DYNAMAC
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ALACHLOR

Task 2: Environmental Fate and Exposure Assessment

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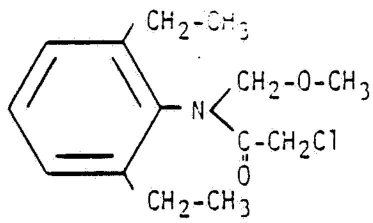
Environmental Fate and Exposure Assessment

Alachlor

ALACHLOR, LASSO, ALANEX, CP 50144, LAZO



2-Chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide

Alachlor is a selective herbicide registered for use on various field and vegetable crops and woody ornamentals. Approximately 104-129 million pounds of the active ingredient are used annually in the United States. Of the total domestic alachlor use, ~96-98% is applied to field corn and soybeans. Nearly all of the alachlor used for corn and soybeans is tank mixed with other herbicides. Application rates range from 1 to 4 lb ai/A. Alachlor may be formulated with atrazine or glyphosate. Single active ingredient formulations of alachlor consist of 10 and 15% G and 4 lb/gal EC. These formulations may be applied with ground equipment and are generally soil incorporated immediately after application. Alachlor may also be applied as a postemergence treatment, and may be applied aerially or injected into center pivot irrigation systems. Applicators need not be certified or under the direct supervision of applicators certified to apply alachlor.

Available data are insufficient to fully assess the environmental fate of alachlor and the exposure of humans and nontarget organisms to alachlor.

[^{14}C]Alachlor appears to photodegrade slowly in water when it is exposed to UV light equivalent to 8 hours of sunlight per day for 16 days. No photodegradation products were detected and ~85% of the applied radioactivity was recovered after 48 hours of continuous exposure to UV light (00023012).

Under aerobic conditions, alachlor at 1-10 ppm was degraded with half-lives of ~2-3 weeks in silt loam, silty clay loam, and sandy loam soils at 24-30 C and at unspecified moisture levels (00037690, 00024559, 00023014). At an unspecified temperature, alachlor at 1 ppm was degraded more rapidly; half-lives were ~4 days in sandy loam and loam soils moistened to 50-100% of field capacity (00003427). 2-Chloro-2'-6'-diethylacetanilide was identified as an alachlor degradate in soil (00023014).

Under aquatic conditions, alachlor is slowly metabolized to CO_2 from treated soil:water slurries incubated aerobically. After 12 weeks, evolved $^{14}CO_2$ accounted for ~2% of the radioactivity initially applied to three soil:water slurries as ring-labeled [^{14}C]alachlor at 10 ppm. Metabolism decreases considerably under anaerobic conditions; only 0.1-0.3% of the radioactivity initially applied was evolved as $^{14}CO_2$ after 12 weeks (00023013). As determined by using cucumber and soybean bioassays, phytotoxic alachlor residues were not detectable after ≤12 weeks in the aqueous phase of soil:water slurries incubated at 10 and 35 C. In the soil phase, alachlor residues were not detectable after ≤12 weeks at 35 C but were still phytotoxic for 24 weeks at 10 C (00027140, 00027139).

Alachlor is very mobile in sand soils having organic matter levels <1% and mobile in sand soils having higher organic matter levels and in finer textured soils. After 8 inches of water were added to 16-inch soil columns, 59% of the applied alachlor leached through a Lakeland sand (0.4% organic matter). Alachlor leached to depths of ~7, 4, and 2 inches in Collombey sand (2.2% organic matter), Les Evouettes silt loam (3.6% organic matter), and Vetroz sandy clay loam (5.6% organic matter) columns, respectively (00078301). When 8 inches of water was applied to 8-inch soil columns, 0, ~51, and ~96% of the applied [^{14}C]alachlor leached through Sharpsburg silty clay loam (4.6% organic matter), Jansen sandy loam (2.9% organic matter), and Jansen gravelly sand (0.1% organic matter), respectively. K_d values showed similar results; mean K_d values for the respective soils were 3.74, 2.88, and 0.80 (00027140, 00027139). K_d values for 10 Wisconsin soils ranged from 0.62 for a Plainfield sand with 0.8% organic matter to 8.13 for a Sebewa sandy loam with 11.7% organic matter (00031329).

Freundlich K values for the respective soils were 0.5 and 7.1 (00031328). Soil thick-layer chromatography data of phytotoxic alachlor residues showed a similar trend; R_f values ranged from 0.47-0.65 for the sand to 0.12-0.14 for the sandy loam (00031329, 00031328). The same general trend was found when soil TLC plates were used. Although R_f values were not given, [^{14}C]alachlor mobility was as follows: Norfolk sandy loam > Ray silt loam (both soils had 1% organic matter) > Drummer silty clay loam (6% organic matter) (00023011).

Alachlor dissipated to $\leq$0.15 and $\leq$0.12 ppm 64 days and 10 months, respectively, after alachlor (uncharacterized test substance) was applied to corn fields at 2.3 kg/ha. Alachlor generally remained in the top 8 cm of soil; runoff accounted for 0.2% of that applied (Wu, No MRID).

The mobility of alachlor is low in runoff water and eroded soil. [^{14}C]Alachlor was essentially not present in runoff water or eroded soil from inclined planes of Norfolk sandy loam, Ray silt loam, or Drummer silty clay loam, <1% of the applied radioactivity was recovered in water and soil samples after application of water at 0.75 inches/hour at 1, 3, and 7 days after treatment (00023016).

Alachlor has been found in tailwater pit sediment and water samples. Monitoring studies conducted in 1973 and 1974 in Haskell County, Kansas, showed that the highest concentrations found were 189 ppb for sediment and 99 ppb for water from 36 tailwater pits (00079801).

[^{14}C]Alachlor residues are taken up by corn plants. Up to 3.1% of uncharacterized radioactivity present in soils 90 days after treatment with ring-labeled [^{14}C]-alachlor at 4 lb/A were taken up within 4 weeks by corn seedlings planted as a rotational crop (00023015).

Exposure during reentry operations is expected to be minimal for current uses.

Dermal and inhalation exposures to workers may occur during application. The primary potential from the EC formulation is during mixing and loading where both dermal and ocular exposure can occur via splashing. Exposure from the G formulations is expected to be mainly dermal. Such exposure could be greatly minimized by the use of gloves and other protective clothing during handling and application. Application by aircraft increases the potential for exposure of humans and nontarget organisms to alachlor due to spray drift and volatilization of alachlor. Human exposure to alachlor during application and soil incorporation operations could be minimized by the use of approved respirators and protective clothing. However, data are not available to fully assess such exposures.

Reported pesticide incidents involving alachlor include 41 involving human injury and 4 involving animals. Most of the incidents occurred during application of alachlor, although a few incidents took place during handling and disposal.

In summary, alachlor appears to photodegrade slowly in water when exposed to UV light but is degraded in soil under aerobic conditions with half-lives of ~2-3 weeks. Under aquatic conditions, alachlor is metabolized slowly to CO_2 under aerobic conditions; under anaerobic conditions, metabolism essentially ceases. Alachlor is mobile in coarse-textured soils and soils with low levels of organic matter, but it is not mobile in runoff water. Alachlor has been found in tailwater pit sediment and water samples at <189 and <99 ppb, respectively. [^{14}C]Alachlor residues are taken up by corn plants.

The following data are required (EPA Guidelines for Registering Pesticides, 1983):

Hydrolysis studies: No data were submitted, but all data are required.

Photodegradation studies in water: One study was reviewed (00023012) that does not fulfill data requirements because it was not carried out long enough. This study needs to be carried out until either one-half of the test substance is degraded or until there is an exposure equivalent to 30 days of natural sunlight, whichever comes first. All data are required.

Photodegradation studies on soil: No data were submitted, but all data are required to support uses where soil incorporation is not required.

Photodegradation studies in air: No data were submitted, but all data are required.

Aerobic soil metabolism studies: Five studies were reviewed; one is scientifically invalid (00028377) because of unexplained discrepancies in day 0 analyses and/or application rates. Three of the four valid studies do not fulfill data requirements because the test compound was not characterized (00037690, 00003427), incubation temperature was not specified (00003427), or soil moisture conditions were not given (00024559). The fourth study (00023014) partially fulfills data requirements by identifying an alachlor degradate. A study is needed to determine the degradation rate of alachlor in soil and the formation and decline of degradation products.

Anaerobic soil metabolism studies: No data were submitted, but all data are required.

Anaerobic aquatic metabolism studies: No data are required because alachlor does not have a forestry, aquatic, or aquatic impact use. One study was reviewed and considered scientifically valid (00023013) but it does not meet data requirements because residues other than CO_2 and alachlor were not characterized. In addition, alachlor was not adequately quantitated.

Aerobic aquatic metabolism studies: No data are required because alachlor does not have an aquatic or aquatic impact use. Three studies were reviewed and considered scientifically valid, but they do not fulfill data requirements because residues other than CO_2 and alachlor were not characterized (00023013) and because alachlor analyses were performed by using bioassay procedures (000027140, 00027139).

Leaching and adsorption/desorption studies: Six studies were reviewed and considered scientifically valid. One study (00031328) does not fulfill data requirements because a bioassay was used to determine alachlor in the soil thick-layer chromatography portion of the study and calculations were not provided for the K values reported in the adsorption portion. Another study (00023011) using soil TLC tests does not meet data requirements because the mobility of alachlor was not determined quantitatively, and the relative mobilities were not presented as R_f values to facilitate mobility classification. A third study (00031329) does not fulfill data requirements because equilibrium conditions apparently were not obtained for desorption data and a bioassay was used to generate R_f values. The remaining three studies fulfill data requirements by providing column leaching information for Sharpsburg silty clay loam, Jansen sandy loam, and Jansen gravelly sand (00027140, 00027139); and column leaching data for Collembey and Lakeland sand soils (amount of water used was insufficient to determine leachability in two other soils) (00078301). Data on the leaching of alachlor degradation products are required.

Laboratory and field volatility studies: No data were submitted, but all data are required.

Terrestrial field dissipation studies: Seven studies were reviewed and two are considered scientifically invalid because soil sampling intervals were inadequate (00052161, 00032228) and two could not be validated because the analytical methodology employed was not described (00023666, 00023667). The remaining three studies are scientifically valid but do not meet data requirements because one is a monitoring study (00079801); one contains only runoff data (00023016); and the test substance used was not characterized, alachlor was applied in a mixture that contained a second herbicide, and untreated controls were not sampled throughout the experiment in the third study (Wu, No MRID). Therefore, all data are required.

Aquatic field dissipation studies: No data were submitted; however, no data are required because alachlor does not have an aquatic or an aquatic impact use.

Forestry dissipation studies: No data were submitted; however, no data are required because alachlor does not have a forestry use.

Dissipation studies for combination products and tank mix uses: There is currently no requirement for these studies.

Long-term field dissipation studies: No data were submitted, but all data are required depending on data from required aerobic soil metabolism or field dissipation studies.

Confined accumulation studies on rotational crops: One study was reviewed (00023015) that partially fulfills data requirements by showing uptake of alachlor residues in corn seedlings. All other data as outlined in Section 165-1 are required.

Field accumulation studies on rotational crops: No data were submitted, but all data are required.

Accumulation studies on irrigated crops: No data were submitted; however, no data are required because alachlor does not have an aquatic food crop or aquatic noncrop use, is not used in and around holding ponds used for irrigation purposes, and has no use involving effluents or discharges to water used for crop irrigation.

Laboratory studies of pesticide accumulation in fish: One study was reviewed (00023017) that is scientifically invalid because procedures and protocols used were not sufficient for assessment of the accumulation potential of alachlor in fish. All data are required.

Field accumulation studies of aquatic nontarget organisms: No data were submitted. No data are required.

Reentry studies: No data were submitted, however worker exposure is expected to be minimal for current uses. Therefore, no data are required.

Label Restriction

There is currently no restriction for the application of alachlor relating to environmental chemistry. Pending the submission of complete crop rotation data, it is suggested that crops for which there are no registered alachlor uses be restricted from being planted in alachlor-treated soil.

References (All Studies Reviewed)

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