ARS
GAINESVILLE, FL USA

Florida Citrus Production
Research Advisory Council

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RESEARCH PROPOSAL
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POLYMERIC ENHANCEMENT OF FRUIT-FLY BAIT-SPRAYS TO INCREASE FIELD LONGEVITY, DECREASE COST, & REDUCE PESTICIDE USE

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PROBLEM DESCRIPTION - (Why do this research?)

A major problem associated with the current use of Caribbean Fruit-Fly (CFF) protein bait-sprays (e.g. such as NuLure® or Naturalyte®) is that they typically have to be re-applied every 7 to 10 days because of their susceptibility to being washed off by rain and/or overhead irrigation systems.

Because of this lack of "rain-fastness" in the current protein bait-sprays:

Repetitive aerial applications of bait-sprays are necessary to insure crop security.

Multiple aerial treatments significantly increases the growers production cost.

Re-application of bait-sprays results in additional amounts of pesticides used.

Increased pesticide usage ends-up contaminating surface and ground waters.*

* *A major concern for all Florida citizens, political environmental groups and governmental regulatory agencies (EPA, FDEP).*

SIGNIFICANCE OF THE PROBLEM - Background

A total of 363,018 "treated acres" were certified "Fly-Free" under the Florida Caribbean Fruit Fly-Free Protocol (CFFFP) using aerial bait-sprays in 2002 -2003 growing Season.*
** (source: C. Jenkins, CFFFP Administrator, FDACS-DPI)*

This represented 54,440 acres of "actual land-area" (groves); of which, many acres had to be re-treated due to continued presence of pests determined by FDACS monitoring.

There were 4,893 aerial bait-spray treatments done on various protocol "blocks".
(a "block" representing approximately 40 acres of crops plus a buffer zone).

The treatment-period ranged from 5 to 6 weeks before crop harvest with an average aerial treatment-period of 36 days for all protocol treated block zones.

During this 36 day period, aerial CFF bait-spray treatments were typically reapplied every 7-10 days for those block zones requiring re-treatment according to the protocol.

SIGNIFICANCE OF THE PROBLEM - Cost$

Aerial bait-spray treatments alone ranged from $4.50 to $5.78 per acre treated, with a statewide average cost of $5.14 per acre treated using a CFF bait-spray (typ. Nulure®).

Note: This aerial application cost does not include the additional $3.50 per acre per month CFFFP fly-trap monitoring & maintenance fee charged by FDACS-DPI.

In all, the total cost to Florida citrus growers who implemented the Caribbean Fruit Fly-Free Protocol aerial bait-spray program in the 2002 - 2003 season was $1,865,913.

(Based on an average cost of $5.14 to treat one acre x 363,018 total "treated-acres").

The average number of aerial-bait spray re-treatments done was 6.7 times per acre with an average cost per each aerial treatment of $278,494 for all "treated-acres".

(Based on the "treated-acres" (363,018) versus the "actual-acres" or land-area (54,440))

67,385 lbs. (34 tons) of pesticide agent was applied to those 363,018 treated-acres!

(Based on the standard application rate used of 9.6 oz. Nulure® + 2.4 oz. Malathion per acre)

RESEARCH OBJECTIVE

To develop a new chemical additive that can be mixed with standard water-soluble protein-based fruit fly bait-sprays (such as Nulure®), which will increase the bait-spray's water-fastness and become more resistant to wash-out from rainfall or overhead irrigation.

Additionally, the new additive when mixed with a bait-spray should:

- **Remain equally attractive to Caribbean Fruit Flies as current bait-sprays.**
- **Not retard the toxicant effect of the active pesticide agent.**
- **Be very inexpensive and can be easily mixed into the bait solution.**
- **Must work with current bait-spray equipment.**
- **Be environmentally safe, biodegradable, & add no additional toxicity.**
- **Be allowable for EPA registration (preferably fast-tract).**





TECHNICAL GOALS TO MEET OBJECTIVE

A. Produce new polymer formulations that when added to standard Nulure® protein bait solution, will cause an increase in its rain-fastness.

B. Validate the rain-fastness and longevity of the newly formulated mixture in the laboratory under simulated rainfall conditions.

C. Analyze the attractive (Nulure®) and toxicant (Malathion) volatile component release rates and compare the rates of the standard Nulure® bait against the newly combined formulation (Nulure® + Additive) to insure that the new mixture is equivalent in to the original standard bait alone.

D. Determine the acceptability and efficacy of the best newly formulated bait solution to Caribbean Fruit Flies for attraction, feeding and mortality through laboratory bioassays conducted by FDCAS – Division of Plant Industries.



METHODS & APPROACH

Objective (A): Create new additive formulations

Initial focus will be on starches, carboxy-methyl cellulose (CMC), and poly(vinyl alcohol) (PVOH). All are 100% environmentally safe, biodegradable, and have zero health and safety concerns (commonly used in food processing).

STARCHES:

Starches can only be dissolved in very hot water and are not soluble in cold water.

This produces a viscous solution and the starch remains in solution, even after subsequent cooling and then can be secondarily mixed with a cold solution.

A starch solution applied to a surface and dried cannot be easily removed by cold water.

The thickening properties of starch will increase the viscosity of sprayed droplets, which will promote adhesion of the spray to leaves – i.e. less spray will run off into the soil.


METHODS & APPROACH - Continued

PVOH & CMC:

Both have similar solubility properties as starches, but have subtle differences in their rates of dissolution and viscosity.

PVOH is derived from poly(vinyl acetate) (PVAc) by hydrolysis.

Copolymers and blends of PVOH and PVAc are commonly used in water-based adhesives such as paper and carpenter's glues, which are water-proof after drying, and yet are initially an aqueous solution.

Numerous grades are available for each of these three materials. These grades vary in molecular weight, degree of hydrolysis (SEE FIGURE 1), and chain branching.

Blends of different grades, or mixtures with different materials can be utilized in order to fine-tune the desired properties.

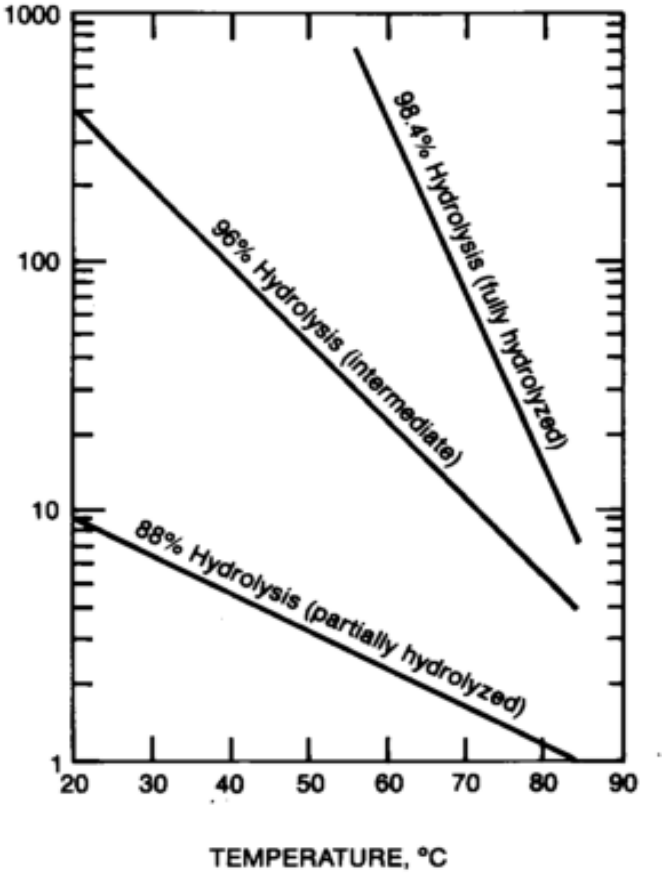

FIGURE 1. Solubility in water of 0.4mm (0.015") thick PVOH film as a function of temperature and degree C of hydrolysis.

Note that fully (>98%) hydrolyzed material is completely insoluble in water at low temperatures (Below 55"C)!

(Reprinted from Handbook of Adhesives – 3rd Edition, Irving Skeist, editor, Chapter 22, page 402, Van Nostrand Reinhold, New York 1990.)




METHODS & APPROACH - Continued

Objective (B): Validate rain-fastness and longevity of new additive + bait solution

Apply new mixtures to standard squares & plant leaves and expose to simulated rainfall in environmental chambers. Analyze wash-off for presence of bait & pesticide.

Objective (C): Analyze volatiles from new additive + bait solution

Apply new mixtures & control bait solution to standard squares & plant leaves and analyze volatiles released from bait & pesticide. Compare release rates of VOC's.

Objective (B): Bioassay best formulations with live Caribbean Fruit-Flies

Provide best formulations (as determined in lab after A,B,& C) to FDCAS-DPI to conduct lab cage bioassays on live CFF's to compare the new formulation(s) to standard control baits to determine attraction, feeding & mortality.

DERIVED BENEFITS FOR THE CITRUS INDUSTRY:

1. PROVIDE UP TO A 75% COST SAVINGS BY REDUCING TREATMENT TO ONCE OR 2X PER MONTH INSTEAD OF 4X PER MONTH ($300K-$600K vs. $1.5M-$2.0M / YR.)

2. ENVIRONMENTAL & ANIMAL HEALTH BENEFITS GAINED FROM REDUCED USE OF MALATHION OR OTHER PESTICIDE AGENTS

3. POLITICAL AND PUBLIC RELATIONS BENEFITS FROM USING LESS PESTICIDES

4. INCREASED PROTOCOL SECURITY DUE TO IMPROVED RAIN-FASTNESS

5. COMPATIBILE WITH OTHER BAITS & OTHER TOXICANTS (e.g., Spinosad / Solulys)

6. ROYALTY INCOME DERIVED FROM LICENSING OF PRODUCT INTELLECTUAL PROPERTY WOULD BE SHARED WITH FCPRAC PROGRAM

7. SHOULD BE RELEVANT FOR CONTROL OF OTHER FRUIT-FLY SPECIES IN OTHER COUNTRIES, GREATLY INCREASING COMMERCIAL POTENTIAL OF TECHNOLOGY

8. FCPRAC GRANT WILL PROVIDE LEVERAGE TOWARD RECEIVING USDA & EPA SBIR GRANT FUNDING FOR LARGE SCALE FIELD TESTING & RESEARCH