The Sustained Effort to Discover, Develop, and Register a New Aquatic Herbicide

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Need for new Aquatic Herbicide Technology

- Improved efficacy on new weed threats
- Better control under difficult conditions
- Better selectivity to desirable native aquatic plants
- Reduce risk to human health
- Reduce risk to the environment
- Respond to new regulatory requirements
- Resistance Management
- Improve applicator and handler safety
- Integrate for most sustainable long-term success
Limited Herbicides for Aquatics

• Just 15 of 250+ herbicide active have aquatic use.
• Why?

  • Unusually strong human health and environmental profile is required.
  • Aquatics and agricultural use of herbicides generally have conflicting objectives.

  **AQUATICS:** Control single aquatic weed and leave other desirable aquatic plants unharmed

  **VERSUS**

  **AGRICULTURE:** Control a broad spectrum of terrestrial weeds and do not harm the crop.
Limited Herbicides for Aquatics

• Why?
  • Discovery, development, and commercialization of new actives is extremely high risk from a business perspective.
  • Focus on highest probability of large return on high investment (~$250 million current cost to register new AI) and avoiding regulatory challenges/costs.
  • Crop biotechnology focus (GMO) also has limited recent herbicide discovery and development.
  • Aquatics is a very small market, has high regulatory requirements, and is technically difficult to support.
Are we going to see many new active ingredients in Aquatics in future?

• Simply...NO.

• New actives will be rare for any weed management.
• They will almost never be discovered and developed with aquatic use as first objective.

• John Gallagher definitely had the right definition...
What is an aquatic herbicide?

J.E. Gallagher, 1965
Presentation Outline

• **Steps to a New Aquatic Herbicide**
  
  • Discovery and primary screening
  • Secondary screening
  • EPA registration studies
  • Late-stage, pre-registration development
  • Interaction on EPA reviews to finalize label
  • State registration
  • Initial operational adoption and post-registration development
Discovery and Primary screening

WHAT DO YOU LOOK FOR?

• Does herbicide have a favorable toxicological profile that fits aquatic use?

• Is there a likely technical fit for mode of action, type of herbicide, etc?

• Is there a business case for aquatic development based on commercial status including patent life?
Discovery and Primary screening

• Focus of Primary screening for aquatic uses

  • Major invasives weeds in US
    • hydrilla and Eurasian watermilfoil

  • Algae control
    • Broad spectrum, non-copper technology is a major goal.
    • Selective control of cyanobacteria has been given greater recent emphasis.
Discovery and Primary screening

• Design of Primary Screening
  
  • Look at broad range of use rates in search to find highly sensitive responses.

• Refine use rates in subsequent secondary screening
  
  • concentration-exposure time (CET) for in-water use or amount of a.i. / acre foliar
Secondary screening

• Successful candidate from primary screening is further evaluated.

• Does this technology have full profile necessary for aquatic use?
  • Technical fit? (efficacy, selectivity)
  • Regulatory fit? (profile, restrictions)
  • Economic fit? (market fit, return on investment, lifetime value)
Secondary screening

- **Further efficacy testing on target weeds** to refine use patterns
  - Necessary CET in-water or rate/acre foliar
  - Select best candidate formulation(s)
  - Defines final use assumptions for all decision criteria...

Example of SLF-9522 (ProcellaCOR SC) in 2011 Secondary Efficacy Screening on Hydrilla

<table>
<thead>
<tr>
<th>Untreated</th>
<th>1 PDU</th>
<th>2 PDU</th>
<th>5 PDU</th>
<th>10 PDU</th>
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24 hour exposures
Secondary screening

• **Field validation of controlled study outcomes**

• Can you control weeds in the real world?...Or at least in study ponds

• Federal Experimental Use Permits (EUPs) are now rare ...but some state-specific opportunities
Secondary screening

• Non-target plant selectivity

• Response of desirable aquatic plants
Secondary screening

• **Non-target plant selectivity**
  
  • Activity on potentially irrigated terrestrial plants
    • Non-agricultural / Non-food
      • Turf, landscape
    • Agricultural
      • Food crops
Secondary screening

• Other Non-target organisms?
  • Wildlife?
  • Fish?
  • Aquatic Invertebrates?
The Decision...and supporting tough questions

• **Will EPA aquatic registration be pursued?**

  • What studies will be necessary and how much is investment?
  
  • Can that major investment be supported by current and projected revenues?
  
  • How long will it take for registration (generally 8 – 10 years)?
  
  • How will market look different at that time?
  
  • How quickly will product be adopted and investment recovered?
EPA Registration Studies (5 – 7 years)

• Product Chemistry – 35 tests
• Risk to Humans and Domestic Animals – 47 studies
• Risk to Nontarget Organisms – 32 studies (multiple organisms often within each)
• Post-Application and Applicator/User Exposure Studies plus Pesticide Spray Drift Evaluation – 20 studies
• Environmental Fate – 16 studies
• Residue Chemistry – 17 studies
Aquatic field dissipation studies
EPA Registration Studies

- EPA review timing for new active ingredients

  - R010 – New AI, food use 24 months
  - R020 – New AI, food use, reduced risk 18 months

- PRIA fee for both = $627,568
Late-stage, pre-registration development

• What do you do while you wait?

CONTINUE DEVELOPMENT!
Thanks to many partners – public and private
Late-stage, pre-registration development
UF Hygrophila Mesocosm ProcellaCOR CET

Visual Injury through 3 weeks post treatment

6, 24, 48, or 96 hour exposures

Study photos courtesy of Dr. Lyn Gettys UF
Late-stage, pre-registration development

ProcellaCOR at 60 DAT showing selective control of Lygodium (courtesy of Dr. Stephen Enloe UF)
Early publications as part of development


• Haug EJ. 2018. Monoecious Hydrilla and Crested Floating Heart Biology, and the Response of Aquatic Plant Species to Floprpyrauxifen-benzyl Herbicide. NC State University PhD dissertation. https://repository.lib.ncsu.edu/bitstream/handle/1840.20/35124/etd.pdf?sequence=1
Interaction on EPA reviews to finalize label

• New AI reviews are consistently delayed versus PRIA timeline.
  • Human risk, ecological risk, and benefits are all formally assessed
• Public comment period required on registration decisions for new AI.
• Final decision on registration after all comments are reviewed.
• For aquatics, establishing fish and shellfish tolerances is a common first step.
• Discussions to finalize initial label occurs during this late stage.
• The first label for a new active is always the hardest.
State registration

• Following USEPA federal registration, each state has its own process for registration that can take weeks to many months.

• In Florida, new actives are reviewed by the FDACS Pesticide Review Evaluation Committee (PREC) before label approval (~60 day process).

• Once federal and state registrations are received, it is legal to apply the new herbicide with exception of site-specific or other local permitting (e.g., FWC permits in Florida)
Initial operational support and post-registration development

- Lots of excitement
- Plenty of questions
- Hard work to train and assist so hopefully easy and smooth to adopt

- Must evaluate and report early outcomes to validate and refine field use.

- Partnership in early adoption leads to collective success and improvement.
How do you encourage new herbicide or algaecide development?

- Steward both new and old tools very well.
- Conduct science-based, aquatic plant, algae and water quality management.
- Advocate for research and development of new technology.
- Support the solutions of entities innovating for the future.
Thank you!

Questions?

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