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

AUG 25 2004

OFFICE OF
PREVENTION,
PESTICIDES AND
TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Atrazine/Propazine Use on Sorghum

FROM: William Phillips, II, MSc., Agronomist
Nicole Zinn, Biologist
Biological Analysis Branch
Biological and Economic Analysis Division (7503C)

THRU: Arnet Jones, Chief
Biological Analysis Branch
Biological and Economic Analysis Division (7503C) 08/20/2004

TO: Eric Olson, Risk Manager Reviewer
Special Review and Reregistration Division (7508C)

PEER REVIEW PANEL: August 18, 2004

Note

~~Portions of This Memorandum May Contain Confidential Business Information~~.

Summary

Special Review and Reregistration Division (SRRD) requested of BEAD the evaluation of the potential for a one to one replacement of atrazine with propazine for weed control in sorghum production. The purpose for this request was to aid in the determination of whether the one to one replacement could be used for HED's cumulative assessment of triazines (atrazine, simazine, and propazine).

Within the scope of this memorandum, replacement connotes the switch to an herbicide that is deemed like another with respect to mode of action, target organisms and most of its chemistry, while an alternative chemical is similar only in its target organism. In this request there was no sorghum crop type or production management system specified for the analysis. As a result, the focus of this analysis was placed on the potential for this one to one replacement in the production of conventional tillage grain sorghum, also known as milo, which is the predominant cropping system and crop type in the United States.

BEAD has made an attempt to evaluate this question based on findings in the research literature and other resources. The registrant and growers group did not offer scientific evidence

in support of their position that propazine is a one to one replacement for atrazine. Future claims of chemicals offered as "replacements" or "alternatives" to existing herbicides would be served best by the inclusion of supporting data by the registrant. Several factors were considered in the analysis including the lower solubility of propazine with respect to atrazine, label restrictions for coarse soil types, and historical data regarding the use of atrazine during the time that propazine was available to farmers. The lower solubility of propazine may potentially result in an efficacy problem for small seeded broadleaf weeds (BLW) as a result of decreased efficacy. The low water solubility of propazine could potentially pose less of a risk in areas where groundwater is close to the surface and the soil types are not precluded by the label but are of a coarse/sandy type (i.e. sandy loam or sandy clay loam). As for the replacement of atrazine by propazine, the historical data has demonstrated that total sorghum area treated with atrazine did not change during the time that propazine was available.

It is the conclusion of BEAD that in the narrow scope of preemergence control of BLW species in sorghum crop production, propazine is an agronomic replacement for atrazine; however, this does not preclude the possible use of atrazine as a postemergence "rescue treatment" in fields where an application of propazine was made and failed to provide adequate control. An evaluation of BEAD's aforementioned conclusion of the question posed by SRRD is detailed in the following analysis.

Introduction

Propazine as a preemergence herbicide in grain sorghum production has had a use history, then later it was the subject of section 18 requests by Colorado, Kansas, New Mexico, and Texas. In 1989, the manufacturer halted propazine production and supplies of propazine lasted producers until the mid 1990's; this is the time when states began submitting section 18 requests to EPA. There are several useful alternatives to the triazine family of herbicides when the primary BLW pests are from the AMARANTHACEAE family: Red Root and Smooth Pigweed, Palmer Amaranth, and/or Common and Tall Waterhemp. Most of these herbicides require an intense production management system in order to avoid crop injury. Some of the alternatives vary in their efficacy from species to species within this family. While resistance management is an important issue in weed science, generally the triazine herbicides are those with the predominant resistance problems and thus are not a primary tool in resistance management programs. Similar in many ways, atrazine and propazine have some differences in their chemistry and use that require consideration. The following is a concise evaluation of alternatives to triazine herbicides, resistance management and a basic comparison of the two herbicides.

Alternatives

Atrazine is currently labeled for use as both a preemergence and postemergence herbicide while the proposed label for propazine will restrict its use to preemergence applications. Registered BLW herbicide alternatives to triazines include, but are not limited to: preemergence-alachlor, bromoxynil, dicamba, dimethenamid, S-metolachlor, prosulfuron, and postemergence-2,4-D, basagran, carfentrazone-ethyl, dicamba and prosulfuron. Some of these chemicals have crop rotation, efficacy, phytotoxicity, and application timing problems[1]. The problems with many of these herbicides were addressed in the registrant's "Response to Propazine SMART Questions". It is worth mentioning some general statements about these limitations, particularly crop injury. Crop injury from herbicides such as 2,4-D are often a result of missing the narrow

application timing, while prosulfuron cannot be applied to crops under stress and other herbicides require the use of treated seed. While these are limitations, herbicides such as 2,4-D and prosulfuron (postemergence) remain viable choices as triazine alternatives for chemical rotation strategies. These limitations for alternative herbicides are valid concerns that have resulted in the request by farmers for the return of propazine.

Resistance Management

Resistance management is a very important topic regarding the triazine herbicides. Both atrazine and propazine are triazines and the exchange of one for another will do nothing to aid in the control of triazine resistant weed species. In fact, the transfer to propazine by those farmers using herbicides with a mode of action different from the triazines may potentially increase the population of resistant weeds. This can, however, be avoided with adequate management programs and chemical rotation. The issue raised by the registrant in the "Response to Propazine SMART Questions" (#21) regarding the use of propazine as "a resistant management tool" for the sulfonylurea herbicides is confusing. In the same response the registrant states that the use of the sulfonylurea herbicides has "reported to cause injury to sorghum when used pre-emergence". When added to the knowledge that reliance on this herbicide family has only been since the mid 1990's, this implies that the use has been low and thus resistant populations must be low. Without supporting data, it would seem that this benefit is not valid. While resistance management is very important in today's intensive agricultural systems, the introduction of propazine does not play a significant role.

Comparison

Propazine and atrazine share the same basic chemistry, basic weed spectrum, and mode of action within the target organisms. However, there are significant differences that warrant consideration.

1. The solubility of propazine is ~3.8 times less than that of atrazine (see table). There could be a concern of adequate soil coverage if correction for this is not made in the formulation of the product. The lower solubility of propazine may potentially result in an efficacy problem for small seeded BLW.
2. A compromise of any type in the efficacy of propazine will require a "rescue" or follow-up treatment with a postemergence herbicide. While it is not a good agronomic practice, there would be nothing to prohibit the postemergence application of atrazine in the same field where propazine was applied as a preemergence treatment in the same season.
3. The use of propazine will be restricted from "sandy and loamy sand soils where the water table (groundwater) is close to the surface and where these soils are very permeable, i.e., well-drained"[8]. The low water solubility of propazine could pose less of a risk in areas where groundwater is close to the surface and the soil types are not precluded by the label but are of a coarse/sandy type (i.e. sandy loam or sandy clay loam). These are in fact the predominant soils found in portions of the sorghum growing south-central region of the country.
4. As a rationale for the need of propazine, an emphasis was placed on the use of propazine in the cotton growing regions due to carryover of atrazine limiting crop rotation choices. Carryover of atrazine has specifically limited cotton rotation in areas where soil types are

conducive to low sorption and slow degradation of herbicides. Atrazine treated fields cannot be planted to any crops other than sorghum or corn until the following year. However, the proposed label for propazine states that there is a 12 to 18 month restriction on the rotation to any crop other than corn or sorghum; in some regions of Texas, a rotation prohibition to cotton is specifically stated. The carryover problem does not seem to be due to the DT_{50} as there is evidence that atrazine is degraded faster than propazine (see table). The metabolites are not the same for the two herbicides, thus the metabolite toxicity may be the carryover problem.

5. Using an EPA proprietary database, a comparison of total sorghum area treated (TSAT) with atrazine and propazine was evaluated. In Texas and Kansas, a comparison of TSAT with atrazine during a three-year mean when propazine was available, to a three year mean where no propazine was available found that TSAT with atrazine did not change. Given this as a history, the argument that propazine will replace atrazine on a one for one basis remains questionable.

	Herbicide Comparison	
	Atrazine	Propazine
Solubility[6]	33 mg L^{-1}	8.7 mg L^{-1}
DT_{50}[7]	16-77 Days	80-100 Days
Soil Mobility Class	Very High to Medium[4]	Low to Moderate[5]
Crop Selectivity	Corn, Sorghum & Sugar Cane[6]	Sorghum & Various Ornamentals[7]
Weed Spectrum	Annual Grasses & BLW[6]	Grasses & BLW[7]
Phytotoxicity[7]	Soybeans, Peanuts, Potatoes, & Some Vegetable Crops	Sugar Beets & Some Vegetable Crops
Formulation	4 L[6]	4 L[7]
Maximum Use Rate	2.0 lbs ai $Acre^{-1}$ [6]	1.2 lbs ai $Acre^{-1}$ [7]

Conclusions

While the comparison of propazine and atrazine are close, the above issues remain unresolved. From the viewpoint of a sorghum and/or cotton producer, the need for an herbicide with the weed control spectrum and preemergence use like that of atrazine, but with reduced crop rotation restrictions is very important. The registrant and the grower groups have faith in the fact that propazine will fill this niche and limited research on efficacy demonstrated a favorable comparison with atrazine[2]. Concerns still remain that applications of postemergence atrazine treatments following preemergence treatments of propazine, while unlikely, will not be constrained by proposed label statements and are not agronomic infeasibilities. It is the conclusion of BEAD that in the narrow scope of preemergence control of broadleaf weed species in sorghum crop production, propazine is an agronomic replacement for atrazine; however, this does not preclude the possible use of atrazine as a postemergence applied herbicide in fields where an application of propazine was made.

References

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