UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C., 20460

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

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MEMORANDUM

SUBJECT: Review of Benefits of the Registration of Florpyrauxifen-benzyl in Aquatic Use Sites

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Product Review Panel: May 3, 2017

SUMMARY

In 2016, the Environmental Protection Agency (EPA or the Agency) reviewed documents providing benefits information on florpyrauxifen-benzyl submitted by the registrant (Daniels et al., 2015; Breaux, 2017) in support of a proposed new use for the active ingredient. EPA's Biological and Economic Analysis Division (BEAD) here provides an assessment of benefits for this active ingredient, which is currently labeled for the control of freshwater aquatic vegetation in ponds, lakes, reservoirs, marshes, wetlands, bayous, drainage ditches, and canals. BEAD finds this active ingredient will be an effective tool for spot and wide area treatments to quickly control problematic aquatic weeds such as hydrilla, Eurasian watermilfoil, and crested floating heart. Florpyrauxifen-benzyl also provides an additional tool to manage herbicide resistant aquatic weeds and restore aquatic habitat in ecosystems that have been compromised by invasive species.

The benefits demonstrated by the registrant, with which BEAD agrees, include: improved control of economically important aquatic weed species, control of aquatic weed species that have developed resistance to currently registered herbicides, and increased flexibility in integrated aquatic weed management plans.

INTRODUCTION

EPA registers pesticides under section 3(c) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). A registration is granted unconditionally under section 3(c)(5) of FIFRA or conditionally under 3(c)(7) of FIFRA if the appropriate criteria are met. Each authority available to EPA for registering a pesticide under section 3(c) involves a finding related to whether the pesticide poses unreasonable adverse effects on the environment. "Unreasonable adverse effects on the environment" is defined in section 2(bb) of FIFRA to include "any unreasonable risk to man or the environment taking into account the economic, social, and environmental costs and benefits of the use of the pesticide." Therefore, in cases where a pesticide presents meaningful risks, EPA assesses the benefits of the pesticide to determine whether those risks would lead to unreasonable adverse effects.

The registrant has requested new registrations for the herbicide florpyrauxifen-benzyl in multiple aquatic use sites. As part of the registration process, BEAD here provides its review regarding the statements of benefits claimed by the registrant (Daniels et al., 2015; Breaux, 2017). This analysis first lists the benefits as claimed by the registrant and then reviews these benefits item by item. BEAD finds that florpyrauxifen-benzyl will provide another tool to address problematic aquatic weeds that are not fully or effectively controlled by other registered aquatic herbicides.

Nonnative aquatic plants often become an issue for aquatic resource managers because they prevent intended uses of water bodies and can change the structure and function of diverse native aquatic ecosystems (Gettys et al., 2009). Aquatic weeds often require significant resources for control, as invasive species can interfere with use of water, increase the risk of flooding, and result in conditions that threaten public health (e.g., harmful algal blooms that produce cyanotoxins). Some examples of the economic and ecological impacts of aquatic weeds are listed in Table 1.

Table 1: Examples of the Economic and Ecological Impacts of Aquatic Weeds

Economic Impacts	Ecological Impacts
Impair commercial navigation	Degrade water quality
Disrupt hydropower generation	Reduce species diversity
Increase flood frequency, duration, and intensity	Suppress native plants
Impair drinking water	Increase extinction rate of rare, threatened and endangered species
Provide habitat for insect-borne disease vectors	Alter animal community interactions
Impair recreational navigation	Increase detritus buildup
Interfere with safe swimming	Change sediment chemistry
Reduce property value	
Endanger human health, increase drowning risk	

Source: Gettys et al., 2009

BENEFITS ACCORDING TO THE REGISTRANT

The registrant submitted the following information in support of the benefits of an aquatic registration for florpyrauxifen-benzyl (Daniels et al., 2015; Breaux, 2017). The numbers associated with each claim are for organizational purposes only and do not represent the relative importance of each benefit or a numbering system provided by the registrant.

1. Florpyrauxifen-benzyl offers a new mode of action that will reduce selection pressure for resistance to other MOAs and prevent or delay the onset of new cases of resistance;
2. Florpyrauxifen-benzyl offers improved control of aquatic weed species;
3. Florpyrauxifen-benzyl offers flexibility in use to meet the need for spot/partial treatments;
4. Florpyrauxifen-benzyl offers superior tolerance to native aquatic plant species;
5. Florpyrauxifen-benzyl offers attributes that fit well in integrated weed management programs;
6. Florpyrauxifen-benzyl has no drinking water or recreation use water restrictions unlike alternative active ingredients.

BEAD REVIEW OF INFORMATION SUBMITTED BY REGISTRANT

BEAD's review below follows point by point the claims made by the registrant listed in the previous section.

1. *Registrant claim: Florpyrauxifen-benzyl offers a new mode of action that will reduce selection pressure for resistance to other MOAs and prevent or delay the onset of new cases of resistance.*

   Resistance management for weeds in aquatic systems differs considerably from agricultural herbicide resistance management, as growers in agricultural settings are able to rotate both the crop and active ingredient for resistance management purposes. In aquatic weed control, a resource manager may only rotate active ingredients, depending on the target pest that is present and local regulations that apply to that waterbody. Options are limited, as there are only 14 registered aquatic herbicides in the United States.

   Florpyrauxifen-benzyl is an auxin herbicide (WSSA group 4) and does not provide a new mode of action (MOA) to aquatic use sites; however, florpyrauxifen-benzyl will provide a new effective MOA for the federally mandated submersed noxious weed species, hydrilla (*Hydrilla verticullata*).

   There are multiple aquatic herbicides labeled for hydrilla control in the United States: endothall (WSSA Group undefined), diquat (WSSA Group 22), flumioxazin (Group 14), copper products (WSSA Group not defined), fluridone (WSSA Group 12), penoxsulam (WSSA Group 2), bispyribac-sodium (WSSA Group 2), imazomox (WSSA Group 2), and topramezone (WSSA Group 28). None of these herbicides belong to WSSA Group 4. The currently available herbicides have variable control of hydrilla depending on the pH of treated water, density of hydrilla populations, and exposure times needed for control. While hydrilla resistance is not widespread and multiple options are labeled for hydrilla control, variable site conditions often reduce management strategies to one or two active ingredients per site (APMS, 2014). In Florida, for example, there are multiple factors that limit hydrilla management:

- State regulations limit copper in public lakes and rivers;
- Carfentrazone and flumioxazin have moderate activity on hydrilla and degrade rapidly in high pH conditions;
- When used alone, fluridone, penoxsulam, and bispyribac require several months for effective hydrilla control (concentrations must be sustained by repeated ["bump"] treatments and extending limitations may be put on the water body);
- Each combination of herbicides has a different level of effectiveness or impact different non-target plants (APMS, 2014; University of Florida, 2015).

There is documented resistance to both fluridone and endothall in hydrilla species (University of Florida, undated; Heap, 2017), most of the aquatic herbicides available for hydrilla are only active on one gene site (which increases the likelihood of resistance development) (APMS, 2014), and multiple alternative options belong to a single mode of action (penoxsulam, imazamox, and bispyribac-sodium are all WSSA Group 2). Therefore, BEAD concludes that florpyrauxifen-benzyl will provide a new mode of action for control of the economically and ecologically detrimental species, hydrilla.

2. *Registrant Claim: Florpyrauxifen-benzyl offers improved control of aquatic weed species.*

BEAD is unable to determine if florpyrauxifen-benzyl will provide greater (statistically significant) control of problematic aquatic weeds than registered alternatives, based on the efficacy information provided by the registrant and publicly available scientific literature. However, available literature suggests that florpyrauxifen-benzyl will provide excellent control of hydrilla and watermilfoil species (Netherland and Richardson, 2016; Richardson et al., 2016). As mentioned above, there is documented resistance to both fluridone and endothall for hydrilla species (University of Florida, undated; Heap, 2017). Hydrilla reproduces efficiently, outcompetes native plants, reduces habitat for aquatic wildlife and fish, and it can also obstruct water flow resulting in clogged irrigation systems and flooding (Gettys, 2009; True-Meadows et al., 2016). Hydrilla has been called the "perfect aquatic weed" due to its highly specialized growth characteristics, wide variety of acceptable habitats, and rapid reproduction (Langeland, 1996). The economic impacts of controlling hydrilla (mechanical, biocontrol, and/or chemical control) can be substantial. For example, the costs of hydrilla control in Florida over a seven-year period from 2008-2015 were estimated at $66 million (University of Florida, 2016). Non-chemical means of control are often ineffective when used alone or prohibitively expensive. For example, mechanical control and suction control of hydrilla can cost as much as $1,000 per acre and $25,000 per acre, respectively (Gillett-Kaufman et al., 2014). Mechanical control of hydrilla is not usually recommended as there is fragmentation of the vegetation and other impacts to biota such as fish (True-Meadows et al., 2016). Hydrilla has also been documented as hosting

Aetokthonos hydrillicola (Wilde et al., 2014), a cyanobacterium that is believed to produce a neurotoxin responsible for avian vacuolar myelinopathy (AVM). AVM is a neurological disease which impacts waterfowl in the southeastern United States, including bald eagles (Wilde et al., 2005; William et al., 2007).

Florpyrauxifen-benzyl provides control of alligatorweed, monoecious hydrilla, parrotfeather, variable watermilfoil, and American waterwillow in several days to a few weeks in mesocosm studies at static concentrations consistent with the application rates on the draft label (Richardson et al., 2016). Florpyrauxifen-benzyl also has high activity on alligatorweed, Carolina waterhyssop, and crested floating heart (Richardson et al., 2016; Netherland and Richardson, 2016). Therefore, BEAD concludes that florpyrauxifen-benzyl has to potential to provide rapid control of problematic aquatic weeds.

3. *Registrant Claim: Florpyrauxifen-benzyl offers flexibility in use to meet the need for spot/partial treatments.*

Herbicidal control of aquatic plants is a complex process involving herbicide concentration exposure time and water quality parameters. Florpyrauxifen-benzyl is effective under a broad range of environmental conditions and fast-acting (Netherland and Richardson, 2016); therefore, it may be used for partial and spot treatments for a rapid reduction in target biomass. As mentioned above, some alternatives such as fluridone, penoxsulam, and topramezone require 2 to 4 months to provide hydrilla control in the field (Netherland, 2015; University of Florida, 2017), while florpyrauxifen-benzyl at low static concentrations (9 μg ai L) provides hydrilla control in several days in growth chamber studies (Richardson et al., 2016; Netherland and Richardson, 2016). Although small scale study conditions do not completely reflect the variability of field conditions, BEAD concludes that the herbicidal properties of florpyrauxifen-benzyl may offer flexibility to meet the need for spot/partial treatments and rapid, systemic control of species such as hydrilla.

4. *Registrant Claim: Florpyrauxifen-benzyl offers superior tolerance to native aquatic plant species.*

Native plant selectivity is an important consideration for aquatic herbicide treatments. There is ongoing research as to the non-target plant selectivity of florpyrauxifen-benzyl and one study showed that aquatic plants native to North America (elodea and megalodonta) were more tolerant of florpyrauxifen-benzyl than Eurasian watermilfoil and hydrilla (Kurt Getsinger, pers. comm., April 12, 2017; Netherland and Richardson, 2016). Due to a lack of comparative information about superior selectivity to native plant species, the Agency cannot conclude that this is a benefit of registration.

5. *Florpyrauxifen-benzyl offers attributes that fit well in integrated weed management programs.*

Florpyrauxifen-benzyl has attributes that fit in well with integrated weed management programs. Some of these attributes include:

- Ability to be applied in-water or to foliage;
- Fast-acting, systemic action;
- Control of many problematic species, including hydrilla;
- A resistance management tool for hydrilla control;
- No drinking water or recreational restrictions (see number 6 below).

BEAD concludes that florpyrauxifen-benzyl has attributes that fit in well with integrated weed management programs; however, the ability to fit into integrated weed management programs is not unique to this registration and should not be considered as a main benefit of florpyrauxifen-benzyl.

6. *Florpyrauxifen-benzyl has no drinking water or recreation use water restrictions unlike alternative active ingredients.*

Several alternatives to florpyrauxifen-benzyl (diquat, endothall, tricolpyr, imazapyr, and 2,4-D) have drinking water or recreational use restrictions depending on the state in which the product is used, the formulation, or the location of drinking water intakes (Texas A&M University, 2017; University of Florida, 2017). The draft label (GF-3301) for the aquatic use of florpyrauxifen-benzyl contains no restrictions on drinking water use or recreational use and the Agency has not identified drinking water risks associated with this registration. Therefore, BEAD concludes that the lack of drinking water and recreational use restrictions will allow applicators more flexibility in planning their integrated weed management programs.

CONCLUSION—BENEFITS

BEAD reviewed the stated benefits of florpyrauxifen-benzyl and finds this active ingredient has the potential to be an effective tool for spot and wide area treatments for the control of problematic aquatic weeds in various settings. Florpyrauxifen-benzyl provides an additional tool to manage herbicide resistant aquatic weed species and a tool to restore aquatic habitat. The benefits demonstrated by the registrant, with which BEAD agrees, include: the potential for improved control of economically important aquatic weed species (particularly hydrilla and Eurasian watermilfoil) in aquatic use sites with limited registered active ingredients and environmental conditions that may preclude the use of alternatives, control of aquatic weed species that have shown resistance to currently registered herbicides (hydrilla), and increased flexibility in integrated weed management plans.

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