Overview of Sodium Acifluorfen
Risk Assessment
April 4, 2002

Introduction

This document summarizes EPA's human health and ecological risk findings for the herbicide sodium acifluorfen, as presented fully in the documents: *Sodium Acifluorfen: Revised HED Chapter for the Reregistration Eligibility Document,* dated January 15, 2002, the Environmental Fate and Effects Division (EFED) risk assessment *Reregistration of Sodium Acifluorfen for Use on Soybeans, Peanuts, and Rice* dated June 8, 2000, and two risk assessment addenda, dated February 4 and February 11, 2002. These documents also summarize the HED and EFED response to comments as submitted by the registrant, BASF and other stakeholders, during Phase III of the Public Participation Process. The purpose of this summary is to assist the reader by identifying the key features and findings of the risk assessments in order to better understand the conclusions reached in the assessments. This summary was developed in response to comments and requests from the public which indicated that the risk assessments were difficult to understand, that they were too lengthy, and that it was not easy to compare the assessments for different chemicals due to the use of different formats.

The Food Quality Protection Act (FQPA) requires that, when considering whether to establish, modify, or revoke a tolerance, the Agency consider "available information" concerning the cumulative effects of a particular pesticide's residues and "other substances that have a common mechanism of toxicity." Sodium acifluorfen is a member of the diphenyl ether group of herbicides, which includes lactofen, oxyfluorfen, nitrofen, and fomefasen. The acifluorfen anion is also a degradate of lactofen. The Agency has evidence that these compounds induce similar toxic effects but has not yet determined whether these compounds exhibit a common mechanism of toxicity. The Agency defers the cumulative risk assessment of acifluorfen and the other diphenyl ethers to a later date. For the purposes of tolerance reassessment, EPA is assuming no common mechanism.

The risk assessments for sodium acifluorfen are available on the Internet and in the Pesticide Docket for public viewing. Meetings with stakeholders (i.e., growers, environmental groups, commodity groups, and other government offices) may be held to discuss the identified risks and to solicit input on risk mitigation strategies. This feedback will be used to complete the Reregistration Eligibility Decision (RED) document, which will include the resultant risk management decisions. Before issuing its reregistration decision, the Agency plans to conduct a closure conference call with interested stakeholders to describe the regulatory decisions that will be presented in the RED.

Use Profile

Broad Spectrum Herbicide registered for use on soybeans, peanuts, and rice for post-emergent weed control. Also registered as a spot treatment for residential use along driveways, sidewalks, and patios.

Formulations: Sodium acifluorfen is sold in the United States under the trade names Blazer® and Status®. It is also sold as a co-pack or premix with other herbicides under the trade names Galaxy® (premix with bentazon), Manifest® (co-pack with bentazon and sethoxydim), Storm (premix with bentazon), Conclude® (co-pack with bentazon), and Scepter OT® (co-pack with imaziquin). Sodium acifluorfen is formulated as a technical grade manufacturing product (39% active ingredient), soluble concentrate/liquid (6.8 to 21.4% active ingredient), and a liquid ready to use product (0.12% ai). When active ingredient is expressed in terms of weight per volume, sodium acifluorfen formulations range from 0.67 to 2.0 lb active ingredient per gallon.

Methods of Application: Sodium acifluorfen is applied with spray adjuvants using aerial or groundboom equipment.

Use Rates: Depending on the crop and formulation, sodium acifluorfen rates range from 0.125 to 0.375 lb active ingredient/acre.

Annual Poundage: Approximately 1.5 million pounds of sodium acifluorfen active ingredient are applied annually.

Use Sites: Soybeans, peanuts, and rice. Residential driveways, sidewalks, and patios.

Registrants: BASF, Bonide

Acute Toxicity

- Sodium acifluorfen has low acute toxicity via the oral, dermal, and inhalation routes of exposure, but causes severe eye irritation and moderate skin irritation.

- Sodium acifluorfen has been placed in Acute Toxicity Category I for acute eye irritation and in Category II for acute dermal irritation.

Human Health Risk Assessment

Acute Dietary (Food) Risk

Acute dietary risk is calculated considering what is eaten in one day. A risk estimate that is less than 100% of the acute Population Adjusted Dose (aPAD) (the dose at which an individual could be exposed on any given day with no expected adverse health effects) does not exceed the Agency's level of concern. The aPAD is the reference dose (RfD) adjusted for the FQPA Safety Factor.

For the acute dietary exposure, average field trial residues incorporating the likely maximum percent crop treated were used as a point estimate for the blended commodities, rice, peanuts, and soybeans. The dietary risk assessment was based only on residues of acifluorfen because metabolites are not expected to be present at significant levels. The Agency, therefore, believes that exposure to potential residues of sodium acifluorfen are not underestimated. The only acute effect identified was developmental toxicity, which is relevant only to women of childbearing age. Because no relevant effects following a single exposure of sodium acifluorfen were identified for the U.S. general population, an acute dietary risk assessment for the entire U.S. population was not conducted. The acute dietary assessment applied only to the subpopulation of females 13-50 years of age because EPA is concerned that developmental effects could occur after a single dietary exposure.

The acute dietary exposure analysis is a Tier III assessment based on the Dietary Exposure Evaluation Model (DEEM™). The DEEM™ analysis evaluated the individual food consumption as reported by respondents in the USDA 1989-92 Continuing Surveys for Food Intake by Individuals (CSFII) and accumulated exposure to the chemical for each commodity.

- The acute dietary (food) risk estimate based on field trial data is not of concern. The Tier III assessment showed that acute dietary exposure comprises < 1% of the aPAD for females age 13-50 years, the only population whose acute dietary exposure was assessed. The acute PAD for this population group include a 10X FQPA safety factor. No acute PAD was established for the general population.

- For "females 13-50 years," a NOAEL of 20 mg/kg/day was established based on effects of decreased fetal weight and increased incidence of dilated lateral ventricles of the brain observed in a rat developmental toxicity study. Both the decreased fetal weight and the brain malformations are presumed to occur after a single exposure (dose), and thus, are appropriate for this acute risk assessment. These effects were observed at 90 mg/kg/day (LOAEL).

- The uncertainty factor (UF) is 100 to account for inter-species extrapolation (10X) and intra-species variation (10X).

- The FQPA safety factor of 10X was retained for acute dietary exposures for females age 13-50 years based on the following:

  - data gap for developmental neurotoxicity study and
  - increased susceptibility following *in utero* exposure to rats in a developmental toxicity study.

- The acute PAD for females age 13-50 years is 0.02 mg/kg/day. No acute PAD has been established for the general population because the toxicity database did not indicate any potential acute effects other than developmental toxicity, which is relevant only to females of childbearing age.

Chronic Dietary (Food) Risk

For the chronic (non-cancer) dietary risk assessment, an average of consumption values for each sub-population is combined with average residue values in/on commodities over a 70-year lifetime to determine average exposure. A risk estimate that is less than 100% of the chronic PAD (the dose at which an individual could be exposed over the course of a lifetime and no adverse health effects would be expected) does not exceed the Agency's level of concern.

The chronic dietary analysis utilized anticipated residue values based on field trial studies, concentration factors from processing studies, and percent crop treated information. The Agency, therefore, believes that exposure to potential residues of sodium acifluorfen are not underestimated.

- The chronic dietary (food) risk estimate is not of concern. Chronic dietary exposure comprises <1% of the cPAD for the U.S. population and all subpopulations.

- The toxicity endpoint for the chronic dietary assessment is increased incidences of kidney lesions based on the results of a 2-generation reproductive toxicity study in rats (NOAEL=1.25 mg/kg/day). These effects were observed at 25 mg/kg/day (LOAEL).

- The uncertainty factor (UF) is 100 to account for inter-species extrapolation (10X) and intra-species variation (10X).

- The FQPA safety factor of 3X was retained for chronic dietary exposures for females age 13-50 years, infants, and children based on the data gap for the developmental neurotoxicity study. This study provides important information about the susceptibility of infants, children, and women of childbearing age to potential neurotoxic effects following single or repeated exposure to a chemical. EPA retains a 3X safety factor when a data gap is identified for this study. EPA has determined that the increased susceptibility seen in the rat developmental toxicity study, which supported use of a 10X FQPA safety factor for acute exposure, has no bearing on chronic exposure.

- The chronic PAD is 0.013 mg/kg/day for the general population based upon microscopic kidney lesions in both generations of a 2-generation reproduction study in rats (NOAEL = 1.25 mg/kg/day). The chronic PAD for females 13-50 years, infants, and children is 0.004 mg/kg/day from the same study. The chronic PAD for infants, children, and females 13-50 years reflects the additional 3X FQPA safety factor while the chronic PAD for the general population does not.

Cancer Dietary (Food) Risk

Chronic (cancer) dietary risk is also calculated by using the average consumption values for food and average residue values for those foods over a 70-year lifetime. The chronic exposure value is combined with a linear low-dose (Q_1*) approach to determine the lifetime (cancer) risk estimate. The Agency generally considers cancer risks greater than 1×10^{-6} (1 in 1 million) to exceed its level of concern for dietary exposure.

- Sodium acifluorfen is currently classified as a B2 chemical carcinogen (probable human carcinogen). The Agency has not yet re-evaluated the carcinogenic potential of sodium acifluorfen using the new cancer risk assessment guidelines. Although the Registrant is developing additional data on a possible cancer mechanism of action, data submitted to the Agency to date are not sufficient to warrant re-evaluation of the mechanism of action or the carcinogenic potential of sodium acifluorfen. The Agency may revisit the mechanism of action when additional data are submitted.

- A linear low-dose (Q_1*) approach was used to characterize human health cancer risk. The unit risk, or Q_1*, is based on liver tumors (adenoma and carcinoma) seen in a chronic cancer study in mice, and a 3/4 scaling factor to extrapolate from animals to humans. The Q_1* is $1.27 \text{ X } 10^{-2}$ $(\text{mg/kg/day})^{-1}$ in human equivalents. The Q_1* has been revised in response to a Phase 3 comment concerning the percent active ingredient tested in the cancer bioassay. The Q_1* was corrected, using feed analysis data, for the actual percent active ingredient tested and the corresponding mg/kg/day dose levels.

- The results of EPA's refined Tier III risk analysis show that the cancer dietary risk from food alone is $5.2 \text{ X } 10^{-9}$ for the general U.S. population, which is below the Agency's level of concern. The dietary exposure is based on field trial data.

Drinking Water Dietary Risk

Drinking water exposure to pesticides can occur through groundwater and surface water contamination. EPA considers acute (one day) and chronic (lifetime) drinking water risks and uses either modeling or actual monitoring data, if available, to estimate those risks. To determine the maximum allowable contribution from water allowed in the diet, EPA first looks at how much of the overall allowable risk is contributed by food and then determines a "drinking water level of comparison" (DWLOC) to determine whether modeled or monitoring estimated environmental

concentration (EEC) levels exceed this level. EECs that are above the corresponding DWLOC exceed the Agency's level of concern. Modeling is generally considered to be an unrefined assessment that provides high-end estimates.

For the sodium acifluorfen drinking water assessment, the Agency considered both sodium acifluorfen and lactofen, a related pesticide. Lactofen degrades to acifluorfen in the environment at a rate of approximately 52%. Therefore, EPA estimated total acifluorfen residues, from both acifluorfen and lactofen, and compared the estimates of total residues with the appropriate DWLOC. Although some ground and surface water monitoring data were available for sodium acifluorfen, these data were not considered appropriate for use in a national drinking water assessment.

- **Acute drinking water concentrations** for surface water (modeled with PRZM/EXAMS and refined with the Index Reservoir) and groundwater (modeled with SCI-GROW) were less than the acute DWLOCs of 600 ppb for females age 13-50 years; therefore, acute dietary risk from food and drinking water are not of concern. The acute surface water EEC for total acifluorfen (from both acifluorfen and lactofen) is 18.9 ppb, and the acute groundwater EEC for total acifluorfen is 15.7 ppb.

- **Chronic drinking water concentrations** for surface water and groundwater were less than the chronic DWLOCs of 455 ppb for the general U.S. population, 120 ppb for females 13-50 years, and 40 ppb for infants and children. Therefore, chronic dietary risk from food and drinking water are not of concern. The average chronic surface water EEC for total acifluorfen is 4 ppb and the chronic groundwater EEC is 15.7 ppb.

- However, **the chronic drinking water concentration for ground water exceeded the cancer DWLOC of 2.8 ppb**. Although the modeled concentration of 1.7 ppb total acifluorfen in surface water did not exceed the DWLOC, the modeled concentration of 15.7 ppb total acifluorfen in groundwater exceeded the cancer DWLOC of 2.8 ppb. Total acifluorfen includes acifluorfen derived from both sodium acifluorfen and lactofen.

- **Acifluorfen was detected in several water monitoring studies.** A small-scale prospective ground water monitoring study was required by the Agency and subsequently conducted in vulnerable soils. Sodium acifluorfen was detected in 56 out of 283 ground water samples with concentrations ranging from 1 to 46 ppb. The overall mean for the 56 detections was 8.36 ppb. The USGS National Water Quality Assessment (NAWQA) reported a single acifluorfen detection of 0.17 ppb of 965 samples collected from major aquifers and a single detect of 0.07 ppb of 314 samples collected from shallow urban ground water. The Pesticides in Ground Water Database (PGWDB, USEPA, 1992) reported residues in 4 of 1185 wells sampled with concentrations ranging from 0.003 to 0.025 ppb. The only surface water monitoring for acifluorfen is from NAWQA, which reported a maximum level of 2.2 ppb.

Residential Risk

- The only scenario for residential exposure is a short-term spot treatment exposure scenario to kill weeds on driveways, sidewalks, and patios.

- A margin of exposure (MOE) of 1,000 or greater is not of concern for residential exposure scenarios. The FQPA safety factor of 10X was retained for short term residential exposures for females age 13-50 years for the reasons given previously. The MOE for residential exposure is 18,000 and is not of concern.

- In the residential handler cancer risk assessment, EPA assumed that a one gallon container of ready-to-use product would be used by an applicator for spot treatments in one year and that applicators would be potentially exposed for 50 years over a 70 year life span.

- A cancer risk of less than 1×10^{-6} does not exceed the Agency's level of concern for residential exposure. For this scenario there was a cancer risk of 4.5×10^{-8} which is less than the cancer risk of 1×10^{-6} and, is therefore, not of concern.

- EPA does not anticipate post-application dermal exposures for adults or children due to the frequency, duration and location of residential spot treatment applications.

Aggregate Risk

Aggregate risk considers the combined risk from exposure through food, drinking water, and, if appropriate, residential uses. Generally, all risks from these exposures must be less than 100% of the aPAD and cPAD (*non-cancer*) and cancer risks must be less than $1 \text{ X } 10^{-6}$. For sodium acifluorfen, the aggregate risks would include food, drinking water, and residential exposure. Residential exposure was considered for the short-term and cancer aggregate assessment since intermediate and chronic (non-cancer) residential exposure is not expected with sodium acifluorfen.

- As stated previously, both the acute and chronic aggregate dietary risks (food and water only) from acifluorfen are not of concern. Residential exposure is considered to be short term rather than acute exposure. As stated above, short term residential risk is not of concern for sodium acifluorfen. The short term DWLOC for females 13-50 years was 600 ppb, which is far greater than the modeled water concentrations of 0.34 to 10.3 ppb. Therefore, EPA has no concern for short-term aggregate exposure.

- For cancer, aggregate risk is of concern. A cancer DWLOC of 2.8 ppb was calculated. This value represents the concentration of acifluorfen in drinking water as part of the aggregate exposure from food and water that results in a negligible cancer risk. The modeled surface water concentration of 1.7 ppb does not exceed the DWLOC and the Agency is therefore not concerned with potential surface water exposure to sodium acifluorfen. The modeled groundwater concentration of 15.7 ppb, exceeds the DWLOC of 2.8 ppb. Regarding the residential cancer scenario, the calculated cancer risk of 4.5×10^{-8} is less than 1×10^{-6} and, is therefore, not of concern. In conclusion, the Agency is

concerned with aggregate cancer risks associated with the potential exposure to sodium acifluorfen residues in ground water.

Occupational Risk

Workers can be exposed to a pesticide through mixing, loading, or applying the pesticide, and re-entering a treated site. Worker risk is measured by a Margin of Exposure (MOE), which determines how close the occupational exposure comes to the No Observed Adverse Effect Level (NOAEL) taken from animal studies. For sodium acifluorfen, dermal MOEs that are greater than 100 and cancer risks which are in the range of 1×10^{-4} to $1X\ 10^{-6}$, do not exceed the Agency's level of concern. However, EPA strives to achieve worker cancer risks as close to $1\ X\ 10^{-6}$ as feasible through the use of personal protective equipment and engineering controls. A dermal absorption factor of 20% was used to account for differences in absorption between the oral and dermal routes. Oral and inhalation absorption were assumed to be equivalent.

For workers entering a treated site, restricted entry intervals (REIs) are generally calculated to determine the minimum length of time required before workers or others are allowed to enter.

Summary of Toxicological Information

- **Short- and Intermediate Term:** The NOAEL chosen to assess risk from dermal exposure is 20 mg/kg/day, based on decreased fetal weight and increased incidence of dilated lateral ventricles of the brain in an oral rat developmental toxicity study. These effects were observed at 90 mg/kg/day (LOAEL). This same NOAEL from the rat developmental toxicity study was also chosen to assess risk from inhalation exposure. EPA used a factor of 20% to extrapolate from oral study to dermal exposure, but assumed oral and inhalation exposure to be equivalent.

- **Long-term:** No toxicological endpoint was selected because long term occupational exposure to sodium acifluorfen is not expected based on the currently registered uses.

- **The cancer Q_1*** is $1.27\ X\ 10^{-2}\ (mg/kg/day)^{-1}$ based on liver tumors in mice. As mentioned previously, the Q_1* has been revised to correct the mg/kg/day dose levels for the both the 3/4 scaling factor and the percent active ingredient tested.

Mixer/Loader/Applicator Risk

Short and Intermediate-Term Risk:

- The registrant conducted a worker exposure and biomonitoring study on sodium acifluorfen. This study monitored dermal and inhalation exposure to workers who mixed,

loaded, and applied acifluorfen to soybean fields for weed control. Dermal and inhalation exposure from this study were used in the worker exposure assessment. Surrogate data from the Pesticide Handlers Exposure Database (PHED), version 1.1, were also used to assess potential exposures resulting from mixing, loading, or applying sodium acifluorfen.

- Most short and intermediate combined MOEs for mixers and loaders are of concern at baseline (MOEs less than 100). Applicators and flaggers are the only scenarios with MOEs not of concern at baseline. When personal protective equipment is used, MOEs for all scenarios are greater than 100 and not of concern.

Cancer Risk:

- For most scenarios, cancer risks are not of concern at baseline, and any scenarios with risk concerns at baseline are mitigated with the addition of the personal protective equipment specified on current product labels (i.e., long sleeve shirt, long pants, goggles, hat). Cancer risks range from 3.8×10^{-7} to 3.5×10^{-8} for private growers and 3.8×10^{-6} to 3.5×10^{-7} for custom applicators when these personal protective equipment are considered. When gloves and a double layer of clothing are added, cancer risks are in the range of 10^{-7} to 10^{-8} for private growers and range from 1.5×10^{-6} to 2.3×10^{-7} for custom applicators. With engineering controls, cancer risks are in the range of 10^{-7} to 10^{-9} and are not of concern.

Post-Application Risk:

- The post-application risk assessment estimated potential exposures for workers entering treated fields for specific tasks. Chemical-specific foliar dislodgeable residue data for sodium acifluorfen were used in this postapplication assessment. For sodium acifluorfen, all post-application MOEs are greater than 100 and all cancer risk estimates are less than 5.9×10^{-6} on the day of application. Cancer risks are greater than 1×10^{-6} on day 2 to 4 after application, depending on the scenario and data source.

- The current REI for sodium acifluorfen is 48 hours based on the acute toxicity.

Incident Data

- No poisoning incidents from exposure to sodium acifluorfen have been reported to the OPP Incident Data System, Poison Control Centers nationwide, or the California Department of Food and Agriculture. Further, the National Pesticide Telecommunications Network (NPTN) has received no reports of human poisonings from sodium acifluorfen.

Ecological Risk Assessment

To estimate potential ecological risk, EPA integrates the results of exposure and ecological toxicity studies using the risk quotient method. Risk quotients (RQs) are calculated by dividing exposure estimates by ecological toxicity values, both acute and chronic, for various species. The higher the RQ the greater the concern. Risk characterization provides further information on the likelihood of adverse effects occurring by considering the fate of the chemical in the environment, communities and species potentially at risk, their spatial and temporal distributions, and the nature of the effects observed in studies.

- Sodium acifluorfen is persistent on soils and in aquatic environments and is relatively mobile. Acifluorfen is stable to hydrolysis and does not break down in sunlight. Initial off-target transport is expected to be through drift, leaching, and later through erosion and runoff.

- Sodium acifluorfen exists in the anion (negatively charged) form in most agricultural soils. Several factors, including soil pH, soil organic carbon content, and soil iron content determine the extent to which acifluorfen adsorbs to soil particles. Therefore, the persistence and mobility of acifluorfen vary with different soil conditions.

- Because acifluorfen's fate properties showed that it might leach to groundwater, EPA required a small scale prospective ground water monitoring study, which was conducted on soybeans in the central sands of Wisconsin. Acifluorfen and two degradates were monitored; parent only was detected at concentrations ranging from 1 to 46 ppb (mean 8.36 ppb) in 56 out of 283 samples.

- EPA's water quality assessment for sodium acifluorfen also considers the herbicide lactofen, which degrades to acifluorfen.

Ecological Risk

- EPA does not have acute risk concerns for terrestrial animals, freshwater and estuarine animals, or aquatic plants. The Agency does not have chronic risk concerns for birds or mammals when acifluorfen is used at a rate of 0.25 lb ai/A and above.

- The Agency is uncertain about risks to freshwater and estuarine animals. The acute toxicity data do not suggest a risk concern. However, EPA does not have sufficient information to assess chronic risk. A no observed adverse effect level could not be determined in a chronic fish toxicity study because the lowest dose level resulted in an effect (reduced larvae weight). A comparison of the maximum peak concentration of acifluorfen in water is 100 fold lower than the LC_{50} for rainbow trout or bluegill sunfish. Because acifluorfen is persistent in water, the Agency is concerned about the potential for chronic risk. EPA is also concerned about the potential for chronic risk based on the phototoxic mechanism of action of sodium acifluorfen. Confirmatory data will be required to address this concern.

- The Agency is uncertain about risks to terrestrial plants. EPA could not conduct a risk assessment for terrestrial plants due to lack of adequate data. Since sodium acifluorfen is an herbicide, EPA assumes that there is a risk to nontarget plants, although the magnitude of the potential risk is unknown.

Data Needs

Areas of information and data needs for sodium acifluorfen include the following:

- The Hazard Identification Assessment Review Committee recommended a developmental neurotoxicity study in rats be conducted (OPPTS Guideline 870.6300). This study is required because of neurotoxicity which occurred in a developmental toxicity study in rats (increased incidence of dilated lateral ventricles of the fetal brain, MRID 00122743).

- The following product and residue chemistry requirements are needed: UV/visible absorption data (OPPTS 830.7050) and additional plant analytical methodology data (radio validation and a lower LOQ for rice straw).

- There are data gaps for Tier I terrestrial plant test data: Seed Germination/Seedling Emergence (OPPTS 850.4100) and Vegetative Vigor (OPPTS 850.4150).

- EPA recommends that an additional fate study, Sediment and Soil Adsorption/Desorption for Parent and Degradates (OPPTS 835.1230), be conducted for sodium acifluorfen to better understand the fate processes that control its movement in soil under different environmental conditions. A Terrestrial Field Dissipation Study (OPPTS 835.6100) may also be required depending upon the results of the sorption/desorption study.

- EPA also recommends that an Aquatic Photoxicity Study be conducted to address the potential increased risk posed by acifluorfen because it acts via a phototoxic mechanism of action. A modification of the Fish Early Life Stage Toxicity Study (OPPTS 850.1400) would be acceptable. EPA needs to determine if animals exposed to sodium acifluorfen show increased toxicity when exposed to sunlight relative to controls because sodium acifluorfen belongs to a class of herbicides with this specific mode of action. The Agency has noted differences in toxicity with other herbicides that act by this mechanism.

Potential Alternatives

As part of the reregistration process, EPA has conducted a preliminary analysis of potential alternatives to sodium acifluorfen. These alternatives are summarized in the table below. During phase 3 of the public process, EPA sought and received comments on the viability of these potential alternatives, as part of the overall evaluation of sodium acifluorfen.

Crops, Weeds, and Potential Alternatives

Crop	Major Weeds	Registered Alternatives
Peanuts	Cocklebur	2,4-DB, bentazon, chlorimuron, imazapic, imazethapyr, paraquat, pyridate
	Morning glory	2,4-DB, bentazon, chlorimuron, glyphosate, imazapic, imazethapyr, paraquat,
	Ragweed	2,4-DB, bentazon, chlorimuron, glyphosate, imazethapyr, paraquat,
	Sesbania, Hemp	2,4-D amine, bensulfuron, bentazon, MCPA, propanil, quinclorac, triclopyr
Soybeans	Cocklebur	2,4-DB, bentazon, cloransulam-methyl, chlorimuron, flumetsulam, fomesafen, glyphosate, imazamox, imazaquin, imazethapyr, lactofen, metribuzin, sulfentrazone, thifensulfuron, trifluralin
	Lambsquarters	2,4-DB, bentazon, clomazone, flumetsulam, fomesafen, glyphosate, imazamox, imazaquin, imazethapyr, lactofen, linuron, metolachlor, metribuzin, pendimethalin, sulfentrazone, trifluralin.
	Morning glory	2,4-DB, bentazon, chlorimuron, clorasulam-methyl, flumetsulam, fomesafen, glyphosate, imazaquin, imazethapyr, lactofen, sulfentrazone.
	Pigweed, Redroot	2,4-DB, bentazon, chlorimuron, flumetsulam, fomesafen, glyphosate, imazamox, imazaquin, imazethapyr, lactofen, metolachlor, metribuzin, pendimethalin, sulfentrazone, thifensulfuron, trifluralin
	Ragweed	2,4-DB, bentazon, chlorimuron, clorasulam-methyl, fomesafen, glyphosate, imazamox, imazaquin, imazethapyr, lactofen, linuron, metribuzin.
	Velvetleaf	2,4-DB, bentazon, chlorimuron, clomazone, clorasulam-methyl, flumetsulam, fomesafen, glyphosate, imazamox, imazaquin, imazethapyr, lactofen, metribuzin, thifensulfuron
	Waterhemp, Common	2,4-D, bentazon, chlorimuron, clorasulam-methyl, fomesafen, glyphosate, imazaquin, imazethapyr, lactofen, metribuzin, sulfentrazone, thifensulfuron.