February 18, 2021

Docket ID: **EPA-HQ-OPP-2020-0514**

Tracy Perry
Environmental Protection Agency
Office of Pesticide Programs
Pesticide Re-Evaluation Division (7508P)
1200 Pennsylvania Ave, NW
Washington, DC 20460-0001

Re: **Draft Endangered Species Act Biological Evaluations: Atrazine, Simazine, and Propazine Registration Review.**

The Weed Science Society of America (WSSA) is very concerned about the potential loss of the triazine herbicides for use in integrated weed management programs that support American farmers. We appreciate the opportunity to submit comments on EPA's draft Endangered Species Act (ESA) Biological Evaluations (BEs) for atrazine, simazine, and propazine. The WSSA was founded in 1956 as a non-profit scientific society that fosters an awareness of weeds and their impact on our environment. Our membership includes academic and private sector professionals providing science-based information to the public and government policymakers, while promoting research, education, and outreach activities.

Before discussing the draft BEs for the triazines, WSSA raised numerous concerns about the Agency's 2016 draft ecological risk assessment for the triazines that have not been adequately addressed before conducting the BEs. The concerns from the 2016 draft ecological risk assessments included:

- Errors in endpoint data and the water monitoring database.
- Use of models that have not been not validated with field data.
- Estimates of inflated hypothetical risks (e.g. atrazine applications resulting in 36% bird mortality) that have never been observed in the history of atrazine use.
- Use of data or findings not conducted in accordance with EPA's scientific guidelines required under FIFRA.
- Ignoring the advice and findings of previous Science Advisory Panels on atrazine.

These same issues have been repeated and compounded in the draft BEs and if not fixed, could affect the future availability of triazines in the marketplace. WSSA is resubmitting its comments on the triazine draft ecological assessments from 2016 (Docket ID: EPA-HQ-OPP-2013-0266), which are included in Appendix 1 (p. 12).

As EPA has engaged in additional analysis in recent years working towards compliance with the Endangered Species Act (ESA), the triazine BE's continue to lack a workable and consistent approach to species assessments. The current documents are:

- Overly complex,
- Incorporate unrealistic modeling assumptions,
- Fail to meet the stated goals of EPA's revised methods,
- Lack transparency, and
- Result in an assessment which does little to distinguish which species may truly benefit from possible label changes.

An assessment process which essentially equates **ANY** exposure to a pesticide as a possible concern to any species does little to advance appropriate options which could be tailored to improve species protection.

The implications of unrealistic analyses will result in unjustified restrictions on the use of triazine products which remain critical weed management tools across the U.S.

WSSA areas of concern include:

- The triazine BE's fail to incorporate best available science and lack a quantitative weight of evidence approach which are critical to a reliable assessment of possible species risk. Probabilistic methodologies have been recommended, and promised, for many years, yet assessments continue to lack these improvements.

- EPA has not responded to past comments raising grower concerns about the problems with EPA's process for conducting pesticide BE's as part of the registration review process. These problems include use of results and conclusions based on data that does not meet the rigor and objectivity required, failure to use probabilistic methods, failure to use a rigorous weight of evidence approach, and using overly conservative ecological endpoints to identify possible concerns.

- EPA, in effect, moves the responsibility to make accurate and realistic assessments to other agencies (the US Fish and Wildlife Service and the National Marine Fisheries Service [the Services]). The Services are understaffed and generally unfamiliar with the registration evaluation process EPA conducts under FIFRA – further adding to the likelihood of unrealistic, and overly simplistic conclusions.

- There is little evidence in the triazine draft BEs that EPA has established whether pesticide exposure at a concentration causing adverse effects is reasonably certain to occur or that the BE's incorporate available geographic use data to refine assessments of possibly impacted areas.

EPA should make a significant effort in the final triazine BEs to **reduce the level of compounding conservatism** in the assessment. EPA's use of worst-case scenarios

throughout the assessment and the use of overly conservative assumptions accumulate in the analysis in a way that greatly exaggerates the effect of atrazine on endangered and threatened species. EPA should adjust the approach to more accurately incorporate use and usage information, and strive to better establish whether pesticide exposure at a concentration potentially causing adverse effects is reasonably certain to occur.

As EPA completes its registration review process for the triazines, WSSA wants to stress that these products have large and significant benefits to growers across the country. We have attached letters (included at the end of this document) on current triazine use patterns and the importance of triazines in integrated weed management plans from some of our leading weed science experts:

- Dr. Mark VanGessel, University of Delaware (p. 4)
- Dr. Aaron Hager, University of Illinois (p. 5)
- Dr. Robert Hartzler, Iowa State University (p. 6)
- Dr. William Johnson, Purdue University (p. 7)
- Dr. Thomas Barber, University of Arkansas (p. 8)
- Dr. Calvin Odero, University of Florida (p. 10)
- Dr. Joseph Ikley, North Dakota State University (p. 11)

In closing, WSSA supports the continued safe and effective use of the triazine herbicides. We encourage EPA to revisit its ecological endpoints determinations provided in the draft BE, update its approach and methodologies to incorporate the most recent and best available data, and employ a rigorous quantitative weight of evidence approach. WSSA appreciates the opportunity to comment on this critical weed management issue and gladly offers the expertise of our members to answer any questions the Agency may have as it proceeds to make improvements in its BE assessment process.

Sincerely,

Dr. William S. Curran
President, Weed Science Society of America

College of Agriculture & Natural Resources
DEPARTMENT OF PLANT & SOIL SCIENCES
UD COOPERATIVE EXTENSION

Mark VanGessel
Extension Specialist / Professor
Research and Education Center
Georgetown, DE 19947
Phone: (302) 856-7303
Email: mjv@udel.edu

February 14, 2021

Dr. Van Wychen

Triazines are still a mainstay for weed programs in Delaware. I estimate 90 to 95% of all of our corn acreage gets at least one triazine treatment. Atrazine is used for the range of weeds it controls, to help augment control of HPPD-inhibiting herbicides, and it's a very cost-effective treatment. Atrazine is a key herbicide to manage morningglory species in the region, and it is used extensively to control glyphosate-resistant species such as Palmer amaranth and common ragweed. The vegetable growers in the region often rotate to field corn to control hard to control weeds and to "clean up a field" before rotating back to vegetables.

Conventionally tilled-corn gets an application as part of the preemergence application at planting. Most of this is in the form of a prepackaged mixture such as Bicep, Harness Xtra or Acuron. As a result, the atrazine rate is 1.25 to 1.5 lb atrazine. A portion of the fields will be treated postemergence and often atrazine is included. The standard rate is 1 lb active ingredient.

The no-till fields often will get an additional triazine in the form of simazine at 1 to 1.25 lbs active ingredient with the burndown treatment applied two to three weeks prior to planting.

Likewise, almost all of our sorghum fields get a treatment of atrazine. The standard rate is 1 lb active ingredient at planting and sometimes an additional 1 lb as part of the postemergence applications.

Sincerely,

Mark VanGessel
Extension Specialist / Professor

ILLINOIS

COLLEGE OF AGRICULTURAL, CONSUMER AND ENVIRONMENTAL SCIENCES

Department of Crop Sciences
AW-101 Turner Hall, MC-046
1102 S. Goodwin Ave.
Urbana, IL 61801-4730

February 15, 2021

Dr. Lee Van Wychen
Executive Director of Science Policy
National and Regional Weed Science Societies
5720 Glenmullen Pl, Alexandria, VA 22303

Dear Dr. Van Wychen:

Triazine herbicides are a critically important component of weed management programs in Illinois corn production. We estimate over 90% of Illinois corn acres are treated with a triazine-containing product each growing season to control a broad spectrum of dicot weed species, including those resistant to glyphosate and ALS-inhibiting herbicides. The most common use pattern of atrazine in Illinois is in combination with one or more other active ingredients, and many Illinois corn producers realize the benefits of efficacious, broad-spectrum weed control when combining atrazine with HPPD-inhibiting herbicides. Utilizing atrazine in combination with other active ingredients results in application rates below the maximum rate allowed by label. The most common application rate of atrazine in Illinois corn ranges from 0.5–1.0 pound active ingredient per acre for foliar applications, to 1.0–1.5 pound active ingredient per acre for soil applications.

Respectfully,

Associate Professor
Extension Weed Science
Department of Crop Sciences
University of Illinois

IOWA STATE UNIVERSITY
Department of Agronomy
Crop, Soil, and Environmental Sciences

2104 Agronomy Hall
Ames, Iowa 50011-1010
515 294-1164
FAX 515 294-9985
hartzler@iastate.edu

February 15, 2021

Dear Dr. Van Wychen,

Although Iowa farmers tend to use atrazine on fewer corn acres (approximately 60%) than in many other corn producing states, it is still a very important product. The lower use is due to high pH soils in many areas of the state that increase the likelihood of atrazine carryover injury to rotational crops.

Atrazine is used in combination with other products to increase the spectrum of weeds controlled, and to improve the consistency of control of difficult to control weeds such as giant ragweed, cocklebur and velvetleaf. Since it is used in combination with other products, the average use rate in Iowa is less than 1 lb/acre, therefore reducing environmental risks.

The value of atrazine to Iowa farmers is documented by the continued use of the product in spite of the fact that the majority of waterhemp (the Cornbelt's worst weed problem) in Iowa is resistant to the product. Although atrazine doesn't help farmers manage waterhemp, it provides value in controlling other weeds and reduces the likelihood of other weeds developing herbicide resistance. In the absence of atrazine, farmers would increase the use of other, more expensive, herbicides.

Sincerely,

Robert Hartzler
Professor/Extension Weed Scientist
Department of Agronomy
Iowa State University

PURDUE
UNIVERSITY

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY

February 15, 2021

Dear Dr. Van Wychen,

Atrazine and simazine are vital for our weed control programs in Indiana. Atrazine is used because of the wide range of weeds it controls at a very low cost, and it helps to improve control with group 27 herbicides, which are widely used as well. Atrazine is a key herbicide for control of waterhemp, lambsquarter, ragweeds, velvetleaf, and morningglory in corn production.

Approximately 50% of our corn is grown with conventional tillage practices, and 50% is grown with no tillage practices. Regardless of the tillage practice, most of the cornfields will receive atrazine in the form of a prepackaged mixture with metolachlor or acetochlor, mesotrione, or some kind of a three or four way mixture with these active ingredients (Lexar or Acuron). The use rate of atrazine in a preemergence program like this ranges from 1.5 to 2 lb ai/A, depending on the location in the state. About 20% of our corn receives the maximum use rate of 2.5 lb ai/A per year where the preemergence application is followed by a postemergence atrazine treatment to supplement the weed control provided by the other postemergence herbicides.

Our sorghum acres are somewhat limited, but every field would be treated with atrazine since we do not have as wide of a range of herbicides to use in sorghum. The rates would be 1 to 1.5 lb ai/A.

Best Regards,

William G. (Bill) Johnson
Professor of Weed Science
1-361 Lilly Hall of Life Sciences
Purdue University
West Lafayette, IN 47907
wgj@purdue.edu

UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE
Cooperative Extension Service

2/17/21

Dr. Van Wychen

Herbicides containing the active ingredient atrazine remain critical in Arkansas for the effective control of multiple herbicide-resistant Palmer amaranth (pigweed) and morningglory species in corn and grain sorghum. Palmer amaranth has been confirmed resistant to six herbicide modes of action in several counties of Northeast Arkansas. Recently 3 populations have been found tolerant to field rates of glufosinate. Atrazine is one of only a few herbicides labeled for corn and grain sorghum that remains highly effective in controlling these multiple-resistant populations of pigweed. Therefore the use of atrazine remains critical for Integrated Weed Management techniques in regards to crop rotation with soybean and cotton where we have developed resistance in pigweed not only to glyphosate, but also the DNA herbicides (Prowl/Treflan), ALS chemistry (Classic/Scepter), PPO inhibitors such as Flexstar and Valor, and VLCFA inhibitors such as metolachlor. We currently have no documented resistance of pigweed to atrazine or this class of chemistry in Arkansas or the Midsouth.

The loss or reduction of atrazine rates to less than 2.5lb ai/A/year would be devastating to us from a weed management perspective. In recent studies conducted on-farm with pigweed populations exhibiting 5-way resistance, atrazine provided the best control of pigweed populations from a preemergence or residual standpoint and postemergence. There are only a handful of herbicides available to Arkansas producers that continue to control pigweed, atrazine is one of these and without it, corn and grain sorghum acreage and thus production would decrease due to the lack of pigweed control. Furthermore, it would put an increased burden on glufosinate the active ingredient in Liberty herbicide which is already slipping on some populations of pigweed in Arkansas.

Most corn producers apply at minimum 1lb ai/A atrazine PRE followed by a post herbicide program containing 1.5lb ai/A atrazine plus a WSSA group 27 and 15 herbicide as a complete program. Removing atrazine out of the corn weed control system or reducing the rate structure below the current maximum of 2.5 lb ai/Acre per year would jeopardize pigweed management not only in corn and sorghum, but in other crops as well because rotation of effective herbicide modes of action would not be possible.

Arkansas Is Our Campus

P. O. Box 357
2001 Highway 70 East
Lonoke, AR 72086
501-676-3124 – Telephone
501-676-3125 - Fax

Arkansas producers need every available herbicide mode of action possible to battle resistant pigweed and reduce the probability of further increasing resistance through use of single herbicide modes of action. Removing atrazine or reducing the maximum use rate would take a viable tool from corn and grain sorghum producers as well as increase the potential for herbicide resistance in Midsouth pigweed populations.

I strongly encourage the EPA to not place any further restrictions on atrazine. Please feel free to contact me with any questions.

Sincerely,

Tom Barber
Professor and Extension Weed Scientist
University of Arkansas – Division of Agriculture

P. O. Box 357
2001 Highway 70 East
Lonoke, AR 72086
501-676-3124 – Telephone
501-676-3125 - Fax

UF UNIVERSITY of FLORIDA

IFAS Research
Everglades Research and
Education Center

3200 E. Palm Beach Rd.
Belle Glade, FL 33430
561-993-1509
561-993-1582 Fax
http://erec.ifas.ufl.edu

February 18, 2021

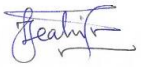
Dr. Van Wychen

Triazine herbicides (atrazine, ametryn and metribuzin) are an integral component of our sugarcane weed management programs. Over 90% of our sugarcane acreage is treated with at least one or a combination of these herbicides. The triazines are used in our sugarcane weed control programs because of their ability to provide broad spectrum weed control, flexibility of application and tank mixing.

Atrazine, the most widely used is commonly tank-mixed with HPPD inhibiting herbicides (mesotrione and topramezone) for control of broadleaf weeds and also for early postemergence control of annual grasses such as fall panicum, our most prevalent and problematic annual grass. The atrazine-topramezone combination is also used to provide suppression of new bermudagrass growth in our cane fields. Our growers also tank mix atrazine or metribuzin with pendimethalin for preemergence weed control. The premix of atrazine, *S*-metolachlor and mesotrione (Lumax EZ) has recently become available to our growers for preemergence or early postemergence control programs. Because our sugarcane planting coincides with the beginning of our dry season, many of our growers rarely use true preemergence herbicide programs.

Our growers use atrazine at 0.5 to 2 lb depending on the tank mix partner. For example, the tank mix with mesotrione can be as low as 0.5 lb atrazine for broadleaf weed control while the tank mix with topramezone is usually 1 to 2 lb atrazine. Many growers seldom use atrazine at the maximum rate for single application (4 lb atrazine) because most do use tank mixes in their herbicide programs thereby resulting in use of low rates of atrazine. Similar to atrazine, our growers do not use the maximum-labeled rates for single application of ametryn and metribuzin, which are 1.2 and 1.75 lb, respectively. Ametryn is applied at 0.2 to 0.4 while metribuzin use rate is typically <1.12 lb. These triazines are used early postemergence and subsequent herbicide applications will mainly be for grass control using asulam alone or tank mixed with trifloxysulfuron.

Sincerely,



Calvin Odero
Extension Weed Specialist and Associate Professor

NDSU NORTH DAKOTA STATE UNIVERSITY

February 17, 2021

Dr. Lee Van Wychen
Executive Director of Science Policy
National and Regional Weed Science Societies
5720 Glenmullen Pl, Alexandria, VA 22303

Dear Dr. Van Wychen,

Triazine herbicides continue to be an important component of corn production across the state of North Dakota. I estimate over 70% of our corn acres receive one application of atrazine each year. The most popular use rate is 0.38 pounds per acre, with a maximum use rate of 0.5 pounds per acre. Application of 0.38 pounds per acre is popular on many corn fields because it allows flexibility to rotate to most crops grown in North Dakota. Atrazine is typically tank-mixed with a HPPD-inhibiting herbicide for early postemergence control of many problematic weeds including glyphosate-resistant and ALS-inhibiting herbicide-resistant kochia, waterhemp, common ragweed, and horseweed. The addition of atrazine to HPPD-inhibiting herbicides also helps increase control on green foxtail and wild oats that are resistant to ACCase-inhibiting and ALS-inhibiting herbicides. Corn yields are typically lower in North Dakota than many other states in the US, and the ability to use atrazine at 0.38 to 0.5 pounds per acre is cost-effective and helps limit input costs for fields with a history of lower yields.

Sincerely,

Joseph Ikley

Dr. Joseph Ikley
Assistant Professor and Extension Weed Control Specialist
Joseph.ikley@ndsu.edu
(701) 231-8157
470-H Loftsgard Hall
1360 Albrecht Blvd.
Fargo, ND 58102

APPENDIX 1

WSSA
WEED SCIENCE SOCIETY OF AMERICA
www.wssa.net

October 5, 2016

Docket ID: **EPA-HQ-OPP-2013-0266**

Environmental Protection Agency Docket Center (EPA/DC)
(28221T)
1200 Pennsylvania Ave, NW
Washington, DC 20460-0001

Re: **Atrazine: Draft Ecological Risk Assessment.**

The Weed Science Society of America (WSSA) is very concerned about the potential loss of atrazine and simazine as integrated weed management tools and appreciates the opportunity to submit comments on EPA's draft ecological risk assessment. The WSSA was founded in 1956 as a non-profit professional society that fosters an awareness of weeds and their impact on our environment. We provide science-based information to the public and government policymakers while promoting research, education, and outreach activities.

The WSSA is aware of concerns raised by various stakeholders relative to the Agency's draft ecological risk assessment for the triazines. These concerns include:

- errors in endpoint data and the water monitoring database
- use of models that are not validated with field data
- estimates of inflated hypothetical risks (e.g. atrazine applications resulting in 36% bird mortality) that have not been observed in over 55 years of atrazine use
- use of data or findings not conducted in accordance with EPA's scientific guidelines required under FIFRA
- ignoring the advice and findings of previous Science Advisory Panels on atrazine

The WSSA stresses the importance of addressing these concerns in order to maintain stakeholder confidence in the Agency's science-based regulatory framework. However, our main concern, based on the current ecological draft risk assessment, is that atrazine and simazine would be restricted to less than 0.25 lbs a.i./A and 0.5 lbs a.i./A, respectively. At these low rates, atrazine and simazine would not provide efficacious weed control (Armel et al., 2007; Bollman et al., 2006; Johnson et al., 2005; Liu and O'Connell, 2003; Yu and McCullough, 2016). In addition, using sub-lethal rates of atrazine or simazine is not an effective option for resistance

management as it has been shown that this practice is likely to result in weeds with multiple-site or polygenic resistance (Busi et al., 2016; Norsworthy et al., 2012) which would make it more difficult to control these weeds.

The importance and value of atrazine in integrated weed management programs cannot be overstated (Johnson et al. 2005). Atrazine is used on approximately 60% of corn, 65% of sorghum, 70% of sugar cane, and 70% of sweet corn acres in the United States and is a critical and economical weed management tool, particularly for herbicide resistance weed management. Sweet corn production may actually be most impacted by the loss of atrazine because sweet corn has fewer registered herbicides and is a weaker competitor with weeds due to limited seedling vigor and lower seeding rates compared to conventional field corn (Williams II et al., 2010). **Most of our extension weed scientists have expressed that the loss of atrazine would be devastating from an integrated weed management perspective.**

Simazine is an important management tool for weed control in vineyards, citrus, fruit, and nut orchards, and other perennial crops because of its relatively low price, reliable control of several problem weeds including horseweed (*Conyza canadensis*), hairy fleabane (*Conyza bonariensis*), and junglerice (*Echinochloa colona*), and strong residual activity (Abit et al., 2012; Kadir and Al-Khatib, 2006; Liu and O'Connell, 2002; Tworkoski et al. 2000). The continued use of simazine in these perennial crops where herbicide options are limited is essential to maintaining herbicide diversity and mitigating weed resistance.

Simazine is also an important herbicide treatment in the fall prior to planting corn in the southern Corn Belt for control of glyphosate-resistant horseweed and other winter annual grass and broadleaf weed species (Krausz et al., 2003; Monnig and Bradley, 2008). Fall herbicide applications target winter annual weeds at their vulnerable seedling stage, allow growers and applicators to better manage their spring workload and reduce tillage operations in the subsequent spring. Fall applications may also eliminate or reduce the need for a burn-down herbicide application before planting no-till corn.

Atrazine and simazine have been important for increasing conservation tillage and no-till farming. Atrazine helps farmers reduce aggregate soil erosion by up to 85 million tons per year and saves them 18 million gallons of fuel due to reduced tillage requirements (Mitchell, 2011). Banning atrazine and simazine would greatly diminish the vital conservation efforts of farmers by increasing both soil erosion and the use of fossil fuels. It is estimated that the net economic benefits generated by triazine herbicides exceeds $3 billion per year in the United States (Bridges, 2011, Mitchell, 2014).

While weeds with triazine resistance (WSSA Group 5, Photosystem II inhibitors) have been reported since the 1970's, the occurrences per year, area infested and severity of infestations have declined since 1984 (LeBaron, 1998). In addition, many of the agronomically important triazine-resistant weeds **demonstrate a significant fitness penalty.** For example, Ahrens and Stoller (1983) demonstrated that triazine-resistant smooth pigweed (*Amaranthus hybridus*) produced less shoot biomass and seed dry weight under competitive conditions and exhibited a significantly lower relative growth rate and net assimilation ratio compared to a triazine-susceptible biotype. Thus, many triazine-resistant weeds are not as competitive within integrated crop production systems (Holt et al., 1993; Owen, 2011, Parks et al., 1996; Williams II et al., 1995). Conrad and Radosevich (1979) concluded that triazine-resistant redroot pigweed

(*Amaranthus retroflexus*) and common groundsel (*Senecio vulgaris*) were less fit than their respective wild types under both competitive and non-competitive conditions. They concluded that triazine resistance was only a benefit to plants where triazine herbicides are used repeatedly.

Triazine-resistant weeds may differ not only in their fitness and vigor, but also in their sensitivity to herbicides compared to their triazine-susceptible biotypes (Owen and Gressel, 2001; Parks et al., 1996). If the resistant biotype is easier to control with alternative herbicides, this phenomenon is referred to as **negative cross-resistance**. For example, Gadamski et al. (2000) reported that atrazine-resistant horseweed (*Conyza canadensis*) and barnyardgrass (*Echinochloa crus-galli*) were significantly more sensitive or negatively cross-resistant to 11 of 18 herbicides that were tested. The continued use of atrazine as a principle tactic for weed management in corn, sorghum and sugarcane production is testament to the fact that triazine-resistant weeds do not have a major economic impact and can be effectively managed (Owen, 2011).

In closing, **WSSA supports the continued use of atrazine and simazine with appropriate provisions to steward their safe use and provide for their continued efficacy.** Careful consideration should be given to whether a decision to further restrict or ban triazine herbicides will inadvertently exacerbate other ecological risks and issues surrounding other herbicides and products. Atrazine and simazine are critical for integrated weed management programs and mitigating resistant weeds. WSSA encourages EPA to find a balance between the environmental effects and the benefits triazine herbicides provide because no alternative herbicides with equal economic and agronomic attributes are available at this time. WSSA appreciates the opportunity to comment on this critical weed management issue and gladly offers the expertise of our members to answer any questions the Agency may have as it proceeds.

Sincerely,

Dr. Kevin Bradley
President
Weed Science Society of America

Literature Cited:

Abit, M. M., C. M. Rainbolt, L. J. Krutz, D. L. Shaner and B. D. Hanson. (2012) Effects of Long-Term Use on Simazine Dissipation in Central California Vineyards. Weed Sci. 60:531-536.

Ahrens, W. H and E. W. Stoller. 1983. Competition, growth rate, and CO2 fixation in triazine-susceptible and –resistant smooth pigweed (*Amaranthus hybridus*). Weed Sci. 31:438-444.

Armel, G. R., P. L. Rardon, M. C. McCormick and N. M. Ferry. 2007. Differential Response of Several Carotenoid Biosynthesis Inhibitors in Mixtures with Atrazine. Weed Tech. 21:947-953.

Bollman, S. L., J. J. Kells and D. Penner. 2006. Weed Response to Mesotrione and Atrazine Applied Alone and in Combination Preemergence. Weed Tech. 20:903-907.

Bridges D. 2011. A Biological Analysis of the Use and Benefits of Chloro-s-triazine Herbicides in U.S. Corn and Sorghum Production. Tifton, GA: Abraham Baldwin Agricultural College. Available: http://www.weeds.iastate.edu/mgmt/2011/atrazine/Bridges__9Nov2011.pdf

Busi, R., M. Girotto and S. B. Powles. 2016. Response to low-dose herbicide selection in self-pollinated *Avena fatua*. Pest Management Science, 72(3), pp.603-608.

Conrad, S. G. and S. R. Radosevich. 1979. Ecological Fitness of Senecio vulgaris and Amaranthus retroflexus Biotypes Susceptible or Resistant to Atrazine. Journal of Applied Ecology 16: 171-177.

Gadamski, G., D. Ciarka, J. Gressel and S. W. Gawronski. 2000. Negative cross-resistance in triazine-resistant biotypes of *Echinochloa crus-galli* and *Conyza Canadensis*. Weed Sci. 48:176-180.

Holt, J. S., S. B. Powles and J. A. Holtum. 1993. Mechanisms and agronomic aspects of herbicide resistance. Annu. Rev. Plant Physiol. Plant Mol. Biol 44:203–209.

Johnson, W. G., F. Whitford, D. Flakne, T. Bauman, G. Nice, J. Frankenberger, L. Hahn, T. Bailey, B. Donald, C. Mann, L. Murrell, D. Bowers, D. Tierney and C. Janssen. (2005). Atrazine Use and Weed Management Strategies to Protect Surface Water Quality. West Lafayette, IN: Purdue University Extension. PPP-67. https://www.extension.purdue.edu/extmedia/PPP/PPP-67.pdf

Kadir, S. and K. Al-Khatib. (2006) Weed Control in Grape After Fall and Spring Application of Selected Herbicides. Weed Tech. 20:74-80.

Krausz, R. F, B. G. Young and J. L. Matthews. (2003) Winter Annual Weed Control with Fall-Applied Corn *(Zea mays*) Herbicides. Weed Tech. 17:516-520.

LeBaron, H. M. 1998. The role of triazines in managing weeds resistant to other herbicides. Pages 9-23 in L. G. Ballantine, J. E. McFarland, and D. S. Hackett, eds. Triazine herbicide risk assessment. Washington D.C.: American Chemical Society.

Liu, F. and N. V. O'Connell. (2002) Off-site movement of surface-applied simazine from a citrus orchard as affected by irrigation incorporation. Weed Sci. 50:672-676.

Liu, F. and N. V. O'Connell. (2003) Movement of simazine in runoff water and weed control from citrus orchard as affected by reduced rate of herbicide application. Bioresource Tech. 86:253-258.

Mitchell, P. D., 2011. Economic assessment of the benefits of chloro-s-triazine herbicides to US corn, sorghum, and sugarcane producers. Univ. of Wisconsin Agricultural and Applied Economics Staff Paper, (564), p.51.

Mitchell, P. D., 2014. Market-level assessment of the economic benefits of atrazine in the United States. Pest Manag Sci. 70:1684-1696.

Monnig, N. and K. W. Bradley. (2008) Influence of Fall and Early Spring Herbicide Applications on Winter and Summer Annual Weed Populations in No-Till Corn. Weed Tech. 22:42-48.

Norsworthy, J. K., S. M. Ward, D. R. Shaw, R. S. Llewellyn, R. L. Nichols, T. M. Webster, K. W. Bradley, G. Frisvold, S. B. Powles, N. R. Burgos and W. W. Witt. 2012. Reducing the risks of herbicide resistance: best management practices and recommendations. Weed Science, 60(sp1), pp.31-62.

Owen, M. D., 2011. The importance of atrazine in the integrated management of herbicide-resistant weeds. Ames, IA: Iowa State University. Available: http://www.weeds.iastate.edu/mgmt/2011/atrazine/owen__8nov2011.pdf

Owen, M. D. and J. Gressel. 2001. Non-traditional concepts of synergy for evaluating integrated pest management. Pages 376-396 in J. C. Hall, R. E. Hoagland, and R.M. Zablotowicz, eds. Pesticide biotransformations in plants and microorganisams; similarities and divergences. Washington: Oxford University Press.

Parks, R. J., W. S. Curran, G. W. Roth, N. L. Hartwig and D. D. Calvin. 1996. Herbicide Susceptibility and Biological Fitness of Triazine-Resistant and Susceptible Common Lambsquarters (*Chenopodium album*). Weed Sci 44: 517-522.

Tworkoski, T. J., W. V. Welker and G. D. Vass. (2000) Weed Community Changes Following Diuron, Simazine, or Terbacil Application. Weed Tech. 14:197-203.

Williams II, M. M. and N. Jordan. 1995. The fitness cost of triazine resistance in jimsonweed (*Datura stramonium L.*). American Midland Naturalist 133: 131-137.

Williams II, M. M., C. M. Boerboom and T. L. Rabaey. (2010) Significance of Atrazine in Sweet Corn Weed Management Systems. Weed Tech: 24:139-142.

Yu, J. and P. E. McCullough. 2016. Efficacy and Fate of Atrazine and Simazine in Doveweed (*Murdannia nudiflora*). Weed Sci. 64:379-388.