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

December 17, 2020

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

MEMORANDUM

SUBJECT: Ethofumesate (110601): Use, Usage, Benefits Information and Impacts from Potential Mitigation

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Product Review Panel date: October 14, 2020

SUMMARY

Ethofumesate is currently undergoing the Environmental Protection Agency's (EPA or Agency) registration review process. This memo provides information on the benefits/use/usage and impacts from potential mitigation.

Ethofumesate is a systemic herbicide that controls grass and broadleaf weed seedlings before they emerge, with some post emergence weed control immediately after weed emergence while weeds are still small. Registered agricultural uses include several minor crops, (including onions), sugar beets, and sod production. Nonagricultural uses include as well as various turf sites like sod farms, residential lawns, golf courses and commercial landscaping maintenance.

Current agricultural usage data indicate that, among surveyed crops, ethofumesate is used in onion (~35% crop treated/year) and sugar beet production (~15% crop treated/year). Recommended alternatives for ethofumesate target weeds in onions include oxyfluorfen and pendimethalin. Recommended alternatives for ethofumesate target weeds in sugar beets include acetochlor, cycloate, dimethenamid-p, and S-metolachlor. Ethofumesate has a mode of action different from other herbicides used in onions, sugar beets, golf courses, and grass grown for seed, which is beneficial to growers for use in resistance management programs, specifically herbicide rotation. Ethofumesate also plays an important role in controlling herbicide resistant annual bluegrass in turf and glyphosate resistant weeds in sugar beet production. In addition, ethofumesate offers growers several weeks of residual weed control. There is not a lot of usage reported in turf sites, but ethofumesate may play a role in controlling annual bluegrass that is resistant to several other herbicides on turf.

The Agency has completed risk assessments for ethofumesate and has identified occupational risks of concern associated with applications made to all use sites, residential/homeowner exposure from lawn treatments, and ecological risks to non-target species due to drift for areas located adjacent to treated areas.

To address occupational risks, the Agency is considering:

- prohibiting the movement of hand set irrigation systems for seven days after application except as permitted by WPS [170.603(d)];
- decreasing maximum single application rates for use on golf course, grass grown for seed, and sod/turf production; as well as
- increased REI to six day for sod/turf production.

To reduce exposure to homeowners, the Agency is considering:

- cancelling the registration for use on residential lawns.

To reduce potential risks to non-target species the Agency may consider:

- spray drift reduction measures that include mandating droplet size, spray release heights, and wind speed.

Potential spray drift mitigation is expected to have little to no impact. However, BEAD cannot determine how a seven-day prohibition for moving hand set irrigation will affect users of ethofumesate across all use sites, but finds that only smaller fields (i.e. onion fields) would be affected due to the unlikelihood that hand set irrigation is used on larger field sites (i.e. corn fields) and that national usage of hand set irrigation effects only 1.2% of irrigated lands. Due to

recommended application rates on golf courses, grass grown for seed, and sod/turf production, BEAD determines that golf course managers and sod/turf producers may not be effected by reduced rates, while producers of grass grown for seed may find the reduced rate inadequate to control some weed species that require the maximum ethofumesate rate. Finally, increased REIs up to six days in sod/turf production, is likely to have a negative impact that precludes growers from performing post application maintenance activities.

INTRODUCTION

Ethofumesate is currently undergoing the Environmental Protection Agency's (EPA or Agency) registration review process. This memo provides information on the benefits and usage of ethofumesate for weed control in agricultural and non-agricultural use sites. The impacts of potential mitigation for each use site with risk concerns is also discussed.

Section 3(g) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) mandates that the United States Environmental Protection Agency (EPA or the Agency) periodically review the registrations of all pesticides to ensure that they do not pose unreasonable adverse effects to human health and the environment. This periodic review is necessary in light of scientific advancements, changes in policy, and changes in use patterns that may alter the conditions underpinning previous registration decisions. In determining whether effects are unreasonable, FIFRA requires that the Agency consider the risks and benefits of any use of the pesticide.

Ethofumesate is a systemic herbicide that controls grass and broadleaf weed seedlings before they emerge, with some post emergence weed control immediately after weed emergence while weeds are still small. Registered agricultural use sites include several vegetable crops and sod farms. Ethofumesate is also used in certain non-agricultural sites (i.e., lawn care, golf courses, turf production, and landscape maintenance) (Kline and Co., 2014; CDPR 2019, 2013-2017).

The Agency has completed risk assessments for ethofumesate and has identified occupational and residential risks of concern associated with applications made to all crop and turf use sites. Ecological risks were also identified for non-target species along the edge of treated areas due to spray drift.

To address occupational risks, the Agency is considering:

- prohibiting the movement of hand set irrigation equipment for seven days after an ethofumesate application except as permitted by WPS [170.603(d)];
- decreasing maximum single application rates for use on golf course from 3.0 to 2.3 lbs./acre, grass grown for seed from 1.9 to 1.5 lbs./acre, and sod/turf production from 2.3 to 2.0 lbs./acre; as well as
- increased REI for sod/turf production from 48 hours to six days for all post application activities.

To reduce exposure to homeowners, the Agency is considering:

- cancelling the registration for use on residential lawns.

To reduce potential risks to non-target species the Agency may consider:

- spray drift reduction measures that include mandating droplet size to medium or courser (no droplet size mandated on current labels), spray release height of 4-feet (most labels

currently have a 4-foot restriction), and a 15 mph wind speed restriction (most labels currently have a 15 mph winds speed restriction).

METHODOLOGY

The benefits of ethofumesate use are evaluated by considering target plant species and comparative advantages of ethofumesate to alternative herbicides. Impacts to users are also assessed by considering how mitigation could impact current practices and the likely consequences of possible mitigation.

The Biological and Economic Analysis Division (BEAD) considered the following sources of information to analyze ethofumesate's benefits:

- Kynetec USA, Inc. (Kynetec, 2019a; Kynetec, 2019b) proprietary data which provides agricultural pesticide usage data, including application rates, number of applications, and percentage of the crop treated for about 60 surveyed crops;
- Kline and Company (Kline and Co., 2014) proprietary data on professional turf and ornamental markets for pesticides and fertilizers; and
- University extension and open scientific literature.

CHEMICAL CHARACTERISTICS, USE, AND USAGE

Ethofumesate is a selective and systemic herbicide that belongs to the benzofuran family (Group 8) of herbicides (Heap, 2020). Selectivity of ethofumesate is more associated with turf grasses than broadleaf weeds and refers to a herbicides' potential to kill certain weeds (e.g. annual bluegrass) without injuring others (e.g. annual ryegrass). Ethofumesate is taken up by shoots and roots of germinating weed seedlings and translocated to the foliage (Kohler and Branham, 2002). Ethofumesate provides residual control for several weeks and can be applied before and after crop emergence.

Use

Ethofumesate products are formulated as emulsifiable and flowable concentrates and can be applied at rates up to 3.75 pounds active ingredient per acre (lbs. AI/A) per application. Applications may be made using ground, aerial, or soil incorporation equipment.

Registered agricultural use sites include carrots (OR and WA only), garlic, onions, garden beets, sugar beets, shallots, spinach grown for seed (OR and WA only), table beets grown for seed (OR and WA only), swiss chard grown for seed (OR and WA only), grasses grown for seed (CA, ID, NV, OR, WA only), and sod/turf farms. Ethofumesate is also registered for use on non-agricultural grass and turf sites including golf courses, parks, recreational areas, and commercial lawns.

Agricultural Usage

On average, about 35% of onion acres and 15% of sugar beet acres (Table 1) were treated with ethofumesate from 2014-2018 (Kynetec, 2019a). (Table 1; Kynetec, 2019a). From 2014-2018, an annual average of 30,000 lbs. and 80,000 lbs. of ethofumesate were applied to onions and sugar beets, respectively (Kynetec, 2019a). During this period, about 50,000 acres of onions and 200,000 acres of sugar beets were treated annually (Kynetec, 2019a). The average application rates for onions and sugar beets are 0.57 lbs. AI/A and 0.38 lbs. AI/A, respectively (Kynetec, 2019a). Approximately 1% of both onion and sugar beet applications were made by air from 2014-2018 (Kynetec, 2019a).

Data on herbicide usage in carrots are available from Kynetec (2019b) in Washington, where the site is registered, but no ethofumesate usage has been reported for at least 20 years. While ethofumesate is registered for use on garlic in all states, garlic usage is only surveyed in California, and usage was not reported for this site (Kynetec, 2019a). The other registered agricultural use sites listed above are not included in the pesticide usage survey.

Table 1. Annual Average Ethofumesate Usage for Onions and Sugar Beets (2014-2018).

Crop	Average Percent Crop Treated (PCT)	Average Pounds Applied	Average Total Acres Treated (TAT)	Average Application Rate (lbs. AI/A)
Onions	35%	30,000	50,000	0.57
Sugar Beets	15%	80,000	200,000	0.38

Source: Kynetec, 2019a

Turf Usage

National usage data indicate that approximately 6,000 pounds of ethofumesate were used for residential, commercial, and industrial lawn care in 2013, the most recent year for which data are available (Kline and Co., 2014). Pesticide usage data from the California Department of Pesticide Regulation (CDPR 2019) also suggests low ethofumesate usage in turf sites in recent years. From 2013-2017, approximately 10,000 pounds of ethofumesate were used annually for landscape maintenance purposes, and minimal usage was reported for golf courses and turf/sod in California (CDPR 2019, 2013-2017; Table 2). However, it is important to note that CDPR data may not be representative of national usage.

Table 2. Average Non-agricultural Usage (California)

Year	Average Pounds AI	Sector
2013-2017	<500	Golf courses
2013-2017	<500	Turf / Sod
2013-2017	10,000	Landscape Maintenance

Source: CDPR 2019, survey years: 2013-2017

BENEFITS OF ETHOFUMESATE

Ethofumesate controls weeds before they emerge and offers residual control for several weeks. Ethofumesate can also be used before and after crops emerge, which benefits growers with a greater flexibility in application timing. When identifying chemical alternatives to ethofumesate, BEAD identified possible alternatives based on these use patterns as well as consideration for ethofumesate target pests in these crops.

Onions

Ninety-seven percent of all ethofumesate usage (in terms of total acres treated, or TAT) in onions occurs in the Pacific Northwest and California (Kynetec, 2019a; 2014-2018). Nationally, onions account for approximately 20% of ethofumesate usage in terms of TAT (Kynetec, 2019a; 2014-2018). Smith et. al. (2018) reports that ethofumesate is recommended after the crop has been planted but before either the crop or weeds emerge. Ethofumesate is also recommended for preemergence weed control after the crop is established. Alternatives that can be used in place of ethofumesate during both these periods are oxyfluorfen and pendimethalin (Smith et. al., 2018) According to agricultural market research data, focusing on the Pacific Northwest and California regions, the greatest amount of ethofumesate is used to control redroot pigweed (*Amaranthus retroflexus*) (45% lbs. applied/year), lambsquarters (*Chenopodium album*) (27% lbs. applied/year), and chickweed (*Stellaria media*) (26% lbs. applied/year) (Kynetec, 2019a). Smith et. al. reports that ethofumesate has good control of these weed pests.

Ethofumesate is the only Group 8 herbicide (Heap, 2020) among most used alternatives in onion production. This unique mode of action offers growers an important chemical tool for herbicide rotation programs.

Sugar Beets

Of sugar beet acres treated with ethofumesate, 98% are in the upper midwest states (Kynetec, 2019a); Minnesota accounts for 70% of ethofumesate usage (total pounds applied/year) followed by Nebraska (16% usage; total pounds applied/year) and North Dakota (9% usage; total pounds applied/year). The remaining usage on sugar beet is spread across Wyoming, Michigan, Colorado, California, Montana, and Idaho (Kynetec, 2019a).

National usage data indicate that in sugar beets, the primary use of ethofumesate is for control of *Amaranthus* species, including common waterhemp (*A. tuberculatus*) (60% lbs. applied/year) and redroot pigweed (*A. retroflexus*) (40% lbs. applied/year) (Kynetec, 2019a). Other common target pests include lambsquarters (*Chenopodium album*), kochia (*Bassia scoparia*), and smartweed varieties (*Persicaria* spp.) (North Dakota State University Production Guide, 2020). Recommended alternatives for this suite of pests include acetochlor, cycloate, dimethenamid-p, ethofumesate, and S-metolachlor (North Dakota State University Sugarbeet Production Guide, 2020). However, according to the production guide, ethofumesate is the only herbicide that has acceptable efficacy (fair to excellent) to control weeds before they emerge for this entire suite of pests.

The adoption of glyphosate resistant sugar beet varieties began around 2009 (Morishita, 2016) which coincides with the decline in ethofumesate usage during that time period (Kynetec, 2019). The increase in ethofumesate usage since 2013 is likely related to glyphosate resistance and the necessity for controlling glyphosate resistant weeds before weeds emerge (Southern Minnesota Beet Sugar Cooperative, 2014). Currently, glyphosate resistant kochia, waterhemp, and wild oat in sugar beet is documented in Idaho (kochia), Michigan (kochia), Oregon (kochia), Montana (wild oat), North Dakota (waterhemp) and Wyoming (kochia) (Heap, 2020).

Ethofumesate is the only Group 8 herbicide (Heap, 2020) among recommended alternatives in sugar beet production. This unique mode of action offers growers an important chemical tool for herbicide rotation in resistance management programs.

Golf Courses

Ethofumesate is used primarily prior to weed emergence in established turfgrass, though this chemical can also control small emerged weeds, up to the four-leaf stage (Christians, 2014; Kowalewski, 2020). Timing of application for turf uses includes both pre- and post-emergence to the weeds for cool season and warm season grasses and is most effective in programs where ethofumesate is used as a before crop emergence as well as a post crop emergence control (UC IPM, 2016). Ethofumesate is safe for most turfgrasses (except zoysia [*Zoysia japonica*] and fine fescue [*Festuca* spp.) (UC IPM, 2016), but is more often used in perennial ryegrass turf (*Lolium perenne*) (Christians, 2014; Hudson and Joseph, 2020; Kowalewski, 2020). Ethofumesate is reported to be important and mainly used for annual bluegrass (*Poa annua*) management (Alabama Cooperative Extension, 2019; Texas A&M, 2018; UC IPM, 2016; Hudson and Joseph, 2020; Kowalewski, 2020). For annual bluegrass control before weeds emerge, Texas A&M (2018) recommend atrazine, ethofumesate, flumioxazin, indaziflam, pronamide, and simazine. However, ethofumesate is the only chemical in this list that can be used on cool season grasses. For control of annual bluegrass before it emerges and shortly after it emerges, Kowalewski (2020) reports that ethofumesate is the only recommended herbicide before annual bluegrass emerges, and that amicarbazone, bispyribac-sodium, and ethofumesate are recommended controls for young emerged bluegrass.

Ethofumesate is one of few herbicides that can be used on both warm and cool season turf grasses and there are a few herbicides for use in turfgrass that have both pre- and postemergence weed control activity. Ethofumesate usage before weed emergence is recommended for use during fall applications at 1.0 lbs. AI/acre (Hudson and Joseph, 2020) to control annual bluegrass, starting in October and reapplied at 3-4 week intervals (Hudson and Joseph, 2020; Kowalewski, 2020) with a 90-100% efficacy rating (Kowalewski, 2020). Kowalewski (2020) recommends pre weed emergence applications at 0.1 – 1.5 lbs. AI/acre, and application rates after weeds emerge at 1.1 – 1.5 lbs. AI/acre. Park (2017) reported that field studies showed that ethofumesate applied at 2.0 lbs. AI/acre was the most effective herbicide strategy to maximize perennial ryegrass populations during establishment.

Ethofumesate is the only Group 8 herbicide (Heap, 2020) among recommended alternatives in turf weed control maintenance. There are 18 documented cases of weed resistance in turf, including six different modes of action; ten of the documented cases is for resistance of annual bluegrass in turf. There is no resistance reported for ethofumesate and because it has a

unique mode of action, ethofumesate offers growers a tool to control annual bluegrass that may be resistant to other herbicides. Ethofumesate also serves as an important chemical in herbicide rotation programs.

Grass Grown for Seed

The majority of grass grown for seed (75%) is produced in the Pacific Northwest and California, with a total of approximately 740,000 acres nationwide (USDA, 2019). Weed control in grass grown for seed may vary between annual and perennial varieties, but there is little research literature published with regards to weed control in different varieties of grass grown for seed. However, in the Pacific Northwest, ethofumesate is reportedly an important herbicide for annual ryegrass grown for seed (DeFrancesco et. al., 2020).

In annual ryegrass production, DeFrancesco et. al. (2020) reports that "ethofumesate is used almost exclusively on nearly 100% of the acreage at time of planting to control grass weeds and again when weeds and crop are young. If needed, postemergence herbicide recommendations include 2,4-D or dicamba". In perennial ryegrass grown for seed, recommended herbicides that can control weeds before they emerge and smaller emerged weeds include diuron, ethofumesate, metribuzin, oxyfluorfen, and pronamide. DeFrancesco et. al. (2020) recommends preemergence (to the weed) applications of ethofumesate at the higher rate of 1.9 lbs. AI/acre when using to control annual bluegrass, mannagrass (*Glyceria* spp.), rattail fescue (*Vulpia myuros*), volunteer cereals (multiple species), wild oat (*Avena fatua*), and other winter annuals before weeds emerge. The 1.9 lbs. AI/acre ethofumesate application rate is also suggested if weeds have emerged.

Sod/Turf Farms

Most of the preemergence herbicides used in turfgrass are root growth inhibitors such as ethofumesate. For this reason, Boyd (2008) reports that preemergence herbicides are rarely used in sod production due to their potential to inhibit root development on sprigs or stolons that are trying to establish. McCurdy (2019) reports that annual bluegrass is a major weed challenge with limited chemical control options due to root growth inhibition by major preemergence herbicides. However, since ethofumesate is recommended for annual bluegrass control after the weed emerges in golf course turf and grass grown for seed (the turf and seed crop are also emerged), it is possible that it is also used in sod/turf production.

McCurdy (2019) recommends preemergence weed control in sod/turf farms to include dithiopyr, oryzalin, pendimethalin, prodiamine, trifluralin, metolachlor, oxadiazon, and indaziflam. Recommended herbicides that control weeds after they emerge include foramsulfuron, rimsulfuron, trifloxysulfuron, sulfosulfuron, and flazasulfuron. Recommended herbicides that control weeds before and after they emerge include atrazine, simazine, flumioxazin, and pronamide. Ethofumesate is not included in pre or post weed control options.

Residential Lawns

Like most other turf uses (i.e. golf courses, sod/turf farms) the main use of ethofumesate in residential lawns is for control of annual bluegrass in cool season turf grasses (University of

Georgia, 2012). Though ethofumesate can be used on residential lawns, it must be applied by a licensed applicator and is not available to homeowners without a commercial applicators license.

The University of Georgia (2012) reports that ethofumesate has good to excellent control of annual bluegrass and that other herbicide alternatives with similar efficacy includes atrazine, foramsulfuron, glufosinate, glyphosate, simazine, and trifloxysulfuron. While LeStrange and Reynolds (2016) recommend use of benefin, bensulide, dimethenamid-P, dithiopyr, ethofumesate, indaziflam, oryzalin, pendimethalin, and prodiamine in California lawns.

IMPACTS OF MITIGATION

As previously discussed, the Agency identified occupational and ecological risks of concern associated with use of ethofumesate. The following discussion on impacts of mitigation is focused on use sites, for which some use sites may have more than a single mitigation to reduce exposure.

All Use Sites

To reduce occupational exposure, to all use sites, the Agency is considering prohibiting the movement of hand set irrigation systems for seven days after application except as permitted by WPS [170.603(d)]. Currently there is no prohibition for moving hand set irrigation. In addition to reducing occupational exposure for all use sites, spray drift mitigation is being considered to reduce ecological exposure to non-target organisms on the edge of fields.

Occupational Exposure

There are many types of irrigation systems, but some growers may have limited choices for a particular farm/field based on size and shape of the land. Evans and Sneed (1996) report that hand set moveable irrigation is often used on small irregularly shaped fields while larger fields are more likely to use permanent irrigational systems. Moving hand set irrigation equipment is very labor intensive; for instance, a 30-acre field requires 22.5-man hours each time pipes are moved. In terms of size, the 30-acre example is a relatively small system indicating that hand set portable systems are not practical for irrigating large acreage (Evans and Sneed, 1996). In addition, the United States Department of Agriculture (USDA) Census of Agriculture Farm and Ranch Irrigation Survey shows that hand set irrigation was only used on approximately 1.2% of all U.S. irrigated farmland in 2018 (USDA, 2018).

Few growers in the US use hand set irrigation, so no widespread impacts are expected. However, growers that do use hand set irrigation may be impacted by having to adjust the application schedule around a seven-day prohibition for moving hand set irrigation equipment. Growers that cannot afford a seven-day prohibition due to post application activities may have to choose a different herbicide that does not have this restriction. In such a case, these growers may have to switch to another herbicide that may increase the cost per acre of weed control or which may result in lower efficacy.

Ecological Exposure

To reduce risks from ethofumesate to non-target organisms on the edge of treated fields, the Agency is considering mandating droplet sizes of medium or courser, spray release height to 4-feet above soil or canopy, and a wind speed restriction of 15 mph or less.

Droplet Size - Most ethofumesate labels do not currently have a droplet size restriction (e.g. EPA registration number 264-613); however, the Agency is considering establishing a mandatory droplet size of "medium or coarser" for all application types.

Ethofumesate is an herbicide that is applied directly to the soil prior to weed emergence. To be effective, ethofumesate requires soil incorporation which will facilitate homogenous spread of the chemical throughout the application site. For this reason, a medium or coarser droplet size should have little to no effect on ethofumesate's efficacy.

However, in cases where ethofumesate is used on small post emerged weeds, a medium or courser droplet size may impact efficacy, since a smaller droplet size is often necessary to achieve complete coverage of weed foliage. Because chemical-specific data for the performance of droplet sizes is limited, EPA was not able to evaluate the effects of droplet sizes (as defined by ASABE S572.1) specifically for ethofumesate. Therefore, the EPA does not know the effect this requirement will have on the performance of ethofumesate across various use patterns. In general, potential negative impacts to growers from requiring larger droplets could include reductions in efficacy, increased selection pressure for the evolution of resistance due to a decrease in lethal dose delivered to target pests, increased application rates used by growers, increased costs associated with reduced yield, more pesticide applications, the purchase of alternative products, or an inability to use tank mix or premix products. The EPA encourages comments on any potential impacts to growers from specifying a mandatory minimum droplet size on product labels.

Release Height - The Agency is considering a maximum spray release height of four feet above the soil or crop canopy for ground boom applications on all use sites. Most labels currently contain a four-foot spray release height restriction. Tindall and Hanson (2018) reviewed manufacturer recommendations and found that a maximum release height of 4-feet allows adequate coverage for the majority of nozzles. Therefore, EPA does not anticipate any negative impacts to growers from the requirement.

Wind Speed - The Agency is considering a 15-miles per hour (mph) maximum wind speed restriction for groundboom applications of ethofumesate. Currently, most labels contain a 15-mph wind speed restriction. The Agency does not anticipate that a 15-mph wind speed restriction will negatively impact users of ethofumesate.

Golf Courses

In addition to the hand set irrigation mitigation (discussed above), to reduce post application exposure to workers that may enter an ethofumesate treated area, the Agency is considering a rate reduction from the current 3.0 lbs. AI per acre to 2.3 lbs. AI per acre for golf course uses.

Ethofumesate is used mainly for annual bluegrass control on golf course turf, and several recommendations indicate ethofumesate usage ranges from 0.1–2.0 lbs. AI/acre at 21-28 day intervals (Hudson and Joseph, 2020; Kowalewski, 2020). This large range is most likely pest driven, because harder to control weed species may need higher rates. BEAD does not expect a rate reduction to 2.3 lbs. AI/acre to impact how ethofumesate is currently used in golf course weed maintenance. However, the Agency invites public comment during the Preliminary Interim Decision period as a means to better understand typical ethofumesate rates used in golf course weed control.

Grass Grown for Seed

In addition to the hand set irrigation mitigation (discussed above), to reduce post application exposure to workers that may enter an ethofumesate treated area, the Agency is considering a rate reduction from the current 1.9 lbs. AI per acre to 1.5 lbs. AI per acre in grass grown for seed.

Research literature (DeFrancesco et. al., 2020) suggests that in perennial ryegrass grown for seed, ethofumesate is used at the higher rate of 1.9 lbs. AI/acre when using to control annual bluegrass, mannagrass (*Glyceria* spp.), rattail fescue (*Vulpia myuros*), volunteer cereals (multiple species), wild oat (*Avena fatua*), and other winter annuals before weeds emerge. The 1.9 lbs. AI/acre ethofumesate application rate is also suggested if weeds have emerged. Therefore, a rate reduction from 1.9 lbs. AI/acre to 1.5 lbs. AI/acre may preclude grass seed producers from controlling various weed species both before and after they emerge. The Agency invites public comment during the Preliminary Interim Decision period as a means to better understand ethofumesate rates typically used in grass grown for seed.

Sod/Turf Production

In addition to the hand set irrigation mitigation (discussed above), to reduce post application exposure to workers that may enter an ethofumesate treated area, the Agency is considering a rate reduction from the current 2.3 lbs. AI per acre to 2.0 lbs. AI per acre in sod/turf production. In addition to an application rate reduction, an REI of six days is being considered for all post application activities.

CDPR (2013-2017) data indicate that in California, less than 500 lbs. of ethofumesate is applied/year to sod/turf production. This low amount of ethofumesate usage indicates that ethofumesate may not be an important herbicide for use in sod/turf production in that state. In addition, literature suggests that few herbicides that control weeds before they emerge (e.g. ethofumesate) can be used safely in sod/turf production due to their ability to damage emerging root (crop) systems (Boyd, 2008). This information may indicate that ethofumesate is not an important herbicide for weed control in sod/turf production. However, because annual bluegrass is identified as a major weed in sod/turf production, as it is for golf courses and grass grown for seed (i.e. other turf sites) it is likely that sod/turf producers also use ethofumesate to control weeds before they emerge. If so, it is likely that similar to golf courses and grass grown for seed, ethofumesate rates would range from 0.1 lbs. AI/acre – 2.0 lbs. AI/acre (DeFrancesco et. al., 2020). In such a case, reducing the rate for sod/turf production to 2.0 lbs. AI/acre is unlikely to have a negative impact on sod/turf production. The Agency invites public comment during the

Preliminary Interim Decision period as a means to better understand ethofumesate rates typically used in grass grown for seed.

For all activities outside of hand set irrigation (that may result in prohibiting the movement of hand set irrigation for seven days after an ethofumesate application), an increased REI from 48 hours to six days may be needed to reduce exposure for all post application activities at the suggested rate reduction of 2.0 lbs. AI per acre rate.

An REI of greater than two days may impede the grower's ability to check fields for herbicide efficacy, presence of additional pest types, or for other maintenance activities. An REI of greater than two days will increase the complexity of scheduling activities around ethofumesate applications. In addition, REIs greater than 48-hours require growers to post warning signs that prohibit workers from entering a treated field which is an additional cost in both time and effort. If growers find a six-day REI to be too prohibitive in performing necessary post application production activities, they would likely use another herbicide with a shorter REI. This may result in decreased efficacy (depending on herbicide) and/or increased costs if the alternative herbicide is more expensive. The Agency invites public comment during the PID period as a means to better understand how increased REI may affect soy/turf production.

Residential Lawns

Though ethofumesate can currently be used on residential lawns, it must be applied by a licensed applicator. Residential use of ethofumesate is often targeted at annual bluegrass control (University of Georgia, 2012) and professional research on home lawn/turf uses indicates that there are several alternatives to ethofumesate for use on home lawns, including several modes of action (LeStrange and Reynolds, 2016). For this reason, BEAD concludes that licensed applicators should have sufficient weed control options for weeds (including annual bluegrass) in residential lawns in the event that ethofumesate is cancelled for this use site.

CONCLUSIONS

Ethofumesate is a systemic herbicide that controls both grass and broadleaf weeds before they emerge and is mainly used in sugar beet and onion production. Ethofumesate can also control recently emerged weeds that are still small. There is a relatively minor amount of non-agricultural usage reported for golf courses, sod/turf maintenance, and commercial landscaping.

Ethofumesate offers residual control with a different mode of action from other most used or recommended herbicides in onions, sugar beets, golf courses, grasses grown for seed, and sod/turf production. Ethofumesate is one of few herbicides that can be used on both warm and cool season turf grasses and that can control weeds both before and after weeds emerge. Unlike other recommended residual herbicides, ethofumesate can be applied both before and after crops and turf emergence. Ethofumesate also plays an important role in controlling herbicide resistant annual bluegrass in turf and glyphosate resistant weeds in sugar beet production. In addition to efficacy, ethofumesate is beneficial to growers for use in integrated pest management programs, specifically herbicide rotation.

To address occupational risks, the Agency is considering prohibiting the movement of hand set irrigation systems for seven days after application except as permitted by WPS [170.603(d)];

decreasing the maximum single application rates for golf course from 3.0 lbs. AI/acre to 2.3 lbs. AI/acre; decreasing the maximum single application rate in grass grown for seed from 1.9 lbs. AI/acre to 1.5 lbs. AI/acre; decreasing the maximum single application rate for sod/turf production from 2.3 lbs. AI/acre to 2.0 lbs./acre; and increasing the REI from 48 hours up to six days for sod/turf production, dependent on rate. To reduce risks to homeowners, the Agency is considering cancellation of ethofumesate on residential lawns. To reduce potential risks to non-target species from spray drift, the Agency is considering a mandated medium to coarser droplet size; a four-foot spray release height for groundboom equipment; and a wind speed restriction of 15 miles per hour or less across all labels.

Potential spray drift mitigation is expected to have little to no impact. However, BEAD cannot determine how a seven-day prohibition for moving hand set irrigation will affect users of ethofumesate across all use sites, but few growers in the US use hand set irrigation, so no widespread impacts are expected. However, growers that do use hand set irrigation may be impacted by having to adjust the application schedule and reentry activities around a seven-day reentry prohibition. Due to recommended application rates on golf courses, grass grown for seed, and sod/turf production, BEAD determines that golf course managers and sod/turf producers may not be effected by reduced rates, while producers of grass grown for seed may find the reduced rate inadequate to control some weed species that require the maximum ethofumesate rate. Finally, increased REIs up to six days in sod/turf production, is likely to have a negative impact that precludes growers from performing post application maintenance activities.

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