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R.E.D. FACTS

Diquat Dibromide

Pesticide Reregistration

All pesticides sold or distributed in the United States must be registered by EPA, based on scientific studies showing that they can be used without posing unreasonable risks to people or the environment. Because of advances in scientific knowledge, the law requires that pesticides which were first registered years ago be reregistered to ensure that they meet today's more stringent standards.

In evaluating pesticides for reregistration, EPA obtains and reviews a complete set of studies from pesticide producers, describing the human health and environmental effects of each pesticide. The Agency imposes any regulatory controls that are needed to effectively manage each pesticide's risks. EPA then reregisters pesticides that can be used without posing unreasonable risks to human health or the environment.

When a pesticide is eligible for reregistration, EPA announces this and explains why in a Reregistration Eligibility Decision (RED) document. This fact sheet summarizes the information in the RED document for reregistration case 0288, diquat dibromide.

Use Profile

Diquat dibromide is a non-selective contact herbicide, algicide, desiccant, and defoliant. As a herbicide/algicide, it is used to control broadleaf and grassy weeds in non-crop (including residential) and aquatic areas. As a desiccant/ defoliant, it is used in seed crops and potatoes. Its largest use is as a desiccant on potato crops.

Diquat dibromide is formulated as a soluble concentrate and ready-to-use liquid. As a herbicide, it is applied using a hand-held or mechanical sprayer; as an algicide, it is injected below the water surface to control submerged weeds. When used as a desiccant, it may be applied by aircraft or ground equipment. Applications in crop areas are made five days to two weeks before harvest.

Use practice limitations include...

Regulatory History

Diquat dibromide is the common name for 6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazinediium dibromide. The manufacture of diquat dibromide may result in the formation of ethylene dibromide (EDB) as a process impurity. EDB is considered a carcinogen, and all pesticide uses have been cancelled. EPA assessed the potential exposure risks of diquat dibromide and concluded in June 1986 that the presence of EDB does not pose a significant dietary risk, based on worst case assumptions. In addition, the registrant certified an upper limit of 10 parts per billion for EDB in diquat dibromide, and demonstrated that EDB does not persist and will slowly dissipate over time in diquat dibromide.

EPA issued a Registration Standard for diquat dibromide in June 1986 (NTIS #PB87-105490). A 1991 Data Call-In required additional toxicology, ecological effects, environmental fate, and residue chemistry data. Currently, 43 products containing the active ingredient diquat dibromide are registered and marketed under the trade name Diquat.

Human Health Assessment

Toxicity

In studies using laboratory animals, diquat dibromide has been shown generally to be of moderate toxicity. It can cause slight to severe eye irritation and has been placed in Toxicity Category II (the second highest of four categories) for acute dermal and eye irritation effects. It is slightly acutely toxic by the oral and inhalation routes and has been placed in Toxicity Category III for these effects. Diquat dibromide causes slight dermal irritation and has been placed in Toxicity Category IV for this effect. It is not a skin sensitizer.

A supplemental subchronic dermal toxicity study using rabbits indicated that diquat dibromide is toxic via repeated dermal exposure. A second dermal study using rats resulted in high mortality, decreased food consumption and weight gain, congestion in the lungs, liver and kidneys, and dermal irritation at the application site. An inhalation study using rats resulted in increases in lung weight, lung/body weight and lung/brain weight, lung lesions, and mottling and reddening of the lungs in females; however, all effects except the latter were reversible. A second inhalation study using rats showed no effects on any of the parameters examined.

A chronic feeding/carcinogenicity study using rats resulted in eye effects including lens opacity and severe cataracts. A feeding study using beagle dogs showed some incidence of cataracts, and decreased adrenal and epididymide weights in males.

Another chronic feeding/cancer study using rats resulted in evidence of bone tumors. The Agency's Health Effects Division Reference Dose/Peer Review Committee evaluated the carcinogenic potential of diquat dibromide in March 1994 and classified it as a Group E carcinogen --a chemical for which there is evidence of non-carcinogenicity for humans--based on a lack of

evidence in studies with two species, rat and mouse. In a study using mice, diquat was not carcinogenic.

A supplemental developmental toxicity study using rats resulted in maternal toxicity and developmental toxicity only at the highest dose level. Another more recent study using rats resulted in effects at high dose levels including decreases in fetal and litter weights, kidney effects, and incomplete development of certain bones. In a supplementary study using rabbits, decreased body weight gain in the high dose group was the only maternal toxicity observed. A recent study using rabbits resulted in developmental effects only in the high dose group, including liver effects and poor ossification. A study using mice resulted in developmental toxicity only in the high dose group, including decreased fetal body weight and increased skeletal alterations.

A reproductive toxicity study using rats resulted in effects at the highest dose level including decreased numbers of live pups per litter and decreased body weight gain. Diquat dibromide was negative in four mutagenicity studies and positive in two other studies. Metabolism studies indicate that it is poorly absorbed from the gastrointestinal tract and primarily excreted in urine. An acute neurotoxicity study using rats resulted in symptoms that may not be due to direct neurotoxicity. In a subchronic neurotoxicity study, toxic signs observed only in the high dose

group included cataracts and decreased body weight gain and food utilization.

Dietary Exposure

People may be exposed to residues of diquat dibromide through the diet. Tolerances or maximum residue limits have been established for a variety of crop and animal commodities (please see 40 CFR 180.226 (a) and (b)). A food additive tolerance is established for residues in potable water (40 CFR 185.2500 (a) and (b)). Food and feed additive tolerances also are established for residues in processed potatoes (including potato chips) (40 CFR 185.2500 (c)) and processed potato waste (40 CFR 186.2600).

The registrant has proposed revised tolerances for many commodities, some at EPA's recommendation. A tolerance for sugarcane must be revoked since this use is no longer registered. A tolerance for potable water also will be revoked since it has been replaced with a Maximum Contaminant Level Goal (MCLG) under the Safe Drinking Water Act. The U.S. tolerances for eggs, poultry, meat, and offal may be raised to achieve harmonization with Codex Maximum Residue Levels (MRLs). With these changes, diquat dibromide tolerances are considered appropriate.

EPA has assessed the dietary risk posed by diquat dibromide considering both published and proposed tolerances. The Anticipated Residue Concentration (ARC) for the overall U.S. population and 22 subgroups represents 31% of the Reference Dose (RfD), or amount believed not to cause adverse effects if consumed daily over a 70-year lifetime. The most highly

exposed subgroup, non-nursing infants less than one year old, has an ARC which represents 49% of the RfD. Diquat dibromide's chronic dietary risk is therefore considered minimal.

Occupational and Residential Exposure

Based on current use patterns, workers (mixers, loaders, applicators, and other handlers) may be exposed to diquat dibromide during and after application in agricultural and other settings. During large-scale applications, the highest potential exposure and risks are to mixers and loaders using open systems to support aerial applications (their dermal Margin of Exposure (MOE) is 71, less than the 100-fold margin considered acceptable). Using closed systems, their dermal MOE is 400. EPA therefore is requiring closed mixing/loading of diquat dibromide for aerial applications.

For applicators participating in large-scale applications and for all workers (including homeowners) participating in small-scale applications, MOEs are greater than 100.

Post-application exposure to diquat dibromide residues on treated foliage is a concern. For uses within the scope of the Worker Protection Standard for Agricultural Pesticides (WPS), EPA is requiring a longer interim Restricted Entry Interval (REI) and more stringent personal protective equipment (PPE) than usual, to reduce potential exposure and risk (see Risk Mitigation below).

For uses outside the scope of the WPS, post-application exposure risks also are posed. For example, golf course workers who have substantial physical contact with treated turf have a MOE of 13, 24 hours after application. At four days post-application, the MOE rises to 105. Therefore, a four-day reentry interval is being recommended for these workers. To reduce the potential for post-application residential exposure, spot treatments will be acceptable but broadcast treatments will be prohibited. Swimmers may be exposed to diquat dibromide residues in treated lakes and ponds, however their estimated MOE of 1,250 is acceptable.

Human Risk Assessment

Diquat dibromide is of moderate acute toxicity causing acute dermal toxicity and primary eye irritation (Toxicity Category II). It is classified as a Group E carcinogen, indicating that it poses no known cancer risk for humans. Diquat dibromide causes developmental and reproductive toxicity at the highest dose levels tested. Human incident data from California and other sources were considered in evaluating diquat dibromide's risks.

Although people may be exposed to residues of diquat dibromide through their diets, the chronic dietary risk from such exposure is minimal. EPA is concerned about worker exposure to diquat dibromide during aerial spray operations, and is requiring use of closed systems to mitigate potential risks. The Agency also is concerned about post-application/reentry exposure for uses both within and outside the scope of the WPS. EPA therefore is imposing stringent reentry restrictions and protective clothing requirements

for commercial uses, and is limiting residential use to spot treatments with label directions warning these users not to touch treated plants until sprays have dried.

Environmental Assessment

Environmental Fate

Diquat dibromide's primary route of environmental dissipation is strong adsorption to soil particles. Diquat does not hydrolyse or photodegrade and is resistant to microbial degradation under aerobic and anaerobic conditions. No major degradates have been isolated. When used as an aquatic herbicide, diquat dibromide is removed from the water column by adsorption to soil sediments, aquatic vegetation, and organic matter. Adsorbed diquat dibromide is persistent and immobile, and is not expected to be a ground-water contaminant.

Ecological Effects

Diquat dibromide is moderately toxic to birds in acute studies, and is slightly to moderately toxic on a subacute dietary basis. It is practically non-toxic to bees. In acute studies, diquat dibromide is slightly to moderately toxic to both cold and warm water fish. In fish early life stage studies, it ranges in toxicity from slightly to moderately toxic. It is slightly to highly toxic to both aquatic invertebrates and estuarine species. Additional studies are required to determine diquat dibromide's toxicity to nontarget aquatic and terrestrial plants.

Ecological Effects Risk Assessment

High acute risk to birds is not expected from use of diquat dibromide. However, the turf use exceeds EPA's level of concern for restricted use, and for endangered bird species feeding on short grass. Regarding chronic effects, birds feeding on diquat dibromide-contaminated food items may experience reproductive problems.

Diquat dibromide will pose only a low overall risk to mammals. Effects, if they occur, should not result in significant ecological damage. However, the Agency is only moderately certain that nonendangered mammals are not at acute risk from diquat dibromide, which exceeds the restricted use level of concern for all uses except cantaloupes. The level of concern for endangered species is exceeded for all use patterns. Chronic risks to mammals are believed to be low.

Diquat dibromide may pose acute or chronic risk to aquatic organisms, but the probability that exposure will occur is relatively low. It is therefore expected to pose only a minimal risk to aquatic organisms from exposure to runoff. Diquat dibromide does not cause adverse effects to freshwater fish. Freshwater invertebrates are not likely to be adversely affected by its use in the short term, but their reproductive success may be adversely effected.

Drift from aerial spraying of diquat dibromide is likely to result in adverse effects to plants. The possibility of risk to non-target aquatic and terrestrial plants from aerial application from all sites is relatively high.

Diquat dibromide poses only minimal risk to non-target insects. However, levels of concern have been exceeded for endangered species of mammals and birds from all terrestrial use sites.

Risk Mitigation

EPA is requiring the following risk mitigation measures for diquat dibromide:

Aquatic Risk Mitigation - To protect aquatic organisms, EPA is requiring labeling that limits application of diquat dibromide to one-third or one-half of the dense weed areas in a water body, and prohibits subsequent applications for two weeks. The untreated part of the water body will act as a refuge for aquatic organisms, and the two-week waiting period allows time for oxygen levels to recover before further applications are made.

Spray Drift Risk Mitigation - Since the possibility of risk to non-target aquatic and terrestrial plants from aerial application is high, EPA is requiring that a Spray Drift Advisory which recommends best management practices to minimize spray drift appear on labels of products that can be applied aerially.

Application and Post-Application Risk Mitigation - To protect handlers during agricultural use, EPA is requiring closed mixing/loading of diquat dibromide liquid formulations for aerial applications, in keeping with WPS provisions. EPA also is requiring a 7-day interim Restricted Entry Interval (REI) for all uses within the scope of the WPS, as well as more stringent Personal Protective Equipment (PPE) including protective eyewear for early-entry workers.

For occupational uses that are not within the scope of the WPS (primarily the turf use), EPA is establishing a 4-day entry restriction for workers.

EPA is retaining the 24-hour swimming prohibition on diquat dibromide products with aquatic uses. Swimmers are prohibited from swimming in treated water for 24 hours.

To protect home users, EPA is establishing an entry restriction for spot treatment applications (label directions warning people and pets not to touch treated plants until sprays have dried), and is prohibiting broadcast applications at residential sites.

Additional Data Required

EPA is requiring the following additional generic data for diquat dibromide to confirm its regulatory assessments and conclusions:

- Enforcement method for plant and animal commodities (independent laboratory validation);
- Product chemistry.

Although not part of the target data base, the following studies also are required:

- Terrestrial plant studies; vegetative vigor.

The Agency is requiring product-specific data including product chemistry and acute toxicity studies, revised Confidential Statements of Formula (CSFs), and revised labeling for reregistration.

Product Labeling Changes Required

All diquat dibromide end-use products must comply with EPA's current pesticide product labeling requirements, and with the additional requirements summarized below. Please see the RED document for a complete list of labeling requirements.

Personal Protective Equipment (PPE) Requirements

For Occupational Use

The minimum, baseline PPE for all diquat dibromide WPS and nonWPS occupational end-use products is:

"Applicators and other handlers must wear:

--Coveralls over long-sleeved shirt and long pants;

--Chemical-resistant gloves;

--Chemical-resistant footwear plus socks;

--Chemical-resistant headgear for overhead exposure;

--Chemical-resistant apron when cleaning equipment, mixing, or loading;

--A dust/mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C).

The PPE that would normally be established based on the toxicity of the end-use product must be compared to the minimum PPE specified above, and the more protective PPE must be placed on the product labeling.

Entry Restrictions

For Occupational Use

A 7-day restricted entry interval (REI) is required for uses within the scope of the WPS. The PPE required for early entry is:

--Coveralls over long-sleeved shirt and long pants;

--Chemical-resistant gloves;

--Chemical-resistant footwear plus socks;

--Chemical-resistant headgear for overhead exposures;

--Protective eyewear.

For products with non-WPS sites such as golf courses, parks, etc., the following statement is required:

"For 4 days following applications to non-crop areas (other than aquatic or residential sites), do not allow employees to have contact with the treated plants, except for contact with their footwear."

For Home Use

For spot treatments to residential sites, the following statement is required:

"Do not allow people or pets to touch treated plants until the sprays have dried."

Other Labeling Requirements

For Occupational Use

- Application Restrictions:

  "Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application."

- Engineering Controls:

  "Mixers and loaders supporting aerial applications are required to use closed systems. The closed system must be used in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for Agricultural Pesticides (40 CFR 170.240(d)(4)). When using the closed system, the mixers' and loaders' PPE requirements may be reduced or modified as specified in the WPS."

  "When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for Agricultural Pesticides (40 CFR 170.240(d)(4-6)), the handler PPE requirements may be reduced or modified as specified in the WPS."

- User Safety Requirements:

  "Follow manufacturer's instructions for cleaning/ maintaining PPE. If no such instructions exist for washables, use detergent and hot water. Keep and wash PPE separately from other laundry."

- User Safety Recommendations:

  - "Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet."
  - "Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing."
  - "Users should remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing."

For Home Use

- Application Restrictions:

  "Do not apply this product in a way that will contact any person or pet, either directly or through drift. Only persons applying this product may be in the area during application."

- User Safety Recommendations:

- "Clothing and protective equipment exposed to this product should be washed in detergent and hot water. Such items should be kept and washed separately from other laundry."
- "Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet."
- "Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing."
- "Users should remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing."

Environmental Hazard -

For products intended for terrestrial nonfood sites, use this precautionary statement:

"This pesticide is toxic to aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate."

For products intended for outdoor residential sites, use this precautionary statement:

"This pesticide is toxic to aquatic invertebrates. Do not apply directly to water."

Spray Drift Label Advisory

See the diquat dibromide RED document for the complete text of this Label Advisory, which must be placed on the labeling of each product that can be applied aerially.

Regulatory Conclusion

The use of currently registered products containing diquat dibromide in accordance with approved labeling will not pose unreasonable risks or adverse effects to humans or the environment. Therefore, all uses of these products are eligible for reregistration.

Diquat dibromide products will be reregistered once the required product specific data, revised Confidential Statements of Formula, and revised labeling are received and accepted by EPA.

For More Information

EPA is requesting public comments on the Reregistration Eligibility Decision (RED) document for diquat dibromide during a 60-day time period, as announced in a Notice of Availability published in the Federal Register. To obtain a copy of the RED document or to submit written comments, please contact the Pesticide Docket, Public Response and Program Resources Branch, Field Operations Division (7506C), Office of Pesticide Programs (OPP), US EPA, Washington, DC 20460, telephone 703-305-5805.

Electronic copies of the RED and this fact sheet can be downloaded from the Pesticide Special Review and Reregistration Information System at

703-308-7224. They also are available on the Internet on EPA's gopher server, *GOPHER.EPA.GOV*, or using ftp on *FTP.EPA.GOV*, or using WWW (World Wide Web) on *WWW.EPA.GOV*.

Printed copies of the RED and fact sheet can be obtained from EPA's National Center for Environmental Publications and Information (EPA/NCEPI), PO Box 42419, Cincinnati, OH 45242-0419, telephone 513-489-8190, fax 513-489-8695.

Following the comment period, the diquat dibromide RED document also will be available from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161, telephone 703-487-4650.

For more information about EPA's pesticide reregistration program, the diquat dibromide RED, or reregistration of individual products containing diquat dibromide, please contact the Special Review and Reregistration Division (7508W), OPP, US EPA, Washington, DC 20460, telephone 703-308-8000.

For information about the health effects of pesticides, or for assistance in recognizing and managing pesticide poisoning symptoms, please contact the National Pesticides Telecommunications Network (NPTN). Call toll-free 1-800-858-7378, between 8:00 am and 8:00 pm Eastern Standard Time, Monday through Friday.