systems (UAS) has been directed toward UAS enabled sensing to detect features of interest. While compelling, there is an immediate need to increase the breadth and depth of UAS-based research, to move beyond sensing, and explore active intervention in agricultural production systems. This paper is focused on the concept of crop protection through ultra-precise, unmanned aerial application systems, and seeks to initiate research discussion in this important area of opportunity. Toward this end, two different, commercially available, small Unmanned Aerial Application Systems (sUAAS - defined as less than 55 lbs. maximum take-off weight) were evaluated for operational techniques and application system efficacy under dynamic field conditions. The performance of the factory supplied spray equipment systems are documented using traditional aerial spray testing methods that have been modified for UAS enabled application systems, referred to as small Unmanned Aerial Application Systems (sUAAS). Results from initial testing protocols indicate that the factory supplied systems are quite different in design and implementation, with spray test results that reflect this difference in design, in both deposition and spray swath. Further, it is apparent that with the advent of unmanned aerial application systems, and the unique characteristics of the integrated aircraft and application systems, there is a very real need for the development of standardized sUAAS testing procedures.*

Keywords. *Unmanned aircraft, unmanned aerial application systems, unmanned aerial spray systems, spray pattern testing, drone sprayer, wind tunnel testing*

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Introduction

The opening of National Air Space to small unmanned aircraft is already becoming a “game changer” for agriculture. Unmanned aircraft systems (UAS) will offer an unparalleled opportunity to place sensors, robotics, and advanced information systems at desired locations for increasing production and improving efficiency of agricultural operations. Research on deployment of UAS for sensing agricultural systems continues to expand, with emphasis on early detection of stress, informing precision agriculture, and advances in phenotyping (Woldt et al., 2016).

At the same time, it is possible to envision unmanned aircraft systems that allow direct interaction within their proximal environment. These systems represent active engagement of the UAS in the agricultural production system and have the potential to continue the evolution of unmanned aircraft in agriculture. One area of promise is the use of unmanned aircraft for application of beneficial products for crop and/or animal agriculture. Toward this vision, this paper is focused on the concept of crop and/or animal protection through ultra-precise small unmanned aerial application systems (sUAAS -- or simplified to UAAS). As such, it seeks to initiate exploration and begin to solve fundamental science and engineering challenges, as these new aerial spray technologies continue to evolve.

While ultra-precise unmanned aircraft spray technologies exist and can be purchased, the technology is so new that standard methods for testing UAS spray system performance have not yet been developed. As a result, vendors are providing equipment that offers somewhat coarse guidance on achieving a desired application rate. This is understandable, given the lack of UAAS testing methods. The purpose of the research reported in this paper is to document the use of spray testing methods that have been modified from traditional piloted aerial testing protocols, to allow for use with UAAS. Two different, factory supplied UAAS were deployed, without any modifications, and results of the field-based research using the modified protocol for spray testing has been documented and reported.

Opportunities

Small unmanned aerial application systems will offer many opportunities for agriculture. Some of these opportunities are noted from agronomic prospects, entomology points of view, and plant pathology perspectives. As resistant weed populations continue to increase, a multifaceted approach to weed management will only become more critical. An important component of resistance management is early detection and rapid response. If resistant populations can be detected early they are often contained to a relatively small area of a field. These small 'patches' of resistant weeds provide an ideal opportunity for targeted herbicide applications. If unmanaged and allowed to go to seed, these patches will often spread over an entire field by the subsequent growing season. The potential economic gain from targeted herbicide applications to small resistant weed populations could be great when compared with the cost of field-wide herbicide programs.

Insect and mite infestations in crops often are not uniform, particularly when the pest colonizes the field from outside areas. Many examples of this exist, including grasshoppers which move into crop fields from nearby untilled areas where eggs overwinter, pivot corners or south facing portions of fields where spider mites may first develop, or infestations by aphids which fly into fields from a distance. Early detection of plant stress or injury by UAS may allow treatment of pest 'hot spots' by UAAS before the infestation becomes more widespread and increasingly costly to treat. Limiting the amount of pesticide applied would have economic benefits as well as ecological benefits by limiting the potential disruption by pesticides of natural biological controls in a field.

Like other pests, plant diseases often develop in seemingly random spots in fields that may be due to a number of conditions, such as wet spots in fields, recent pathogen introductions, spore showers, etc. Often, the pathogen continues to spread from these areas much further into growing crops dramatically increasing their impacts. The same advantages that early detection of diseases in fields of insects/mites and treatment of those spots with UAAS to limit spread, could also help to reduce mitigate overall impacts of disease. Spot treatment for some diseases may prevent or delay the need for widespread treatment of entire fields. Some examples may be the initial development of diseases, such as southern rust in corn, that often develop quickly. Southern rust is often treated with foliar fungicides because there is little plant resistance to it in commercially available corn hybrids and this disease has the potential to rapidly spread and cause severe yield loss under favorable weather conditions. Early detection and spot treatment may allow for more effective and economical control.

Background

Perhaps one of the earliest reported efforts to advance small unmanned aerial application systems can be found in the research reported by Huang et.al. in 2008 and 2009, in which the development of an unmanned aerial spray vehicle for highly accurate application of product is described in an ASABE conference proceeding, followed by an ASABE Applied Engineering in Agriculture journal article, respectively. The emphasis was on the enabling technology that would support a small unmanned aerial application system. Following this early work on enabling technology, Qiu et.al. (2012) describe

research in which a strong correlation is observed between unmanned helicopter flight altitude and speed, and the resulting spray deposition and uniformity. Continuing to build on their early work, a more exhaustive exploration of unmanned aerial application technologies can be found in the work by Huang et.al. (2013).

In order to improve spray uniformity, when using an unmanned helicopter, Bae and Koo (2013) developed a different airframe configuration in which roll balancing was pursued, with somewhat improved results. Additional research on spray drift and deposition can be found in the work by Xinyu et.al. (2014), in which effectiveness of the UAAS spray deposition was tested on a paddy field. Their results tend to indicate that the UAAS deposition efficiency is better than traditional spray systems. Additional research on spray efficiency has been reported by Qin et.al. (2014) in which water sensitive cards were placed at four different levels within a maize canopy. Their results pointed to recommendations for working height of the UAAS above canopy and a recommended spray swath width to achieve the maximum efficiency for the given aircraft/spray system.

Extending the technological and field testing further, Zhang et.al. (2015) developed a simulation model to predict aerial spray drift from an unmanned helicopter, and then ran an experimental verification test to evaluate the model performance. Comparison of the predicted and observed drift curves revealed a promising coincidence. Continuing to explore advances in UAAS, Ru et.al. (2015) developed and conducted flight testing on an electrostatic UAAS. Their results tend to indicate that flight height above canopy had a much greater impact on spray drift, and the electrostatic system offered negligible improvement in drift control. Given the flight characteristics of multi-rotor UAAS, Wang et.al. (2016 and 2016) explored the downwash flow field distribution and found it to be a viable method for analysis of spatial spray deposition distribution under various conditions of flight altitude and crosswind. Zhou and He (2016) report similar research in which water sensitive papers were placed in a crop, and the UAAS was flown at three different velocities. Results indicate that uniformity was improved while droplet density and percentage of spray coverage were decreased as the flight velocity increased.

More recently, Wang et.al. (2017) conducted spray drift research for a single rotor airframe, and concluded that more research is needed provide data to support spray drift control, and to establish aviation spray standards. Research by Chen et.al. (2017) evaluated different methods for testing effective spray width of UAAS, and provides guidance on selecting the more suitable protocols for evaluation of spray swath pattern. A fairly exhaustive study was conducted by Wang et.al. (2017) in which four different aircraft were tested with multiple trials, to develop more of a statistical approach to testing. The results of this study provide insight into the determination of spraying parameters, environmental conditions of UAAS operation, and the formulation of working practices for aerial spraying. A rather unique approach to aerial application is reported by Rodriguez et.al. (2017) in which Herbicide Ballistic Technology (ie, paintball gun type of system) is affixed to a UAAS and highly targeted application of herbicides is achieved in areas that are very difficult to access, and yet the ecosystems are extremely sensitive to herbicides. Finally, Teske et.al. (2018) are reporting on the use of simulation models CHARM+AGDISP to predict the drift and deposition of sprays released from rotary wing UAAS.

Brief comment on regulations

Upon a more in-depth review of the UAAS literature, it becomes apparent that most of the research has been conducted and reported in the Transactions of the Chinese Society of Agricultural Engineering. Perhaps one of the reasons for this can be traced to the regulatory environment for unmanned aircraft. The U.S. Federal Aviation Administration only recently allowed commercial flight of unmanned aircraft in the National Airspace System, through the promulgation of Part 107 rules and regulations for unmanned aircraft systems (FAA, 2016). While it is recognized that Part 107 does permit flight of UAS for commercial purposes, the regulations do not allow for using unmanned aircraft for aerial application systems. At the same time, the Part 137 FAA rules that govern agricultural aircraft operations (FAA, 2018) do not provide for the use of unmanned aircraft systems for aerial application of economic poisons. As a result, the use of unmanned aircraft for aerial application of economic poisons requires specific waivers to both sets of regulations (Part 107 and Part 137), and a certified pilot, or pilots, that hold appropriate pilot certifications for unmanned aircraft and aerial application. Currently, these requirements lead to confusion and difficulty in achieving legal status to fly unmanned aircraft with economic poisons as a payload. These challenges have resulted in minimum progress on UAAS research and development in the United States.

There is a long history of research, development and testing of piloted aerial application systems, including ASTM standards, and an in-depth base of literature on the topic. Piloted aircraft are large, perhaps up to 3,000 liter carrying capacity, and move at a rapid pace, with airspeeds up to 160 kts. At the same time, there is a similar depth of research and literature on spray nozzle testing in wind tunnel environments, to understand more about nozzle performance under dynamic conditions, in fast moving air streams, to emulate spray aircraft. However, with the emerging potential for sUAAS, there is a corresponding need to engage in research and development, to learn more about the performance of these new systems, including the types of applications for which they are most suited. This might include spot spraying of weed patches, edge spraying, spraying small infestations of invasive species in wetland ecosystems, application of dry granular product for mosquito control, as well as a host of other applications that fit the mission profile of a sUAAS platform. This research seeks to develop an initial exploration into field testing of commercially available sUAAS, without any modifications to the factory configuration.

Methods

Field / Flight Test

This study was conducted in an unpaved area surfaced with gravel in Burlinson County, near College Station, TX (30° 40' N, 96° 18' W). Two UASs, DJI Agras MG-1 (Dà-Jiāng Innovations, Shenzhen, Guangdong, China) and V6A (Homeland Surveillance and Electronics, Seattle, WA), were launched to determine the effect of application height and ground speed on spray pattern uniformity and spray droplet spectra characteristics. The MG-1 platform was equipped with XR11001 nozzles (TeeJet Technologies, Wheaton, Ill.) and V6A platform was equipped with CR80005 nozzles (Lechler). The nozzle pressures were 226 and 517 kPa, respectively, for the MG-1 and V6A models. The nozzle configuration was different for each airframe. The MG-1 has a “square nozzle pattern” with two nozzle following two nozzles along the flight path. The V6A has a more conventional boom, with the four nozzles in a single line, perpendicular to the direction of flight (see Table 1).

Table 1. UAS spray application system parameters.

Platform	Nozzle	# of nozzles	Pressure (kPa)	Flow Rate (ml/min.)
MG-1	XR11001	4 (square)	226	354
V6A	CR80005	4 (in line)	517	197

The treatments comprised of three application heights, 2, 3 and 4 m in cohort with four ground speeds, 1, 3, 5 and 7 m/s. Each treatment was replicated four times. A spray mix of tap water with Vision Pink™ dye (GarrCo Products, Converse, IN) at 20 ml/l was sprayed parallel to the prevailing wind over the centerline of an 11 m long x 1 mm diameter cotton string, suspended 1 m above the ground. The amount of fluorescent dye deposited on the cotton string was analyzed fluorometrically using the USDA Swath Analysis System (Hoffmann and Jank, unpublished). Fluorometric response on cotton string was used to assess pattern uniformity and effective swath.

The spectrometer (fluorometer) used for the system has a wavelength measurement range of 200-850 nm at a resolution of 1.5 nm. As the string went through the photocell, the strength of the emission signal at 405 nm would vary depending out how much dye had deposited on the string. The analysis software that was developed only read the signal strength at the 405 nm wavelength, which meant that ambient light did not interfere with the string signal. The string patterns were analyzed with custom USDA-ARS pattern analysis software. Each pattern from each replication first was evaluated individually to determine if the integrity of the deposition data was sufficient to be included in the analysis. The best example of this is if a strong crosswind were to move more than half of the spray off of the string. Those data would then not be included. In all cases, at least two patterns were used for the analysis. It was rare to have less than three replications included for the analysis. The good patterns were first centered using the centroid feature in the software. This feature determines the area under the curves and places the center of the area on the centerline. This helps to correct for the effect of crosswinds. The corrected patterns then were averaged and an effective swath was determined objectively by choosing the widest effective swath with a CV less than 25%. The data also were analyzed by documenting the CV for all treatments at a set effective swath of 4.6 m. This was another way to perform a direct comparison of the two application systems.

Spray droplet spectra were determined using water sensitive paper (WSP) samplers (26 x 76 cm) (Spraying Systems, Wheaton, Ill.). Five WSPs were inserted each into a paper clip attached to separate wooden blocks, and were placed 1-m apart on a table oriented parallel to the cotton string. Soon after spray application was conducted, WSPs were placed inside photographic negative sleeves and transported to the laboratory for analysis. Spray droplet spectra data were analyzed by the DropletScan™ scanner-based system (Whitney and Gardisser, 2003). The droplet spectra parameters measured were $D_{v0.1}$, $D_{v0.5}$, $D_{v0.9}$, percent area coverage and spray application rate. $D_{v0.1}$ is the droplet diameter (μm) where 10% of the spray volume was contained in droplets smaller than this value. Similarly, $D_{v0.5}$ and $D_{v0.9}$ are droplet diameters where 50% and 90% of the spray volume, respectively, contained droplets smaller than these values. $D_{v0.5}$ is commonly known as the Volume Median Diameter (VMD).

Spray Nozzle Test in Wind Tunnel

The spray-droplet spectrum for each UAS spray nozzle was evaluated using the low-speed wind tunnel at the Pesticide Application Technology Lab in North Platte, NE. The droplet spectrum for each treatment was analyzed using a Sympatec HELOS- VARIO/KR laser diffraction system with the R7 lens. The laser is controlled by WINDOX 5.7.0.0 software, which was operated on a computer adjacent to the wind tunnel. This lens is capable of detecting droplets in a range from 9 to 3,700 μm . The laser consists of two main components, an emitter housing containing the optical box and the source of the laser and a receiver housing containing the lens and detector element. The two laser housings were separated (1.2 m) on each side

of the wind tunnel and mounted on an aluminum optical bench rail that connected underneath the wind tunnel to ensure proper laser alignment. The spray plume was oriented perpendicular to the laser beam and traversed through the laser beam by means of a mechanical linear actuator. The actuator moves the nozzle at a constant speed of 0.2 m/s, such that the entire spray plume would pass through the laser beam. The distance from the nozzle tip to the laser was 30 cm. Treatments in this study were compared using the $D_{v0.1}$, $D_{v0.5}$, and $D_{v0.9}$ parameters (Creech et al., 2016).

Data Analysis

Data were sorted by aircraft platform type and were analyzed using Proc GLM procedure (SAS, 2012). Means with significant F -values were separated using Duncan's Multiple Range Test (DMRT) at $P = 5\%$.

Results

Field / Flight Test

The spray droplet spectra data presented in Tables 2 and 3 shows that the differences in droplet parameters were caused by the differences in nozzle type, nozzle orifice size, spray pressure and flow rate. The V6A model was equipped with lechler nozzle, CR80005, with a flow rate of 197 ml/min., while the MG-1 model was equipped with XR11001 nozzle with a flow rate of 354 ml/min. Flow rate has a direct relation to drop size. An increase in flow rate will increase the drop size; similarly a decrease in flow rate will decrease drop size. Pressure has an inverse relationship effect on drop size. An increase in pressure will reduce the drop size. A reduction in pressure will increase the drop size. The atomization of liquids into spray droplets depends upon a number of factors among others, such as spray volume and nozzle type (Creech et al., 2015; Hoffmann and Kirk, 2005; Whisenant et al., 1993). As expected, MG-1 model aircraft with a larger orifice size and flow rate produced larger spray droplets than those of V6A aerial delivery system.

Table 2. Effect of application height and ground speed on spray droplet spectra for UAS model MG-1.

Application Height (m)	$D_{v0.1}$	$D_{v0.5}$	$D_{v0.9}$	Coverage (%)	Liters/ha
2	152.7a	260.4a	371.9a	4.2a	15.3a
3	167.9a	265.1a	373.1a	5.6a	16.7a
4	148.6a	244.1a	347.3a	3.2a	11.5a
df =2,188	$F=2.4$ $P>0.1$	$F=1.5$ $P>0.2$	$F=1.6$ $P>0.2$	$F=2.3$ $P>0.1$	$F=1.0$ $P>0.4$
Ground Speed (m/s)	$D_{v0.1}$	$D_{v0.5}$	$D_{v0.9}$	Coverage (%)	Liters/ha
1	155.3ab	274.9ab	420.2a	9.4a	34.4a
3	146.7b	245.0bc	340.0c	2.5b	9.1b
5	184.9a	279.2a	379.3b	4.01b	9.3b
7	142.7b	231.2c	321.6c	1.4b	4.8b
df=3,188	$F=4.3$ $P>0.0056$	$F=5.0$ $P>0.0024$	$F=13.5$ $P<0.0001$	$F=14.5$ $P<0.0001$	$F=29.1$ $P<0.0001$

Means followed by the same lower case letters are not significantly different ($P = 5\%$).

Table 3. Effect of application height and ground speed on spray droplet spectra for UAS model V6A.

Application Height (m)	D _{v0.1}	D _{v0.5}	D _{v0.9}	Coverage (%)	Liters/ha
2	124.7a	206.1a	292.7a	2.1a	7.0a
3	108.9b	174.1b	252.6b	2.0a	6.1a
4	111.9b	172.3b	242.1b	0.9b	2.7b
df=2,180	<i>F</i> =11.8 <i>P</i> <0.0001	<i>F</i> =28.5 <i>P</i> <0.0001	<i>F</i> =24.6 <i>P</i> <0.0001	<i>F</i> =7.3 <i>P</i> >0.0009	<i>F</i> =7.6 <i>P</i> >0.0007
Ground Speed (m/s)	D _{v0.1}	D _{v0.5}	D _{v0.9}	Coverage (%)	Liters/ha
1	116.3a	195.2a	291.9a	3.8a	12.3a
3	118.3a	192.0a	275.5b	1.6b	4.9b
5	116.1a	178.2b	246.3c	1.0bc	3.0bc
7	111.2a	174.3b	241.4c	0.4c	1.3c
df=3,180	<i>F</i> =1.5 <i>P</i> >0.2	<i>F</i> =6.6 <i>P</i> >0.0003	<i>F</i> =17.1 <i>P</i> <0.0001	<i>F</i> =31.7 <i>P</i> <0.0001	<i>F</i> =30.4 <i>P</i> <0.0001

Means followed by the same lower case letters are not significantly different ($P = 5\%$).

Application height significantly influenced spray droplet spectra for V6A; however the opposite was true for MG-1. Ground speed significantly influenced spray droplet spectra parameters for both aircraft systems. Spray coverage was higher at 1 m/s ground speed compared to 3 m/s for both aircrafts. While ground speed higher than 3 m/s did not increase coverage for MG-1 aircraft, increased ground speed did decrease coverage for V6A aircraft. Using N-3 UAV, 6 Pan et al. (2016) obtained better droplet distribution with higher spray coverage, increased deposition, smaller droplets and smaller coefficient of variation when a rotor UAV was flown at 1.0 m height over citrus trees. Qin et al. (2016) reported that an application height of 1.5 m and spraying speed at 5 m/s with HyB-15L UAV produced improved penetration and distribution of spray droplets on rice canopy. Qin et al. (2018) applied triadimefon fungicide on wheat canopy against powdery mildew and reported uniform distribution of spray droplets when N-3 UAV was launched at 5.0 m height at a speed of 4 m/s.

When analyzing the effect of application height on pattern uniformity for both platforms, the CV was determined with the swath fixed at 4.6 m (Table 4). This allowed for a direct comparison of each application system. Based on the results, overall, the CV for the MG-1 platform was best at 2 m application height. For the V6A, for the 2 and 3 m applications, resulted in very good spray application patterns. The CV for the 4 m application height was much higher most likely due to the smaller droplets from the spray being carried away from the target string. Similarly, the effect of ground speed for the two application systems on pattern uniformity at 4.6 m swath is presented in Table 5. Here, a ground speed of 3 m/s for the MG-1 resulted in the best pattern uniformity of 10.3% with all values less than 14%. For the V6A, the highest groundspeed of 7 m/s provided the best pattern uniformity with a CV of 14.7%. All other values were less than 20%.

Table 4. Swath pattern uniformity at 4.6 m swath at different application heights as indicated by coefficient of variation (%) for two commercially-available unmanned aerial application systems.

UAS models	Application Height (m)	CV (%)
MG-1	2	7.0b
	3	15.5a
	4	13.0a
$F=16.8; df=2,9$		$P > 0.0009$
V6A	2	15.5a
	3	13.5a
	4	22.3a
$F=2.3; df=2,9$		$P > 0.15$

Means followed by the same lower case letters are not significantly different at $P = 5\%$ (DMRT).

Table 5. Swath pattern uniformity at 4.6 m swath at different ground speeds as indicated by coefficient of variation (%) for two commercially-available unmanned aerial application systems.

UAS models	Ground Speed (m/s)	CV (%)
MG-1	1	11.0a
	3	10.3a
	5	13.3a
	7	12.7a
$F=0.27; df=3,8$		$P > 0.85$
V6A	1	19.7a
	3	18.0a
	5	16.0a
	7	14.7a
$F=0.26; df=3,8$		$P > 0.85$

Means followed by the same lower case letters are not significantly different at $P = 5\%$ (DMRT).

The effect of application height on effective swath for both application systems is presented in Table 6. For this analysis, the largest effective swath was chosen for each height which resulted in a CV of less than 25%. For the MG-1, the best effective swath (7.3 m) was achieved at the 2 m application height. Since spray drift increases with application height, being able to have the best effective swath at the lowest application height is an advantage. For the V6A, the 2 m application height also provided the largest effective swath (5.6 m). The effect of ground speed on effective swath was also determined (Table 7). This effective swath also was chosen where the CV remained below 25%. For the MG-1, the best effective swath (6.8 m) was at a groundspeed of 3 m/s, while for the V6A, the highest groundspeed of 7 m/s resulted in the largest effective swath (5.8 m).

Table 6. Effect of application height on effective swath for two commercially-available unmanned aerial application systems. Coefficient of variation was less than 25% for each effective swath.

UAS models	Application Height (m)	Effective Swath (m)
MG-1	2	7.3a
	3	6.6a
	4	5.5b
$F=9.34; df=2,9$		$P > 0.0064$
V6A	2	5.6a
	3	5.3a
	4	5.0a
$F=2.3; df=2,9$		$P > 0.70$

Means followed by the same lower case letters are not significantly different at $P = 5\%$ (DMRT).

Table 7. Effect of ground speed on effective swath for two commercially-available unmanned aerial application systems. Coefficient of variation was less than 25% for each effective swath.

UAS models	Ground Speed (m/s)	Effective Swath (m)
MG-1	1	6.6a
	3	6.8a
	5	6.0a
	7	6.4a
$F=0.32; df=3,8$		$P > 0.81$
V6A	1	5.2a
	3	5.2a
	5	5.2a
	7	5.8a
$F=0.25; df=3,8$		$P > 0.86$

Each of the strings for each of the treatments were analyzed with the USDA String Analysis software. Many factors play into the quality of the spray pattern such as height, droplet spectra, wind speed and direction. Figure 1 shows an example of a pattern from the V6A at 3 m height and a groundspeed of 7 m/s where all the conditions were near optimal, resulting in a “good” pattern. Here, the effective swath for this particular combination of application height and groundspeed would be 17’ as the CV still remains below 25%. A 19’ swath would exceed this CV limit.

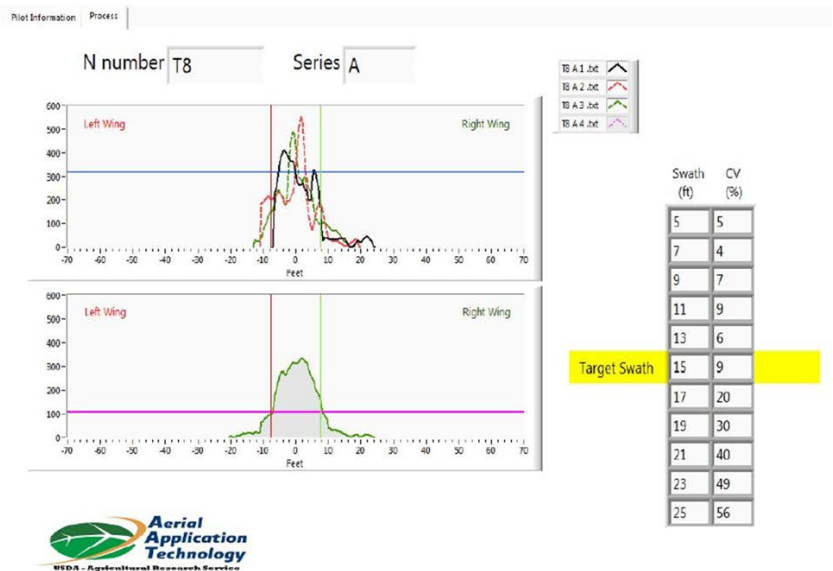


Figure 1. Sample average good pattern from the V6A at 3 m application height and a groundspeed of 7 m/s. The pattern is nice and symmetrical, but has fairly sharp edges around 18'. A good swath for this setup would be around 17'.

Figure 2 is from the same aircraft but at 4 m application height and a groundspeed of 1 m/s. The main issue with this setup is that there was a crosswind from both the left and the right on different passes. Since the aircraft was flying relatively high and has a smaller droplet spectrum, many of the spray droplets were not able to land on the 11 m string target. In one case, we see only the left side of the pattern. In another, the right side of the pattern. These environmental conditions contributed greatly to a “bad” pattern where the CV at 15’ was 58%.

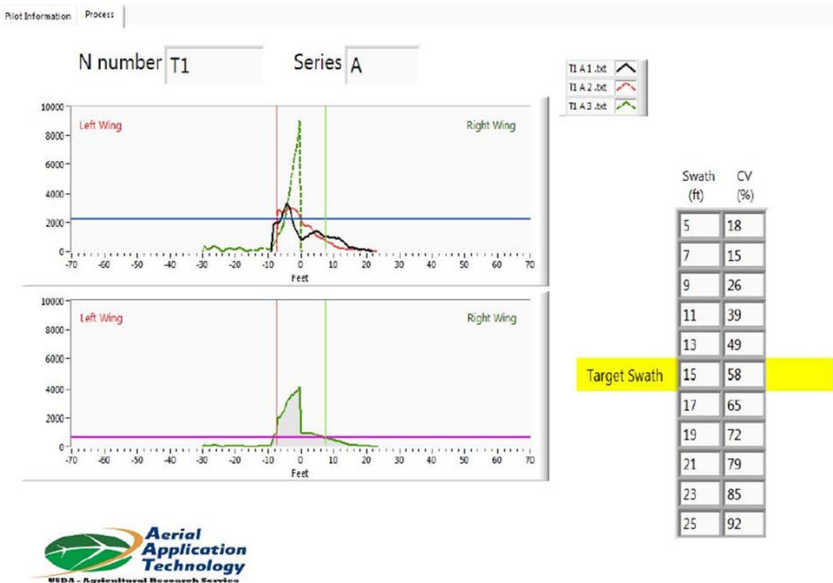


Figure 2. Sample average “bad” pattern from the V6A at 4 m height and 1 m/s. Due to the height, a smaller droplet spectra and crosswind from the left, many of the droplets were not able to land on the target string and thus, resulted in a “poor” pattern and large CV.

A nice sample pattern from the MG-1 at 2 m application height and a groundspeed of 7 m/s is shown in Figure 3. This pattern is broad and symmetrical, resulting in a very “good” pattern with an effective swath of 25’ at a 20% CV. The application height was low and the winds were light and in line with the sampling string, resulting in good deposition on the string target.

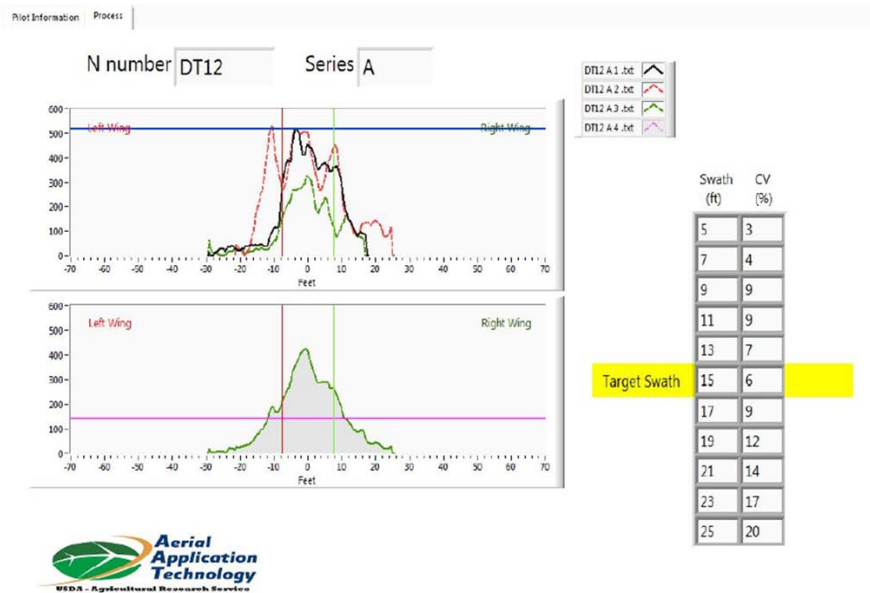


Figure 3. Sample average good pattern from the MG-1 at 2 m application height and a groundspeed of 7 m/s. The pattern is broad and symmetrical. A good pattern (20% CV) could be obtained even at a swath of 25’.

Figure 4 shows the results of the same aircraft flying at 4 m application height and 3 m/s groundspeed. Even with a larger droplet spectrum than the V6A, crosswinds from the left and the right caused portions of the spray to miss the string target, resulting in a “bad” spray pattern with a CV of 28% at 17’.

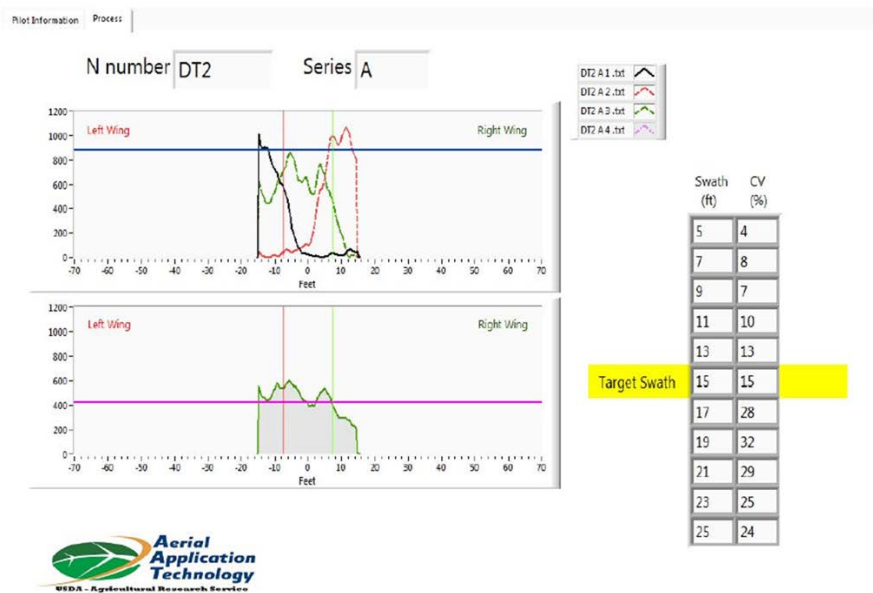


Figure 4. Sample average “bad” pattern from the MG-1 at 4 m height and 3 m/s. Due to the height and crosswind from both the left and the right, many of the droplets were not able to land on the target string and thus, resulted in a “poor” pattern and large CV.

Spray Nozzle Test in Wind Tunnel

Results from the spray nozzle test in the wind tunnel tend to indicate that both nozzles are quite different, with the CR80005 producing smaller droplets, and both nozzles producing very small droplets, when compared to traditional aerial application nozzles (Table 8). The relative span (RS) for both nozzles are fairly comparable. The percentage of droplets

less than 100um, and 200um convey the small droplet size from both nozzles, with the CR80005 representing the smaller.

Table 8. Spray nozzle performance in wind tunnel test

Nozzle	Orifice (mm)	Pressure (kPa)	Dv0.1	Dv0.5	Dv0.9	RS	V<100 μm	V<200 μm
XR11001	0.10	226	72.74	161.37	286.86	1.33	20.55	66.91
CR80005	0.05	517	54.14	112.71	190.05	1.20	40.61	92.36

Discussion and Conclusions

Aerial pesticide applications with current commercially available UAASs is definitely possible. Based on the results from this study, most of the application rates required on pesticide labels can be achieved with these platforms, provided they are operated at the correct groundspeed. The effective swath, given the original manufacturers setup, may vary anywhere between 5 and 7 m depending upon platform, application height and groundspeed. Good spray patterns based upon a coefficient of variation less than 25% have been demonstrated. However, the droplet spectra, overall, for both of these platforms is relatively small, which will make the spray more prone to drift. While the driftability of the sprays was not investigated in this study, previous research has shown a direct strong correlation between droplet size and spray drift. Depending on the target pest and the pesticide class (fungicide, insecticide, herbicide, etc.), the user may want to replace the OEM nozzles for other nozzles that may be more appropriate for their particular application. Traditional aerial application testing procedures were modified for this sUAAS spray test research, and as a result it is apparent that there is a need for standardized testing protocols, as interest in deployment of these systems continues to evolve.

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