**APPENDIX 4-5. Analysis of Granular Uses**

Most atrazine use and usage involve flowable uses (*e.g*., emulsifiable concentrate, wettable powder). Therefore, the methods developed for analyzing terrestrial exposures in this BE focus on flowable uses; however, atrazine also has non-flowable granular uses.

Because exposures related to granular uses are readily modeled using our current aquatic modeling approaches, these types of uses are incorporated into the aquatic exposure analysis used to help make effects determinations for listed aquatic species (and those that rely on aquatic species). However, due to differences in estimating potential exposures from granular uses and flowable uses, these (granular) uses are not as easily incorporated into the current modeling approach for assessing terrestrial exposures to listed terrestrial species. Exposure of listed terrestrial species to flowable uses, which account for most of the use and usage of atrazine, is incorporated into the current terrestrial exposure tools used to inform effects determinations for listed terrestrial species (and those that rely on terrestrial species). While the granular uses are not built into these tools, they are considered when making effects determinations. A discussion of the methods for assessing risk from granular uses for listed terrestrial species is described below.

1. Granule Use

For terrestrial organisms, the primary route of exposure to granules is assumed to be via ingestion (vertebrates) and ingestion and contact (terrestrial invertebrates). Spray drift is not expected from these types of uses; therefore, potential terrestrial exposures are assumed to be limited to the sites of application. Atrazine has two granular registrations for use on various types of turf as represented by the Residential and Open Space Developed Use Data Layers (UDLs): Growstar Atrazine 0.92% Plus Fertilizer (EPA Reg. Number 82757-2) and Edison South (EPA Reg. Number 538-315). Atrazine also has flowable registrations for the same types of turf. Therefore, the atrazine granular use does not represent a different use footprint than the one being captured by the flowable uses. The maximum flowable use rates on turf are 4 lb a.i./acre per application, with a maximum annual application rate of 6 lb a.i./acre (4 lb a.i./acre followed by 2 lb a.i./acre; 30-d minimum retreatment interval) and maximum granular application rates are 2 lb a.i./acre per application, with a maximum annual application rate of 4 lb a.i./acre (2 applications/year; 30-d minimum retreatment interval). (see **APPENDIX 1-3**).

For terrestrial invertebrates, the primary routes of exposure from the granular uses of atrazine are expected to be via contact with contaminated soil and/or ingestion of contaminated plants that uptake atrazine from the soil. There are currently no standard methods for assessing exposure and risk via consumption of contaminated plants that have taken up a pesticide and distributed the residues within the plant. It is anticipated that the residue concentrations in plants from the granular use will be lower than the residues on plants from flowable uses (assuming similar application rates) because the assessment for flowable uses assumes that a plant or invertebrate being consumed is sprayed directly. Therefore, for terrestrial invertebrates, the estimated exposures from the flowable uses are used as a protective proxy for the exposures from the granular uses.

For terrestrial vertebrates, the primary route of exposure is expected to be to birds found on the site of application that may ingest the granules, which are clay-based, as grit. Other vertebrates are generally not expected to ingest the granules because they are not food-based and are only likely to be intentionally ingested by animals that require grit for normal digestion (*i.e*., birds). One exception would be those organisms that will eat soil or have incidental soil ingestion. Because the quantity of potential granules consumed will be lower via incidental soil consumption relative to animals that may consume granules directly, the risk exposure estimates calculated for direct consumption of granule(s) by birds are used as a conservative proxy for the exposure of other terrestrial vertebrates.

The currently registered atrazine granular products contain 0.92 and 1.44% a.i. To explore potential exposures to birds, the number of atrazine granules (0.92 and 1.44% a.i. products) that birds of different sizes would need to ingest to exceed the acute mortality threshold is calculated using T-REX (see **Tables 1** and **2**). Based on this analysis, 20 g, 100 g, and 1,000 g birds would need to ingest at least 99, 636, and 8991 granules, respectively, to exceed the mortality threshold.

**Table 1. T-REX Input and Outputs for the Atrazine Granular Exposure Estimates for Birds (0.92% a.i. products)**

|  |  |  |  |
| --- | --- | --- | --- |
| **In-put/Out-put** | **20 g Bird** | **100 g Bird** | **1,000 g Bird** |
| Weight of bird (kg) | 0.02 | 0.10 | 1.0 |
| Adjusted threshold, mg/kg-bw1, 2 | 720 | 917 | 1295 |
| mg a.i. needed to achieve the adjusted threshold for bird of assessed weight | 720 | 917 | 1295 |
| Fraction of a.i. in formulated product | 0.92 | | |
| Weight of 1 granule (mg, obtained from registrant) | 10 | | |
| mg a.i./granule | 0.092 | | |
| No. of granules needed to exceed mortality threshold | 157 | 996 | 14072 |

1 Based on the LD50 for mortality of 783 mg a.i./kg-bw for a 35 g bird.

2 A Mineau scaling factor of 1.15 is used based on the default value in Mineau, *et al*. 1996.

**Table 2. T-REX Input and Outputs for the Atrazine Granular Exposure Estimates for Birds (1.44% a.i. products)**

|  |  |  |  |
| --- | --- | --- | --- |
| **In-put/Out-put** | **20 g Bird** | **100 g Bird** | **1,000 g Bird** |
| Weight of bird (kg) | 0.02 | 0.10 | 1.0 |
| Adjusted threshold, mg/kg-bw1, 2 | 720 | 917 | 1295 |
| mg a.i. needed to achieve the adjusted threshold for bird of assessed weight | 720 | 917 | 1295 |
| Fraction of a.i. in formulated product | 1.44 | | |
| Weight of 1 granule (mg, assumed) | 10 | | |
| mg a.i./granule | 0.144 | | |
| No. of granules needed to exceed mortality threshold | 99 | 636 | 8991 |

1 Based on the LD50 for mortality of 783 mg a.i./kg-bw for a 35 g bird.

2 A Mineau scaling factor of 1.15 is used based on the default value in Mineau, *et al*. 1996.

For reasons stated earlier, for vertebrate animals that may ingest contaminated plants, it is anticipated that the residue concentrations in plants from the granular use will be lower than the residues on plants from flowable uses (assuming similar application rates) because the assessment for flowable uses assumes that a plant or invertebrate being consumed is sprayed directly. Therefore, for terrestrial vertebrates that may ingest contaminated plant material, the estimated exposures from the flowable uses on turf will be used as a protective proxy for the exposures from the granular use on turf.