UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF PREVENTION, PESTICIDES AND TOXIC SUBSTANCES

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Chemical: Quinclorac
Chemical No. 128974

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Subject: Environmental Fate, Effects and Ecological Risk Assessment for a Section 3 Registration of Quinclorac on Wheat and Sorghum.

EFED has conducted an assessment of the environmental fate and effects of the herbicide quinclorac and the potential ecological risks associated with its proposed use on wheat and sorghum (see attached risk assessment document and associated DERs).

Risk Conclusions

EFED's assessment concludes the following with respect to ecological risks:

- The proposed uses of quinclorac on wheat and sorghum may result in off-site environmental levels of the herbicide that trigger EFED concerns for direct toxic risks to non-target crops as well as wild plants.

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- The proposed uses of quinclorac on wheat and sorghum are not likely to result in environmental levels of the herbicide that trigger EFED concerns for direct toxic risks to mammalian and avian wildlife, beneficial insects, aquatic animals, and aquatic plants.

EFED's concerns for non-target plants are based on both the standard exposure methods employed in the Division as well as supplemental information concerning off-site drift of the herbicide. Furthermore, plant families known to be sensitive to quinclorac are well represented in wheat and sorghum-growing counties by both economically important crop species as well as wild plant species (including a number of endangered plants). Quinclorac exposures for off-site plants may result from a combination of run-off, primary spray drift, secondary transport (i.e., soil particle transport by wind), and irrigation with contaminated surface or groundwater (the reader is encouraged to consult the executive summary and body of the attached document for a more detailed explanation of these routes of exposure).

<u>Additional Data Needs</u>

Guideline Leaching Adsorption/Desorption Studies of Metabolites

EFED has identified two quinclorac metabolites present both in the aerobic soil metabolism studies and terrestrial field dissipation studies (BH514-2-OH and BH514-Me ester). Data are needed to confirm the mobility of these metabolites in soil. Therefore EFED requests that guideline (163-1) leaching adsorption/desorption studies be performed on these two metabolites.

Groundwater Study

The environmental persistence of quinclorac, its potential to enter groundwater as modeled by SCI-GROW and indicated in terrestrial field studies, and the potential for groundwater impacts to non-target crops via contaminated groundwater all suggest the need for additional data to assess the potential for groundwater contamination. EFED therefore requests that a small-scale prospective ground water study be conducted.

Non-guideline Drift/Transport Study

The results of the risk assessment and allegations of non-target crop damage from quinclorac use on rice in three states (Arkansas, Louisiana, and Texas) suggest the need for a non-guideline study to investigate the potential for off-site transport of quinclorac to cause non-target crop and wild plant damage both near to and at distance from the treated fields. Because of quinclorac's persistence in soils, these investigations should address, in addition to primary drift, secondary transport of the compound.

Non-target Plant Toxic By-product Study

Available data concerning the mechanism of action for quinclorac suggests that accumulation of endogenously produced cyanide may contribute to herbicidal activity. The present risk assessment cannot assess the implications of accumulation of cyanide in off-site plants to herbivorous wildlife because there are not available data to allow a characterization of cyanide residues. EFED recommends that the registrant investigate the magnitude of cyanide accumulation in plant species sensitive to quinclorac.

Terrestrial and Aquatic Plant Toxicity Guideline Study for Quinclorac Mixtures with 2,4-D

The Paramount ™ BW formulation contains 60% 2,4-D. This herbicide, like quinclorac, is an auxin mimic by mechanism of action. EFED has *no* toxicity data regarding this mixture of quinclorac and 2,4-D. This represents a considerable uncertainty in the risk assessment for the product mixture. The present lack of toxicity data precludes an assessment of the potential for additive or synergistic effects when organisms are exposed to quinclorac and 2,4-D combined. EFED recommends aquatic and terrestrial plant toxicity testing for the Paramount ™ BW formulation.

Quinclorac
Herbicide
Environmental Fate and Ecological Effects Assessment and Characterization for a Section 3 for Use on Wheat and Sorghum

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EXECUTIVE SUMMARY

This risk assessment evaluates the potential risks to terrestrial wildlife, fish, aquatic invertebrates, beneficial insects, and non-target plants (including non-target crops) associated with the use of quinclorac as a post-harvest, pre-plant, and emergent herbicide on wheat and sorghum.

Quinclorac laboratory fate data suggest that the compound is stable to hydrolysis, soil photolysis, and microbially mediated metabolism. Information regarding the lengthy intervals required between quinclorac use and the planting of sensitive crops further suggests environmental stability. The compound is of relatively high aqueous solubility and has a low affinity for soil organic carbon, factors suggesting that quinclorac is mobile in the environment. Movement of quinclorac residues by surface runoff may be a significant mode of dissipation under terrestrial use conditions, especially if excess precipitation occurs immediately following a quinclorac application

This risk assessment indicates that, under the use scenarios investigated, quinclorac poses no acute or chronic risks above Environmental Fate and Effects Division (EFED) levels of concern for birds, freshwater fish, freshwater invertebrates, and aquatic plants (both unicellular and vascular). No acute risk quotients to mammals exceed EFED levels of concern. The chronic risk quotient for small mammals consuming short grass vegetation, under the maximum use scenario for Paramount™, slightly exceeds the EFED level of concern. However, upon consideration of the conservative assumptions associated with the small mammal risk assessment performed for this document, EFED concludes that this slight excursion beyond the level of concern is not significant.

EFED has concerns for quinclorac risks to terrestrial (upland) and semi-aquatic vascular plants. EFED concerns encompass effects on endangered plants, non-endangered wild plants, and non-target crops. The registrant has identified a number of sensitive plant families. These plant families are well represented by non-target crops that are co-located at the county level with wheat and sorghum cultivation areas. In addition to laboratory toxicity data showing effects in non-target crops, data are available that show that quinclorac drift as far as 1,980 feet from the edge of fields aerially treated with quinclorac at rate equivalent to those proposed for wheat and sorghum, produces characteristic foliar damage in non-target crop plants. In addition, a simulated drift study on cotton showed that drift resulting in non-target crop exposures as low as 2% of the proposed application rate for wheat and sorghum could produce statistically significant reductions in the yield of cotton crops.

In addition to the concern for non-target crops, EFED has concerns for risks to endangered and non-endangered vascular plant species. Over 60 endangered plants are co-located in the same counties as wheat and sorghum cultivation. Of these endangered species, a number are also identified as being members of plant families presented by the registrant on quinclorac product labels as being especially sensitive to the herbicide. Furthermore, the sensitive plant families listed by the registrant on product labels are highly represented by the assemblages of non-endangered wild plant communities in the states proposed for quinclorac use. Damage to these communities would reduce local biodiversity and have indirect effects on the wildlife that uses these communities as sources of food and shelter.

Quinclorac contamination of surface and ground water resources, though not presenting a direct toxic risk to aquatic plants or animals, does pose important risks to non-target crops should those water resources be used for agriculture. Assuming a 2 acre inch overhead irrigation effort, quinclorac residues in surface water and groundwater exceed plant toxicity thresholds and suggest that irrigation with these contaminated waters poses risks for non-target crop damage.

The proposed labels for quinclorac products prohibit off-site drift onto sensitive crop families. However, EFED believes that such statements alone are not effective mitigation. Drift is an unavoidable consequence of spray applications and prohibition of drift onto non-target areas is not a realistic expectation. EFED believes that there are some mitigation options that would reduce, but not necessarily eliminate, primary drift impacts to non-target plants. First, extending the label prohibitions for aerial spraying in selected states to all labeled states proposed for use would reduce the drift level as groundspray applications can be expected to produce lower levels of off-site primary drift. Second, labels could specify the use of spray nozzles with course droplet spectra, which would further reduce the level of off-site primary drift. Third, buffer zones could be incorporated onto the label. Available data suggest that avoidance of foliar damage on non-target plants, at quinlorac use rates equivalent to those for wheat and sorghum, would require buffers of at least 1,980 feet.

The persistence of quinclorac in soils suggests that consecutive years of application may result in accumulation of quinclorac on treated fields. EFED believes that such accumulation may contribute to off-field exposures to quinclorac as a result of secondary transport mechanisms (e.g., soil particle transport with wind). EFED believes that concerns regarding secondary transport of quinclorac off the site of application may be particularly important in areas of wheat and sorghum cultivation involving large continuous quinclorac-treated tracts of cultivated land. To mitigate for the possible increased exposures from secondary transport off of treated fields, EFED recommends that prohibition of treatments in consecutive years be considered.

EFED believes that mitigation measures should also be considered to avoid damage to non-target crops from irrigation with quinclorac-contaminated surface or ground water. These measures could include label prohibition of quinclorac use on wheat and sorghum in areas where surface or groundwater is used for irrigation.

The results of the risk assessment and allegations of non-target crop damage from quinclorac use on rice in three states (Arkansas, Louisiana, and Texas) indicates the need for additional investigation into the potential for off-site transport of quinclorac to cause non-target crop damage both near to and at distance from the treated fields. Because of quinclorac's persistence in soils, these investigations should address, in addition to primary drift, secondary transport of the compound.

Although quinclorac is commonly considered to achieve herbicidal activity through the mimicry of the plant hormone auxin, there exist data to suggest that another mechanism may be operational for this compound. There are data to suggest that the toxic effects of quinclorac on plants may be due, in part or in whole, to stimulation of selected plant metabolic processes that result in accumulation of endogenously produced cyanide. The present risk assessment cannot assess the implications of accumulation of cyanide in off-site plants to herbivorous wildlife because there are not available data to allow a characterization of cyanide residues. EFED recommends that the registrant investigate the magnitude of cyanide accumulation in plant species sensitive to quinclorac.

EFED has identified two quinclorac metabolites present both in the aerobic soil metabolism studies and terrestrial field dissipation studies (BH514-2-OH and BH514-Me ester). Data are needed to confirm the mobility of these metabolites in soil. Therefore EFED requests that guideline (163-1) leaching adsorption/desorption studies be performed on these two metabolites.

Finally, the environmental persistence of quinclorac, its potential to enter groundwater as modeled by SCI-GROW and indicated in terrestrial field studies, and the potential for groundwater impacts to non-target crops via contaminated groundwater all suggest the need for a small scale prospective groundwater contamination study for the compound under the expected conditions of use in wheat and sorghum.

USE PROFILE

Chemical Identification

The subject chemical of this risk assessment is identified by the chemical name 3,7-dichloro-8-quinolinecarboxylic acid. The trade name for this compound is quinclorac. The chemical identification number is 128974.

Type of Use

Quinclorac is a pre- and post-emergent herbicide.

Site of Use

The proposed use site is fallow or preplant wheat and sorghum as well as postemergence sorghum. The proposed geographical areas subject to treatment include Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, Washington, and Wyoming.

Target Pests

Quinclorac is applied to control broadleaf weeds and annual grasses. Tables 1 and 2 present the target weeds listed on the proposed labels for the Paramount™ and Paramount™ BW formulations.

Table 1. Target Weed Species for Quinclorac (Paramount™ Herbicide Product) Use on Wheat and Sorghum

Weeds Controlled	Weeds Suppressed
barnyard grass	Canada thistle
field and hedge bindweed	dandelion
broadleaf signalgrass	kochia
bedstraw	lambsquarters
large crabgrass	pigweed
green foxtail	common and giant ragweed
yellow foxtail	Russian thistle
giant foxtail	common sunflower
morningglory species	velvetleaf
volunteer flax	waterhemp

Table 2. Target Weed Species for Quinclorac (Paramount™ BW Herbicide product) Use on Wheat and Sorghum

field bindweed	field pennycress
crimson, red, and white clovers	pigweed
common cocklebur	plaintains
dandelion	common and giant ragwed
curly dock	sheperdspurse
wild garlic	annual sowthistle
ironweed	speedwell
kochia	wild sunflower
common lambsquarters	Russian thistle
prickly lettuce	wild mustard
annual morningglory	wild onion

Formulation Type

Two labeled formulations of quinclorac are proposed for registration on wheat and sorghum:

1. Paramount™: a dry flowable product composed 75% quinclorac and 25% inert ingredients
2. Paramount™ BW: a dry flowable product composed of 15% quinclorac, 60% 2,4-dichlorophenoxyacetic acid (2,4-D), and 25% inert ingredients.

Method, Rate, and Timing of Application

The recommended application methods for Paramount™ and Paramount™ BW are ground (broadcast) and aerial (Note: the labels prohibit the use of aerial application in Idaho, Oregon, and Washington).

Paramount™

The maximum annual application rate for Paramount™ is 1 lb/acre (0.75 lb a.i./acre). Paramount™ can be applied fallow or preplant in wheat or sorghum at 0.17 to 0.33 lb/acre (0.125 to 0.245 lb ai/acre) for control of annual grasses and broadleaf weeds. For bindweed control, Paramount™ can be applied following harvest of crop and before first frost, with maximum efficacy associated with application to actively growing bindweed at least 4 inches in length. The label recommends a three-year bindweed control program with first year application at 0.33 lb/acre (0.245 lb a.i./acre) and subsequent year applications at (0.125 to 0.245 lb ai/acre).

Paramount™ can be applied to postemergent sorghum at 0.17 to 0.5 lb/acre (0.125 to 0.375 lb a.i./acre). Applications should be made from sorghum emergence to 12 inches for control of annual grasses and broadleaf weeds. Bindweed control applications are at 0.33 lb/acre (0.245 lb a.i./acre) and bindweed maintenance is recommended at 0.17 lb/acre (0.125 lb a.i./acre).

The label does not provide information relative to the intervals between the multiple applications that are possible under compliance with a 1 lb/acre (0.75 lb a.i./acre) annual cap.

Paramount™ BW

The maximum annual application rate for Paramount™ BW is 1.66 lb/acre (0.245 lb a.i./acre). Applications are to actively growing weeds as broadcast (ground spray or aerial) or spot spray. Application rates and timing for field bindweed (at least 4 inches in height) include 1.66 lb/acre (0.245 lb a.i./acre) after harvest of spring or winter wheat in year one. In year two, the application rate may range from 0.83 to 1.66 lb /acre (0.0125 to 0.245 lb a.i./acre). Year three of bindweed control limits the application to 0.83 lb /acre (0.0125 lb ai/acre). Application for the control of other broadleaf weeds is labeled as 0.83 lb /acre (0.0125 lb ai/acre) when weeds are less than 2 inches in height.

The label does not provide information relative to the intervals between the multiple applications that are possible under compliance with a 1.66 lb/acre (0.245 lb a.i./acre) annual cap.

Specific Non-Target Plant Labeling

The labels for both herbicide products containing quinclorac present specific prohibitions regarding drift onto non-target plants. The following documents these label-specific prohibitions.

Paramount™

The label states the following:

> "Do not allow Paramount BW to drift onto other desirable plants, especially sensitive crops belonging to the following plant families:
>
> 1. *Solanaceae* (tomato, potato, tobacco, eggplant, peppers (*Capsicum*), among others)
> 2. *Umbelliferae* (celery, parsley, carrots, among others)
> 3. *Leguminosae* (alfalfa, green bean, among others)
> 4. *Convolvulaceae* (sweet potato, among others)
> 5. *Chenopodicaceae* (spinach, sugar beet, among others)
> 6. *Malvaceae* (okra, among others)
> 7. *Cucurbitaceae* (watermelon, cantaloupe, squash, pumpkin, among others)
> 8. *Compositae* (lettuce, sunflowers, among others)
> 9. *Linaceae* (flax)
>
> Do not allow spray containing Paramount™ to drift onto areas where tomatoes are to be planted, have been planted, or onto emerged tomatoes as severe injury will occur."

Paramount™ BW

The label states the following:

> "Do not allow Paramount BW to drift onto other desirable plants, especially sensitive crops belonging to the following plant families:
>
> 1. *Solanaceae* (tomato, potato, tobacco, eggplant, peppers (*Capsicum*), among others)
> 2. *Umbelliferae* (celery, parsley, carrots, among others)
> 3. *Leguminosae* (alfalfa, green bean, among others)
> 4. *Convolvulaceae* (sweet potato, among others)
> 5. *Chenopodicaceae* (spinach, sugar beet, among others)

6. *Malvaceae* (okra, among others)
7. *Cucurbitaceae* (watermelon, cantaloupe, squash, pumpkin, among others)
8. *Compositae* (lettuce, sunflowers, among others)

Do not allow spray containing Paramount™ BW to drift onto areas where tomatoes are to be planted, have been planted, or onto emerged tomatoes that were transplanted as severe injury will occur."

ENVIRONMENTAL FATE CHARACTERIZATION

Fate Summary and Conclusions[1]

The laboratory data indicate that the compound is stable to hydrolysis, photolysis in sterile water, as well as aerobic and anaerobic metabolism. Furthermore, crop rotation restrictions listed on the submitted label (Paramount, 75% active ingredient) restrict immediate replanting to Spring or Winter wheat or sorghum only, and 309 days (10 months) for most other crops. For crops such as flax, peas, lentils, and sugar beets the crop rotation restriction is 24 months after application. These rotational crop restrictions also provide evidence that quinclorac is persistent. The terrestrial field studies reviewed to date, indicate that quinclorac dissipates slowly to moderately rapidly (18-176 days half-lives).

The environmental fate data submitted indicate that leaching is a route of dissipation. For instance, the laboratory leaching data indicate that the compound is mobile (K_{oc} 13-54 mL/g). From the field dissipation data submitted, it appears that quinclorac can leach in soil, since quinclorac was detected below the 12 inch soil depth in the several of the studies. For example, instances of quinclorac residue detection in the soil down to 42-48 inches (quinclorac), 12-18 inches (BH 514-2-OH) and 6-12 inches (BH 514-ME) were noted in terrestrial field studies performed in KS, CA, MO, and NJ. Furthermore, EFED estimates a concentration of 20.68 ppb for quinclorac in ground water as predicted by SCI-GROW modeling results.

Movement of quinclorac residues by surface runoff may be a significant mode of dissipation under terrestrial use conditions, especially if excess precipitation occurs immediately following a quinclorac application. The K_d is low (<1.0) and the chemical is applied near the soil surface. The peak GENEEC estimated environmental concentration (EEC) of quinclorac in surface water is 39.74 ppb, while the 56 day average is 37.54 ppm.

[1] EFED's internal risk review panel has recommended the inclusion of a degradate characterization to include structures, chemical nomenclature, and degradation pathways. This recommendation was received shortly before finalization of the risk assessment and time did not permit its inclusion in this document prior to the negotiated due date with the Registration Division. EFED will provide this information as a supplement at a later date.

Detailed Environmental Fate Discussion

EFED notes that the registrant conducted 14 terrestrial field dissipation studies on turf plots in CA, FL, GA, MO, NJ, NY, OR, and WI, two terrestrial field studies on corn in IA and NC, two bareground terrestrial field studies in KS, and five aquatic field dissipation studies in CA, MS, and TX. The half-lives ranged from 18 to 176 days. The data generally indicate a moderately rapid to slow dissipation rate.

Although the registrant has not proposed a route of dissipation, EFED proposes the following route of dissipation in terrestrial field uses: leaching of quinclorac is probably a route of dissipation. It also appears that this chemical probably has a high potential to undergo dissolved runoff to near surface water, since the K_d is low and the chemical is near the soil surface. Runoff would be important if excess precipitation occurred immediately after application. Aerobic soil metabolism is probably a secondary route of dissipation, since the laboratory studies have produced results indicating that quinclorac degraded with half-lives ranging from 90 days to > 1 year. Furthermore, CO_2 production in the laboratory studies was generally low ($\leq$ 7%). Soil binding of residues is also a possible route of dissipation since up to 29% of applied radioactivity in the aerobic soil metabolism study was bound residues (extractable by NaOH refluxing).

Photodegradation is probably not a major route of degradation under terrestrial field conditions, since the data indicate that quinclorac when applied to soil in the laboratory is stable (half-life 179 and 233 days, corrected for dark controls) to photolysis. However, soil photolysis may have some importance in quinclorac degradation since the half-life in the dark controls were 382-529 days, suggesting light enhanced degradation. EFED also notes that in these soil photolysis studies, the statistical estimation of the half-lives is of limited value because the calculations involve extrapolation considerably beyond the experimental time limits (30 days) of the study; therefore, the half-lives given are only rough approximations.

The registrant has suggested that the reason for the longer half-lives in the aerobic soil metabolism studies (90 days to > 1 year) as compared to half-lives in terrestrial field studies (18 to 176 days) is probably the result of changes in microbial population or susceptibility of certain microbes to the storage conditions that occur in the laboratory prior to experimentation. This seems to be an acceptable theory since the laboratory data show that fresh soil, either alone or added to stored soil, increases degradation of quinclorac as compared to stored soil.

For example, in one study when stored soil was incubated with quinclorac in the dark, <0.1% $^{14}CO_2$ was produced after 365 days. Conversely, when another stored soil was amended with a "fresh lysimeter soil", and incubated with quinclorac, about 10% $^{14}CO_2$ was produced after 138 days. The half-life was estimated to be between 89 and 138 days.

In another study, degradation was assessed using carrots (a plant sensitive to about 4 ppb quinclorac in soil) as a biological indicator plant. In fresh clay loam, sandy loam, loam and organic soils collected fresh from fields, loss of herbicidal activity against carrots (as measured by

% plant damage) was observed and quinclorac half-lives were estimated to be 30 to 90 days. EFED notes that when the fresh clay loam soil was steam sterilized or air dried to 20% field moisture capacity, sieved, moisture brought to 40 % and stored for 4 months at 20°C, no significant loss of herbicidal activity against carrots was noted for up to 8 months.

However, one of the main concerns with these studies is that the registrant did not compare the same soils, stored or fresh, in order to conclusively show that there is something in fresh soils that is not in stored soils. Furthermore, EFED notes the non-guideline studies submitted indicate that even when fresh soil is used and degradation is increased as compared to stored soil, quinclorac can still be considered moderately stable to aerobic metabolism (i.e., half-life >30 days). These laboratory half-lives, however, are entirely consistent with the observed half-lives noted in the terrestrial field studies.

Degradation

Hydrolysis (161-1)

Fifty ppm [3-^{14}C] quinclorac was hydrolytically stable in aqueous buffered pH 5, 7, and 9 solutions. After 737 hours, quinclorac comprised ≥98% of the applied in the three buffer solutions and was the only [^{14}C]compound detected. This study is acceptable. (MRID 40320816)

Photo degradation in Water (161-2)

[3-^{14}C]Quinclorac (radio chemical purity 99.6%), at 5.4 ppm, degraded slightly (<10% of the applied) in a sterile aqueous pH 7 buffer solution that was irradiated for 697 hours using a xenon arc lamp at 25 C. After 697 hours of irradiation, quinclorac comprised 92% of the recovered radioactivity, an unidentified degradate comprised 1.6%, and 2.7% remained near the origin of the TLC plate. The extrapolated half-life was 100 days (note extrapolations beyond the study duration are uncertain). The sensitized half-life using acetone was 52 days. This study is acceptable. (MRID 41063560)

Conversely, the photolytic half-lives of non-radiolabled quinclorac in non-sterile natural river water and solutions containing activated sewage sludge were, respectively, 5 and 10 days (not corrected for dark control results, which suggest that between 8-12% of degradation would be accounted for processes other than photolysis over a 47-day incubation). The authors concluded that photolysis was the main route of degradation in these two studies; however, they did not identify any degradates. Furthermore, the length of exposure was only 6 hours/day. Had a longer daily sunlight exposure regime been used, the half-lives, as determined may have differed from that reported and may have been less by at least one-half, based on a typical 12-hour daylight exposure period. This study is supplemental. (MRID 41063564)

Similarly, the photolytic half-lives of quinclorac in solutions containing hydrogen peroxide were between 24 and 65 hours. In solutions without H_2O_2 >90% of added quinclorac remained undegraded after 132 hours of irradiation. Carbon dioxide was the major volatile degradate (75-95% of volatile radioactivity). However, in this study it was clear from the data that the photodegradation half-life of quinclorac in water with added H_2O_2 was 65 hours or less and that degradation in nonsensitized water was slow. This study is supplemental (no dark control, degradates were not identified or quantified and material balance was not provided). (MRID 41781402).

In another study, humic acids, obtained by extracting a loam soil with 0.5 N NaOH, were added to deionized water. The half-life was 7 days. Approximately 15 and 30% of the radioactivity was degradates and volatile material, respectively, that was not further identified. This study provides supplemental information (it's not fully acceptable because of a lack of dark control, pH of the solution changed during the study, limited sampling, and incomplete material balance) and shows that the addition of soil humic extracts to aqueous solution of quinclorac can increase the photodegradation of the parent as compared to degradation in pure water. (MRID 41781403)

Further studies show that the addition of quinclorac to aqueous buffered solutions (0.005 phosphate), rice paddy water, and aqueous buffered solution containing humic acid added as photosensitizers, increased the photodegradation of parent as compared to degradation in pure sterilized water. Half-lives of quinclorac in the various solutions used were between 25 to 35 days in the aqueous buffered solution, 28 days in the solution with humic acid, and 22 to 38 days in rice paddy water. About 5% of radioactivity was CO_2. Two degradates were identified at <1% of the applied radioactivity, BH 514 3-deschloro (7-chloroquinoline carboxylic acid) and BH 514 2-OH (2-hydroxy-3,7-dichloroquinoline carboxylic acid). This study is supplemental (no dark control, volatile compounds, except for CO_2, were not determined or identified, and material balance could not be determined). (MRID 41781404).

Another study in rice paddy water and sediment resulted in half-lives of 5.3 and 15.7 days (no correction for dark control reaction), respectively, for quinclorac with and without formulation ingredients. After 30 days 8 and 21% of the TRR was CO_2 for the nonformulated and formulated treatments, respectively. Approximately 65% of the TRR was in the sediment. In the dark controls, >90% of the applied TRR was parent quinclorac, while <1 1% was in the sediment of the dark controls. The study authors concluded that the results indicated that quinclorac is rapidly photolyzed to many products which are mainly bound to sediment or converted to CO_2. Although the addition of the formulation decreased the half-life (5.3 days), the half-life without formulation was 15.7 days, indicating that natural rice paddy water possesses a sufficient concentration of photosensitizers to result in rapid photodecomposition of quinclorac. The increase in photolysis rate with the addition of the formulation materials is probably due to the ability of the some of the ingredients to act as photosensitizers. Whether or not the formulation ingredients would enhance photodegradation under actual field use is not known; but it is likely that the naturally occurring photosensitizers would contribute more to photolysis. <u>This study is supplemental</u>. (MRID 42294101)

Photodegradation on Soil (161-3)

Quinclorac photodegraded with a registrant-calculated half-life of 179-233 days (corrected for the dark control) on silt loam soil irradiated for 30 days with 12 hours per day of xenon lamp light at 26° C. The degradate, carbon dioxide accounted for 1.6% of the applied radioactivity at the end of 30 days. Unidentified polar residues accounted for up to 7.8% of the applied radioactivity during the 30 days incubation. Other unidentified degradates in the ethyl acetate and aqueous phases were ≤8.9% of the applied radioactivity. Unextractable radioactivity in the soil was ≤7.8% of the applied radioactivity. In the dark-controls, quinclorac degraded with a registrant-calculated half-life of 382-529 days. Quinclorac was 93.6-100% of the applied at 14 days posttreatment and 92.9-95.8% at 30 days. Unidentified extractable degradates were ≤6.4%. Unextractable radioactivity was 4.9-5.1%. <u>This study is acceptable</u>. (MRID 41781409).

Metabolism

Aerobic Soil Metabolism (162-1)

[2,3,4-^{14}C]Quinclorac, at 0.5 ppm, degraded slowly with a half-life of >>1 year (after 365 days of incubation 84 and 98 % of the residues were quinclorac) in two silt loam soils that were incubated aerobically in the dark at 23 °C. Quinclorac was the only [^{14}C]compound detected in the extracts, with the exception of trace amounts of 3-chloro-8-quinoline-carboxylic acid (BH 514-1). After 12 months of incubation, 83-100% of the applied radioactivity was extractable and 2.5-11.3% was unextractable. Extrapolation of these results to derive half-lives yields estimates of 1140 to 9125 days. Such extrpolations beyond the study limits are uncertain. <u>This study is acceptable</u>. (MRID 41247301)

In another study, quinclorac was very stable in thc aerobic soil environment, since the half-lives in the loamy sand and clay soil were 391 and 168 days, respectively. The only volatile compound detected in the study was CO_2 at a maximum concentration of 7.1% TRR (0.38 ppm). Other than parent, residues identified at maximum concentrations were: 2-OH-514 H (14.9% TRR, 0.80 ppm), BH 514-Me ester (7.8% TRR, 0.42 ppm). Parent was found at a maximum concentration of 58.1% (3.14 ppm) and 31.0% (1.67 ppm) of the TRR. Soil bound residues accounted for 13.4 to 31.5% of applied radioactivity after 274 days. <u>This study is acceptable</u>. (MRID 44084503)

In this study, stored soil was added to a soil collected from the field 4 days earlier and then quinclorac was added. Compared to the original aerobic metabolism study (MRID 41247301) submitted (in which the soil had been stored for some time prior to use), quinclorac degradation in this mixed soil appeared to be more rapid. Carbon dioxide produced in the original study was 0.08% of applied radioactivity after 365 days, compared to 9.7% after 138 days (the study termination date) in this study . After 138 days of incubation 42.4% of the applied was parent and approximately 30% was reported to be soil-bound residues. The EFED calculated half-life was 131 days. This study is supplemental (the same soil was not used in both studies and the experimental setup was not identical). (MRID 41781411)

Degradation was assessed using carrots as a biological indicator plant. In fresh clay loam, sandy loam, loam and organic soil collected from field, loss of herbicidal activity against carrots was observed and half-lives were estimated to be 30 and 90 days. Conversely, when fresh clay loam soil was steam sterilized, no significant loss of herbicidal activity against carrots was noted for 8 months. Similarly, when the same soil was air dried to 29% moisture capacity, sieved and moisture brought to 40% and stored for 4 months at 20^{0}C, the same effect as sterilization occurred. The study author concluded that some suppression of microbial activity occurred prior to and/or during soil preparation. EFED concludes that this suppression could be responsible for the disparate results in aerobic soil metabolism half-lives among the various studies. Although quinclorac degraded more quickly in the fresh laboratory and field soils than in stored soils, no direct comparison was made between a fresh soil and the same soil stored for an extended period. This component is necessary to indisputably conclude that the observed increase in rate of quinclorac degradation was due to some component in the fresh soil but not in the stored soil. This study is supplemental. (MRID 41781410)

In summary, EFED concludes that under aerobic soil conditions, quinclorac is stable and degrades slowly. Half-lives for the various submitted acceptable laboratory studies are 168, 391 and >>1year (extrapolated values of 1140 to 9125 days). In supplemental studies estimated aerobic soil half-lives were 30, 90, and 131 days.

Anaerobic Aquatic Metabolism (162-3)

[2,3,4-^{14}C]Quinclorac, at 0.5 or 5 ppm, degraded with a half-life of >1 year in flooded silty clay loam and silty clay soils that were incubated under anaerobic conditions in the dark at 23 °C for 365 days. In all samples, quinclorac comprised 100% of the extractable radioactivity. Unextractable (bound) residues accounted for 2-5.2% of applied. This study is supplemental (material balance was incomplete). (MRID 41063561, 41781416)

^{14}C-quinclorac applied at 1.5 ppm to soils from MS and LA were incubated at 25°C in the dark under anaerobic aquatic conditions and samples were taken periodically for 180 days. About 2% of the radioactivity was bound to the soil and about 90% of the parent quinclorac was still present after 180 days. Trace amounts of degradates (totaling 7% of the applied material) consisting of up to 8 components were observed but not identified. These results are consistent with previous studies and indicate that quinclorac is very stable in anaerobic aquatic environments maintained in the dark. Extrapolated half-lives of 1691 and 2263 days were determined. This study is acceptable. (MRID 42294104)

Aerobic Aquatic Metabolism (162-4)

[2,3,4-^{14}C]Quinclorac at 0.5 ppm, degraded with a half-life of >1 year in flooded silty clay and silty clay loam soils that were incubated in aerated flasks in the dark at 23 °C for 360 days. At the end of the study, 74.5-79.7% of the applied radioactivity was extractable and most of this was undegraded quinclorac. No significant degradation of quinclorac occurred in flooded silty clay loam soil treated a 5 ppm. It was determined that 5.4 to 8.8% of the applied radioactivity was evolved as $^{14}CO_2$ during the study. In contrast, in the flooded silty clay soil treated at 5 ppm, quinclorac degraded with an estimated half-life of 4.7 months. One degradate, 3-chloro-8-quinolinecarboxylic acid (BH 514-1) comprised 55.7% of the initial radioactivity after 6 months incubation and 30.8% after 12 months. Evolved $^{14}CO_2$ was not determined in this instance. Three other unidentified compounds were isolated, but not identified, in quantities ranging from 5.0 to 7.6% of the applied radioactivity. Unextractable (bound) residues accounted for 5-15% of applied radioactivity. This study is supplemental (application was not verified, three unknowns were not identified, no explanation for the different results between the added rates of quinclorac). (MRID 40320817)

^{14}C-quinclorac applied at 1.5 ppm to soils from MS and LA were incubated at 25°C in the dark under aerobic conditions and samples were taken periodically for 30 days. About 1% of the radioactivity was bound to the soil and >93% of the parent quinclorac was still present after 30 days. Extrapolated half-lives were determined to be 393 and 1229 days. These results are consistent with previous studies that show quinclorac to be stable in the aerobic aquatic environment in the dark. This study is acceptable. (MRID 42294102, 42294103).

Mobility

Leaching/Adsorption/Desorption (163-1)

Based on batch equilibrium (adsorption/desorption) studies, [^{14}C]quinclorac was determined to be very mobile in sand, sandy loam, loam, clay loam, and silty clay soils. Freundlich K_{ads} values were <0.05 ml/g for the sand soil, 0.067 ml/g for the sandy loam soil, 0.258 ml/g for the loam soil, 0.597 ml/g for the clay loam soil, and 0.516 ml/g for the silty clay soil. The 1/n values were between 0.84 and 1.01. The K_{oc} values were 13 ml/g for the sandy loam soil to 54 ml/g for the clay loam soil (mean = 36 ml/g). In general, adsorption increased with increasing soil organic matter content (r=0.9048), CEC, and clay content. Freundlich K_{des} values were between 0.7 and 0.90 ml/g. This study is acceptable. (MRID 41063562)

In adsorption/desorption studies, a quinclorac degradate [^{14}C]3-chloro-8-quinoline-carboxylic acid (BH-514-1), was determined to be mobile to very mobile in sand, sandy loam, loam, clay loam, and silty clay soils. Freundlich K_{ads} values were 1.56 for the sand soil, 1.97 for the sandy loam soil, 11.4 for the loam soil, 13.3 for the clay loam soil, and 30.2 for the silty clay soil. The respective 1/n values were 0.95, 0.92, 0.87, 0.89, and 0.96. K_{oc} values were 860, 1210, 1300, 1780, and 2080 (mean = 1446 ml/g). In general, adsorption increased with increasing soil organic matter content (r=0.9174), CEC, and clay content. Freundlich K_{des} values were 0.22, 0.54, 0.12, 0.089, and 0.064 ml/g, respectively. <u>This study is acceptable</u>. (MRID 41063563)

<u>In summary</u>, based on the results of these studies, EFED concludes that quinclorac has the potential to leach and runoff in the soil environment and into groundwater. On the other hand, BH 514-1, the primary degradate of quinclorac, has the potential to leach to the groundwater in soil containing low amount of clay or organic matter. EFED notes that quinclorac and BH-514-1 are both carboxylic acids; therefore, they are expected to be anions under the normal environmental pH range (5.5-8.5). This suggests that these two chemicals have the potential to be mobile in mineral soils.

<u>Laboratory Volatility</u> (163-2)

The registrant submitted a waiver request (Nelsen, T. February 1991. Waiver request for a laboratory volatility study with quinclorac (FACET) Registration Document No. 91/5136. BASF Corp. RTP, NC. No MRID Number is available) for the laboratory volatility study with quinclorac. This waiver request was based on the reported vapor pressure of quinclorac of 1×10^{-7} mbar (0.76×10^{-7} mm Hg) at 20° C and the Henry's Law Constant of 1.22 to 24.3×10^{-15} $atm.m^3 mol^{-1}$. The registrant indicated that these two parameters indicate that there is no reasonable expectation of volatility and therefore they requested a waiver.

EFED granted a waiver for the laboratory volatility study (11/7/91), since the vapor pressure of quinclorac, reported to be 1×10^{-7} mbar (0.76×10^{-7} mm Hg) at 20° C, and Henry's Law Constant both indicate a low possibility of volatilization.

<u>Dissipation</u>

<u>Terrestrial Field</u> (164-1)

A field study conducted on bare ground plots in the wheat growing area of KS showed that quinclorac, when applied at a rate of 2.5 lb ai/A (6.6X maximum label rate), dissipated with EFED calculated half-lives of 10 and 40 days when applied in spring and winter, respectively. At this exaggerated rate, BH 514-2-OH was detected at a maximum concentration of 0.034 ppm (2.7% of applied) and BH 514-ME formed to a maximum concentration of 0.043 ppm (3.4% of applied). The study authors' reported DT_{50} values of 8 and 126 days for spring and winter applied quinclorac, respectively. However, these values were calculated from the total amount of quinclorac in the soil profile and should have been calculated from the amount of parent in the 0-6 inch soil depth (the zone of incorporation). All three quinclorac residues were detected with depth in the soil profile. Parent quinclorac was detected at a depth of 42-48 inches (maximum concentration 0.017 ppm (1.36% of applied) at 180 days). BH 514-2-OH was found at a maximum concentration of 0.019 ppm (1.52% of applied) at the 12-18 inch depth at 180 days. BH 514-ME was detected at a maximum concentration of 0.020 ppm (1.6% of applied) in the 6-12 inch depth at 21 days. The study authors proposed a route of degradation: Parent compound degrades to BH 514-2-OH and BH 514-ME. These compounds can then bind with or become incorporated into the soil or humic material of the soil as a part of natural soil components (i.e., carbon pool of soil), and/or can degrade to CO_2, a terminal product. The data indicate that leaching is a major route of quinclorac dissipation. <u>This study is acceptable</u>. (MRID 44342906)

Six field dissipation studies conducted on cropped and bare ground plots of turf cultivation (located in CA, MO and NJ) with quinclorac applied as two 0.90 lb ai/A applications (120% label rate) at a 21 day interval, dissipated with EFED calculated half lives of 53, 60, and 71 days in cropped plots in CA, MO, and NJ and 58, 59, and 176 days in bare ground plots, respectively. At this application rate, a maximum concentration of 0.078 ppm was detected for BH 514-2-OH. The study shows that quinclorac residues were detected at a depth of 24-30" inches in a CA turf plot (one replicate of 0.015 ppm at 30 days), in a MO turf plot (one replicate of 0.011 ppm at 30 days), and a MO bare soil plot (one replicate of 0.011 ppm at 30 days) at the concentration levels near the LOQ, and that no residues were detected below 30 inches. <u>This study is acceptable</u>. (MRID 44129203)

In two field dissipation studies conducted in IA and NC, ^{14}C-quinclorac, applied preemergence to corn at 0.5 lb ai/A, dissipated with half-lives of 42 (r=0.95) and 50 (r=0.79) days, respectively. Soil analyses of the NC plots indicated that quinclorac residues had reached the 9-12 inch soil depth (0.03 ppm) 16 days after treatment (DAT) and to the 12-18 inch depth (0.01 ppm) 205 (DAT) in the 0.5 lb ai/A treatment. Similarly, in the 1.0 lb ai/A treatment, quinclorac residues had penetrated to a depth of 0.02 ppm 205 DAT. In the IA plots quinclorac residues were not found below the 9-12 inch soil depth (0.02 ppm at 60 days) at any sampling time. Crop residues were also analyzed for TRR only. The TRR residues for NC forage were (0.236 ppm at 58 DAT), fodder (0.220 ppm at 113 DAT), grain (0.297 ppm at 113 DAT), and roots (0.285 ppm at 113 DAT). Conversely, at the IA plots TRR in the various plant parts ranged from 0.007 to 0.051 ppm. <u>The studies are supplemental</u> (material balance was too variable, recovery efficiencies were not provided, the samples were composited). (MRID 41432101)

In five field dissipation studies conducted on turf sites in Oregon, Georgia, New Jersey, Missouri and California, quinclorac was applied at a maximum of 2.0 lb ai/A. The resulting dissipation half-lives were reported to be 18, 36, 44, 50 and 166 days with coefficients of determination (R^2) ranging from 0.70 to 0.94. The authors did not speculate on the route of quinclorac degradation. In general, quinclorac was not detected below the 12 inch soil depth. However, in those cases where quinclorac was detected below 12 inches, the authors attributed this to contamination. EFED notes that, given the low K_d values reported for quinclorac (<1.0), it is feasible that leaching below 12 inches occurred. EFED notes that in these studies it was uncertain if sufficient water was applied to the plots for leaching to occur. These studies are supplemental (no route of dissipation provided, contamination of control plots, interception by turf not accounted for, variable recoveries of fortified samples). (MRID 41403505)

Aquatic Field (164-2)

In three aquatic field dissipation studies performed in three states, quinclorac was applied at a rate of 0.5 lb ai/A directly to flooded (California, Mississippi and Texas) and nonflooded (and then flooded after treatment, Mississippi and Texas) plots. The resulting dissipation half-lives were reported to vary from 7.1 to 10 days in the flood water and 36 (MS), 54 (CA) and 70 (TX) days in soil. The studies are supplemental (sampling was inadequate, degradates were not analyzed for, and application rate not confirmed) (MRID 41063564)

^{14}C-quinclorac applied at a rate of 0.5 lb ai/A to soil contained in large outdoor containers, had a half-life in soil + water of 60 days (r^2=0.7411) when the treatment was applied to soil and then flooded 5 days later; while the half-life in the soil + water in the treatment that was applied to the flood water was 43 days (r^2=0.9258). In both experiments, essentially all of the radioactivity in the flood water was parent quinclorac. This suggests that quinclorac can desorb from the soil (when soil applied and then flooded), thereby allowing photolysis of quinclorac to occur. However, EFED notes that from 10 days after flooding the amount of quinclorac in the soil had decreased from 99.8 to 51.6%. From 10 to 91 days after flooding the amount of parent in the soil gradually decreased to 43.7% of the applied. This indicates that although there may be rapid desorption initially during the first 10-15 days, the rate of desorption decreases, perhaps reaching a "steady state" condition resulting in an increase in the persistence of the parent in the soil/water system. The half-lives in the flood water of the plots were 19 (r^2=0.9533) and 24 days (r^2=0.8297). These studies are supplemental. (MRID 42294107, 42786403)

In order to determine the extent to which the ^{14}C-residues produced during the above confined outdoor aquatic field dissipation study would desorb from the soil and to characterize the residues that study author used various solvents and NaOH. The concentration of ^{14}C-residues in the soil decreased with soil depth. At the 4-6" depth, the concentration was 0.044 (11.5% TRR) and 0.037 ppm (8.6%TRR) for the nonflooded and flooded treatments, respectively. Conversely, the majority of residues remained in the 0-2" depth, since the % TRR was 49.3 and 77.6, respectively, for the nonflooded and flooded treatments. The authors suggest that the results indicate that the majority of the ^{14}C-residues in the soil following the application and dissipation of quinclorac in a rice cropping system will remain in the upper soil layers and not leach to a lower depth. In general the amounts of residues desorbed are small, but they increase with increasing polarity of the desorption solvent. The least desorption was observed with the nonpolar solvents hexane and DCM (0.003 ppm maximum amount desorbed); the highest levels of residues were desorbed by water, $CaCl_2$ and NaOH (0.016 ppm maximum amounts desorbed).

There was a much greater amount of ^{14}C-residues released from the soil by refluxing with NaOH. The amounts released were highest in the 0-2" depth at 0.121 and 0.060 ppm for the nonflooded and flooded treatments, respectively. The lowest concentrations were released from the 4-6" depth. The results indicate that a large portion of the ^{14}C-residues in soil is adsorbed and/or absorbed to the soil humic material and released when the humic material is solubilized by refluxing with NaOH.

<u>The study is scientifically valid and provides supplemental information</u> that indicates a significant portion of quinclorac residues remaining in the soil 216 days after application are associated with the humic material in soil and may strongly bind to the soil following an application of quinclorac. (MRID 42294105)

In two other aquatic field dissipation studies quinclorac was applied at a rate of 0.5 lb ai/A to fields in MS and LA either before flooding or after flooding. In Louisiana, quinclorac dissipated with overall half-lives of 19 and 27 days when soil and water residues were combined, respectively, when applied to flood water or directly to soil (and then flooded five days later). The half-life of quinclorac in water when applied directly to a flooded field was 5 days; while the half-life was 12 days when applied directly to the soil and then flooded 5 days later. The half-life of quinclorac in soil was approximately 50 days regardless of when flooding occurred. No residues of BH 514-1, the primary degradate of quinclorac, were found in any sample analyzed. Except for one detection (0.015 ppm, which EFED attributes to sample mix up) in one replicate in a 6-12 inch soil section, no quinclorac residues were detected in the deeper core sections sampled to 48 inches at the termination of the study.

In Mississippi, quinclorac dissipated with overall half-lives of 10 and 39 days when soil and water residues were combined, respectively, when applied to flood water or directly to soil (and then flooded five days later). The half-life of quinclorac in water when applied directly to a flooded field was 5 days; while the half-life was 12 days when applied directly to the soil and then flooded 5 days later. The half-life of quinclorac in soil was approximately 48 days when applied directly to flood water and 114 days when applied directly to soil and then flooded 5 days later. No residues of BH 514-1, the primary degradate of quinclorac, were found in any sample analyzed. When the soil was flooded five days after treatment, the residue analysis of the 48" soil cores indicated residues still present in the 0-6" soil depth 180 (0.052 ppm), 240 (0.037 ppm) and 360 (0.013 ppm) days after treatment. No quinclorac residues were detected at concentrations >0.01 ppm in any of the deeper core sections sampled to 48 inches.

EFED notes that soils used for rice culture are of very limited permeability. In fact, this probably is the main characteristic used in selecting a soil in which to grow rice, since rice production in soils which do not maintain a flood are not economically feasible under the present financial conditions. Therefore, it is not surprising that no detectable concentrations of quinclorac were detected below the 6 inch soil depth sampled.

In both studies, when quinclorac was applied directly to flood water, almost 90% had dissipated by 30 days; however, when applied directly to soil and then flooded, almost 90% had dissipated by 90 days. This shows that quinclorac probably dissipates more rapidly when applied to flood water. <u>The aquatic field dissipation studies are acceptable</u>. (MRID 42294106, 42294107, 42786402)

Accumulation

Confined Accumulation in Rotational Crops (165-1)

The available rotational crop accumulation data were received and reviewed by EFED prior to the transfer of this data requirement to the Health Effects Division. Consequently, EFED has elected to provide comment on the available data.

Application rates of 0.5 and 1.0 lb ai/A ^{14}C-quinclorac were made to 4 ft. x 8 ft plots of soil in which corn was growing and then 309 days later rotational crops (beets, chard and wheat) were planted. The concentration of parent quinclorac was between 0.001 to 0.025 ppm and <0.001 ppm (wheat forage) to 0.110 ppm (chard) in the crops treated with 0.5 and 1.0 lb ai/A, respectively; while the concentration of the methyl ester metabolite was <0.007 ppm, regardless of application rate. No other radioactive residues were identified that exceeded 10% TRR or 0.01 ppm. Concentration of parent quinclorac in the soil, at the time the crops were harvested were 0.01 and 0.024 ppm. <u>This study is acceptable</u>. (MRID 41432101, 42294108)

In another confined accumulation study, pre- and postemergence applications of ^{14}C-quinclorac (0.45 and 0.47 lb ai/A) were applied to sorghum plants, growing in a 4 ft. x 8 ft. x 4 ft. container outdoors, and then 132 days after the preemergence application (107 days after the last application), rotational crops (mustard, turnips and barley) were planted in the container. The concentration of parent quinclorac in the soil at the time of planting was about 0.048 ppm. The concentration of parent quinclorac in the various crops was between 0.010 ppm (turnip root) to 0.129 ppm (turnip greens), while the concentration of the methyl ester was between <0.001 ppm (barley straw and seed) to 0.009 ppm (turnip greens). No other radioactive residues were identified that exceeded 10% TRR or 0.01

ppm. At the time of harvest (396 days after application), the concentration of parent quinclorac in the soil was about 0.006 ppm. <u>This study is supplemental</u> (application rate not verified and soil samples were not sampled from the same depth at all sampling times). (MRID 42294109)

Field Accumulation in Rotation Crops (165-2)

Studies were conducted in CA, LA and MS in rice fields by applying 0.5 ai/A before and after flooding. After the rice crop was harvested, rotational crop (mustard, turnips, wheat, sorghum, soybeans) were planted (105-131 days or 252-327 days after treatment) into the harvested rice plots. Quinclorac was not detected in any of the rotational crops planted (<0.05 ppm). <u>The studies are unacceptable</u> (application rate not confirmed, soils were sampled 0-12 inches and composited, questionable storage stability data). (MRID 41063569-71)

Accumulation in Fish (165-4)

[^{14}C]Quinclorac residues did not accumulate in channel catfish exposed to 1 ppm [^{14}C]quinclorac in a flow-through system for 28 days. Maximum concentrations were 0.80, 0.86, and 0.6 ppm in whole fish, nonedible, and edible tissue, respectively. During the depuration period [^{14}C]residues were not detected (<0.013 ppm) in the aquarium water. <u>This study is acceptable</u>. (MRID 40320819)

<u>Spray Drift</u>

Droplet Size Spectrum (201-1)

The registrant, BASF, is a member of the Spray Drift Task Force (SDTF). The SDTF has completed and submitted to the Agency a series of studies intended to characterize spray droplet drift potential due to various factors, including application methods, application equipment, meteorological conditions, crop geometry and droplet characteristics. EFED has completed its review of these studies and is currently addressing scientific issues identified in peer review mechanisms including the FIFRA Scientific Advisory Panel (aerial field studies and physical properties and atomization data) and open data review workshops. After addressing the issues identified in the peer review, the Agency will determine whether a reassessment is warranted of the potential risks from drift of quinclorac to nontarget organisms.

Drift-Field Evaluation (202-1)

Limited quinclorac-specific spray drift studies were reviewed. The studies indicated that foliar injury to tomatoes plants (that were placed in the field downwind from application site) occurred at 1980 ft. (No MRID, DP Barcode 250179). Additional data which may be related to quinclorac have been submitted by the Spray Drift Task Force (see above).

SURFACE WATER ASSESSMENT

The GENEEC model was used to estimate surface water concentrations for quinclorac. The modeling results indicate that quinclorac has the potential to move into surface waters, especially in areas with large amounts of annual rainfall and the potential for runoff.

Table 3 presents the results of GENEEC modeling for aerial and ground spray applications of quinclorac for both the Paramount™ and Paramount™ BW products applications. The Paramount™ values are based on an assumption of two applications of quinclorac (0.375 lb ai/acre) with an interval of 3 months (90 days) or an interval of 14 days between applications. The 3-month interval was assumed to be the typical interval, based on continuous sorghum propagation. Taking Kansas as an example state for sorghum propagation, planting typically occurs in June and harvesting occurs in October (*Usual Planting and Harvesting Dates for U.S. Field Crops*, United States Department of Agriculture, Agriculture Handbook Number 628). Because quinclorac is to be used from emergence to crop height of 12 inches, the first application may occur as late as July. Because quinclorac must be used post harvest for bindweed control before the first frost, the second annual application was assumed to occur late in September. The 14-day interval was based on a rare but conservative scenario (personal communication between E. Odenkirchen, OPP and T. Nelsen, BASF, January 21, 1999) in which two closely spaced applications of Paramount™ were necessary for weed control on the post-emergent sorghum crop.

The Paramount™ BW values are based on an assumption of one annual application of quinclorac (0.245 lb ai/acre).

GENEEC is a screening model designed by the Environmental Fate and Effects Division (EFED) to estimate the concentrations found in surface water for use in ecological risk assessment. As such, it is often considered to provide upper-bound values on the concentrations that might be found in ecologically sensitive environments because of the use of a pesticide. It was designed to be simple to use and to only require data which is typically available early in the pesticide registration process. GENEEC is a single event model (one runoff event), but can account for spray drift from multiple applications. GENEEC is hardwired to represent a 10-hectare field immediately adjacent to a 1-hectare pond that is 2 meters deep with no outlet. The pond receives a spray drift event from each application plus one runoff event. The runoff event moves a maximum of 10% of the applied pesticide into the pond. This amount can be reduced due to degradation on the field and the effects of soil binding in the field. Spray drift is equal to 1 and 5% of the applied rate for ground and aerial spray application, respectively. In the case of quinclorac, a stable compound with potentially high mobility, water concentrations estimated using the GENEEC model may not actually represent upper bound concentrations. Indeed, second Tier surface water modeling using EFED's other model programs PRZM and EXAMS may result in higher estimated water concentrations than those predicted by GENEEC.

GENEEC is not an ideal tool for drinking water risk assessments. Surface-water-sourced drinking water tends to come from bodies of water that are substantially larger than a 1-hectare pond. Furthermore, GENEEC assumes that essentially the whole basin receives an application of the chemical. In virtually all cases, basins large enough to support a drinking water facility will contain a substantial fraction of area that does not receive the chemical. Furthermore, there is always at least some flow (in a river) or turn over (in a reservoir or lake) of the water so the persistence of the chemical near the drinking water facility is usually over estimated by GENEEC. Given all this, GENEEC does provide an upper bound on the concentration of pesticide that could be found in drinking water and therefore can be appropriately used in screening calculations. If a risk assessment performed using GENEEC output does not exceed the level of concern, then one can be reasonably confident that the risk will also be below the level of concern. However, since GENEEC can substantially overestimate true drinking water concentrations, it will be necessary to refine the GENEEC estimate if the level of concern is exceeded. The input values for GENEEC are listed in Table 4. GENEEC version 1.2 dated May 3, 1995 was used for the calculations.

Table 3. Estimated Environmental Concentrations

Product/ Application Method	Interval (days)	Peak (µg/L)	4 days (µg/L)	21 days (µg/L)	56 days (µg/L)
Paramount™/Aerial	90	40.28	40.27	40.23	40.17
	14	40.28	40.27	40.23	40.17
Paramount™/ Ground Spray	90	40.20	40.20	40.16	40.10
	14	40.20	40.20	40.16	40.10
Paramount™ BW/ Aerial	none	13.16	13.15	13.14	13.11
Paramount™ BW/ Ground Spray	none	13.13	13.13	13.12	13.10

Table 4. GENEEC Environmental Fate Input Parameters for Quinclorac

Input Parameter	Value	Data Assessment	Source
Method of Application	Both products: aerial or ground spray	Verified	Label
Application Rate	Paramount™ 0.375 lb ai/A Paramount DW 0.245 lb ai/A	Verified	Label
Maximum Number of Applications	Paramount™: 2 Paramount DW: 1	Verified	Label
Interval Between Applications	Paramount™ 14 and 90 days	Verified	Label
Batch Equilibrium (Koc)	13 ml/g	Acceptable	MRID 41063562
Aerobic Soil Metabolism	Stable (input set at 0)	Acceptable	MRID 41247301
Solubility	891 ppm	Acceptable	Reported by registrant
Aerobic Aquatic Metabolism	Stable (input set at 0)	Acceptable	MRID 42294102
Hydrolysis	Stable (input set at 0)	Acceptable	MRID 40320816
Photolysis	Stable (input set at 0)	Acceptable	MRID 41063560 41781406

A revised drinking water assessment, reflecting the current surface water modeling results is included as Appendx B of this document.

GROUND WATER ASSESSMENT

No data on quinclorac residues in ground water are readily available. No Maximum Contamination Limit (MCL) or Health Advisory (HA) has been established for quinclorac residues in drinking water (USEPA, 1996).

Table 5 shows the input parameter values used in SCI-GROW for quinclorac as well as the resulting estimated groundwater concentration.

Table 5. SCI-GROW Environmental Fate Input Parameters for Quinclorac

Input Parameter	Value
Median K_{oc} (l/kg)	38.0
Application Rate (lb a.i. $acre^{-1}$)	0.375
Number of Applications	2
Use Rate (Maximum total/season)	0.75
Aerobic Soil Metabolism half-life (days)	1500[1]
Estimated Groundwater Concentration (ppb)	164.8

[1]A value of 1500 is predicated on acceptable studies suggesting compound stability and a recommendation by the EFED Risk Review Panel that a value of 1500 represents a conservative maximum assumption of stability in the model.

EFED estimates a drinking water exposure concentration of 164.8 ppb for quinclorac as predicted by SCI-GROW modeling results.

There may be exceptional circumstances under which groundwater concentrations could exceed the SCI-GROW estimates. However, such exceptions should be quite rare since the SCI-GROW model is based exclusively on maximum groundwater concentrations from studies conducted at sites and under conditions which are most likely to result in groundwater contamination. The groundwater concentrations generated by SCI-GROW are based on the largest 90-day average recorded during the sampling period. Since there is relatively little temporal variation in groundwater concentrations compared to surface water, the concentration (164.88 ppb) can be considered as both the acute and chronic values.

A revised drinking water assessment, reflecting the results of this groundwater assessment are included as Appendix B to this document.

TOXICOLOGICAL CHARACTERIZATION

Quinclorac is a quinoline carboxylic acid. The mechanism of herbicidal action is generally similar to the mechanism for the phenoxy herbicides (i.e., mimicry of the plant growth hormone auxin).

Toxicity to Terrestrial Animals

Acute and Subacute Avian Toxicity

An acute oral toxicity study using the technical grade of the active ingredient is required to establish the toxicity of a pesticide to birds. The preferred test species is either mallard (a waterfowl species) or northern bobwhite (an upland gamebird). Results of these tests are listed in Table 6. The most sensitive species is the mallard duck (LD_{50} >1900 mg/kg, LD_{50} value expressed on a bodyweight-based dose), which will serve as the toxicological endpoint in avian single oral dose exposure risk calculations.

Table 6. Avian Acute Oral Toxicity Data

Species	% Active Ingredient	LD_{50} (confidence limits) (mg/kg-bw)	MRID No.	Classification
Northern bobwhite quail *Colinus virginianus*	98	>2000 (no mortality at 2000)	41063547	core
Mallard duck *Anas platyrhynchos*	98	>1900 (no mortality at 970, 20% mortality and convulsions at 1900)	40320810	supplemental*

LD_{50}: Lethal dose to 50% of test population
NOAEL: No observed adverse effect level
* listed as supplemental due to questionalbe husbandry practices (e.g., the necks of ducks bound with bands to prevent regurgitation)

Two subacute dietary studies using the technical grade of the active ingredient are required to establish the toxicity of a pesticide to birds. The preferred test species are mallard (a waterfowl species) and northern bobwhite (an upland gamebird). Results of these tests are listed in Table 7. The LC_{50} of >5000 mg/kg-diet exhibited for both northern bobwhite quail and the mallard duck will serve as the basis of the toxicological endpoint for subacute dietary exposure risk calculations.

Table 7. Avian Subacute Dietary Toxicity Data

Species	% Active Ingredient	LC_{50} (confidence limits) (mg/kg-diet)	MRID No.	Classification
Northern bobwhite quail *Colinus virginianus*	96	>5000 (no mortality to 2500)	40320812	core
Mallard duck *Anas platyrhynchos*	96	>5000 (no mortality to 5000)	40320811	core

LC_{50}: Lethal dietary concentration to 50% of test population
NOAEC: No observed adverse effect concentration

Chronic Avian Exposure Effects

Avian reproduction studies using the technical grade of the active ingredient are required when any one of the following conditions are met: (1) birds may be subject to repeated or continuous exposure to the pesticide, especially preceding or during the breeding season; (2) the pesticide is stable in the environment to the extent that potentially toxic amounts may persist in animal feed; (3) the pesticide is stored or accumulated in plant or animal tissues; and/or (4) information derived from mammalian reproduction studies indicates reproduction in terrestrial vertebrates may be adversely affected by the anticipated use of the product. Quinclorac satisfies conditions 1 through 3. The preferred test species are mallard and northern bobwhite.

The results of avian reproduction tests are listed in Table 8. The northern bobwhite reproduction NOAEL of 500 mg/kg-diet serves as the reproduction toxicity endpoint for avian reporduction risk calculations. This NOAEL is established with respect to the most sensitive toxicity endpoint observed for the study, reduced survival of 14-day old hatchlings from eggs set.

Table 8. Avian Reproduction Toxicity Data

Species	% Active Ingredient	LOAEC (mg/kg-diet)	NOAEC (mg/kg-diet)	MRID No.	Classification
Northern bobwhite quail *Colinus virginianus*	99.19	1000 (reduced 14 day survivors of egg set)	500	44129201	core
Mallard duck *Anas platyrhynchos*	99.19	>1000	1000	44084501	core*

LOAEC: Lowest observed adverse effect concentration
NOAEC: No observed adverse effect concentration
*classifiable as core for this risk assessment as highest dose exceeds maximum expected environmental concentration

Acute and Chronic Mammalian Toxicity

Acute mammalian toxicity data are summarized in Table 9. The most sensitive acute endpoint is for the laboratory rat (Wistar strain), with a minimum LD_{50} of 2190 mg/kg bodyweight.

Table 10 summarizes the reproduction, and developmental toxicity data for laboratory mammals chronically exposed to quinclorac. For the purposes of this risk assessment, the rat 2-generation reproduction study NOAEL of 160 mg/kg-bw/day for reduced pup viability was selected as the threshold for mammals chronically exposed to quinclorac. This value is quite similar to the threshold for rabbit developmental data, in which the NOAEL for increased fetal resorptions was 200 mg/kg-bw/day.

Table 9. Mammal Acute Toxicity Data

Species	% Active Ingredient	LD_{50} (mg/kg)	MRID No.	Classification
Rat (Wistar)	technical	male: 3060 female: 2190	41063506	core
Mouse (B6C3F1)	technical	>2000	41063507	core

LD_{50}: Lethal dose to 50% of test population
NOAEL: No observed adverse effect level

Table 10. Mammal Chronic, Reproduction, and Developmental Toxicity Data

Species	% Active	Duration/ Study Type	LOAEL (mg/kg-diet) or (mg/kg-bw/day)	NOAEL (mg/kg-diet) or (mg/kg-bw/day)	MRID No.	Classification
Rat (Wistar)	96.5	3 month feeding	12000 mg/kg-diet slight nephritis	4000 mg/kg-diet	41063516	supplemental
Rat (Wistar)	96.5	Developmental		>438 mg/kg-bw/day	41063524	minimum
Rabbit (Chbb:HM)	98.3	Developmental	600 mg/kg-bw/day increased fetal resorptions	200 mg/kg-bw/day	41063525	minimum
Rat (Wistar)	97.40-98.3	2 generation reproduction	480 mg/kg-bw/day reduced pup viability	160 mg/kg-bw/day	41063526 41910001	minimum

LOAEL: Lowest observed adverse effect level
NOAEL: No observed adverse effect level

Beneficial Insect Toxicity

A honey bee acute contact study using the technical grade of the active ingredient is required if the proposed use will result in honey bee exposure. Results of these tests are listed in Table 11.

The results indicate that technical quinclorac and the 50% formulation are relatively non-toxic to bees on an acute contact basis. The guideline requirements (141-1) are fulfilled (MRID 427702-33 and 434928-45).

Table 11. Beneficial Insect Toxicity Data

Species	% Active Ingredient	LD_{50} (μg/bee)	NOAEL (μg/bee)	MRID No.	Classification
Honeybee *Apis mellifera*	98	>357	238	41063575	core
Honeybee *Apis mellifera*	50	>181	<60.4 (lowest dose tested)	41063576	core

LD_{50}: Lethal dose to 50% of test population
NOAEL: No observed adverse effect level

Toxicity to Aquatic Animals

Freshwater Fish Acute Toxicity

Two freshwater fish toxicity studies using the technical grade of the active ingredient are required to establish the toxicity of a pesticide to freshwater fish. One study should use a coldwater species (preferably the rainbow trout), and the other should use a warmwater species (preferably the bluegill sunfish). The results of these tests are listed in Table 12.

The results indicate that quinclorac is slightly toxic to fish on an acute basis. The guideline requirement (72-1) is fulfilled. The bluegill sunfish LC_{50} of 31.6 mg/L is used as the acute freshwater toxicity endpoint for the risk assessment.

Table 12. Freshwater Fish Acute Toxicity Data

Species	% Active Ingredient	LC_{50} (confidence limit) (mg/L)	MRID No.	Classification
Bluegill sunfish *Lepomis macrochirus*	96	31.6 (26.7-39.6)	41063555	core
Rainbow trout *Oncorhynchus mykiss*	96	>83.5 (no mortality at highest dose tested)	41063548	core

LC_{50}: Lethal concentration to 50% of test population
NOAEC: No observed adverse effect concentration

Freshwater Fish Toxicity from Chronic Exposure

Table 13 summarizes the available freshwater fish toxicity data from chronic exposure.

Table 13. Freshwater Fish Chronic Toxicity Data (Early Life Stage Study)

Species	% Active Ingredient	LOAEC (mg/L)	NOAEC (mg/L)	MRID No.	Classification
Fathead minnow *Pimephales promelas*	technical	31 (larval growth)	16	44084502	core

LOAEC: Lowest observed adverse effect concentration
NOAEC: No observed adverse effect concentration

Freshwater Invertebrate Acute Toxicity

A freshwater aquatic invertebrate toxicity test using the technical grade of the active ingredient is required to assess the toxicity of a pesticide to freshwater invertebrates. The preferred test organism is *Daphnia magna*, but early instar amphipods, stoneflies, mayflies, or midges may also be used. Results of invertebrate toxicity testing are listed in Table 14. The results indicate that quinclorac is slightly toxic to aquatic invertebrates on an acute basis. The guideline requirement (72-2) is fulfilled.

The *Daphnia magna* EC_{50} of 29.8 mg/L serves as the freshwater invertebrate toxicity endpoint for risk assessment.

Table 14. Freshwater Invertebrate Acute Toxicity Data

Species	% Active Ingredient	EC_{50} (confidence limit) (mg/L)	MRID No.	Classification
Daphnia magna	96	29.8 (23.8-42.4)	41063556	core

EC_{50}: Effective concentration to 50% of test population
NOAEC: No observed adverse effect concentration

Freshwater Invertebrate Toxicity from Chronic Exposure

Data for freshwater invertebrate chronic toxicity are listed in Table 15. The guideline requirement (72-4) is fulfilled.

The *Daphnia magna* 21-day NOAEC of 110 mg/L is used as the freshwater invertebrate toxicity endpoint for chronic exposure. It should be noted that the 21-day NOAEC unexpectedly exceeds the 48-hour EC_{50} for the same species. This observation is likely the result of differences in test water conditions, or as the result of surfactant use in the acute toxicity test. As quinclorac is an acid subject to dissociation in water, differences in water hardness may influence the toxicity of the compound. The available data suggest that quinclorac is more toxic to freshwater invertebrates in soft water (48-hour LC_{50}= 28.9 mg/l in water 40-48 mg $CaCO_3$/L) compared to harder water (21-day NOAEC 110 mg/l in water >150 mg $CaCO_3$/L). An alternative explanation for the disparate toxicity results may be the presence of surfactant in the acute test, whereas no surfactant is evident for the chronic test. The use of the available 21-day chronic data as the toxicity endpoint for all freshwater systems represents an uncertainty.

Table 15. Freshwater Invertebrate Chronic Toxicity Data (21-day life cycle test)

Species	% Active Ingredient	LOAEC (mg/L)	NOAEC (mg/L)	MRID No.	Classification
Daphnia magna	technical	>110	110	44129202	core

LOAEC: Lowest observed adverse effect concentration
NOAEC: No observed adverse effect concentration

Estuarine and Marine Animal Acute Toxicity

Table 16 summarizes the data available for quinclorac effects on estuarine and marine animals. For the purposes of this risk assessment, the sheepshead minnow NOAEC of 94.4 mg/L will be used as the acute toxicity threshold for estuarine/marine fish and the mysid EC50 of 69.4 will serve as the threshold for estuarine/marine invertebrates.

Table 16. Estuarine and Marine Animal Acute Toxicity Data

Species	% Active Ingredient	EC_{50}/LC_{50} (confidence limit) (mg/L)	MRID No.	Classification
Sheepshead minnow *Cyprinodon variegatus*	96	>94.4 (no mortality at highest dose)	41063549	core
Quahog clam *Mercenaria mercenaria*	96	>96.1 (26% reduction in number of normal larvae at highest dose)	41063552	core
Mysid *Mysidopsis bahia*	96	69.4 (50.4-118)	41063553	core
Blue crab *Callinectes sapidus*	96	>94.4 (no mortality at highest dose)	41063551	supplemental*

LC_{50}: Lethal concentration to 50% of test population
EC_{50}: Effective concentration to 50% of test population
NOAEC: No observed adverse effect concentration
*not listed acceptable test species

Estuarine and Marine Animal Toxicity from Chronic Exposure

No data are available for the toxicity of quinclorac to estuarine and marine animals following chronic exposures. The significance of this lack of data is discussed in the risk characterization.

Toxicity to Plants

Terrestrial Plant Toxicity

Table 17 summarizes the available data for the effects of quinclorac on terrestrial plants. The toxicological threshold for seedling emergence used in the risk assessment is based on the carrot EC_{25} of 0.004 lb ai/acre. The toxicological threshold for vegetative vigor used in the risk assessment is based on the tomato EC_{25} of 0.007 lb ai/acre.

Table 17. Terrestrial Plant Toxicity Data

Species	% Active Ingredient	Test Type	EC_{25} (lb ai/acre)	NOAEL (lb ai/acre)	MRID No.	Classification
Soybean *Glycine max*	96	SE	0.047	<0.047	41403501	core
	96	VV	0.203	0.125	41403503	core
Lettuce *Lactuca sativa*	96	SE	0.013	<0.01	41403501	core
	96	VV	0.01	<0.01	41403503	core
Carrot *Daucus carota*	96	SE	0.004	<0.004	41403501	core
	96	VV	0.027	0.02	41403503	core
Tomato *Lycopersion esculentum*	96	SE	0.026	0.02	41403501	core
	96	VV	0.007	0.005	41403503	core
Cucumber *Cucumis sativus*	96	SE	0.012	<0.012	41403501	core
	96	VV	0.028	0.012	41403503	core
Cabbage *Brassica oleracea*	96	SE	0.162	0.125	41403501	core
	96	VV	26.0	2.0	41403503	core
Oat *Avena sativa*	96	SE	0.771	<0.77	41403501	core
	96	VV	68.3	2.0	41403503	core
Ryegrass *Lolium perenne*	96	SE	0.271	<0.27	41403501	core
	96	VV	>2.0	2.0	41403503	core
Corn *Zea mays*	96	SE	0.211	<0.211	41403501	core
	96	VV	1.09	0.5	41403503	core
Onion *Allium cepa*	96	SE	0.118	<0.118	41403501	core
	96	VV	12.33	2.0	41403503	core

SE: seedling emergence
VV: vegetative vigor
EC_{25}: Effective concentration for 25% reduction in emergence or growth measures
NOAEL: no observed adverse effect level

Aquatic Plant Toxicity

Table 18 summarizes the available aquatic plant toxicity data for quinclorac

Table 18. Aquatic Plant Toxicity Data

Species	% Active Ingredient	EC_{50} (mg/L)	NOAEC (mg/L)	MRID No.	Classification
Freshwater diatom *Navicula pelliculosa*	96	>0.5	0.5	41063574	core
Green alga *Selenastrum capricornutum*	96	>0.5	0.5	41063574	core
Marine diatom *Skeletonema costatum*	96	>0.5	0.5	41063574	core
Duckweed *Lemna gibba*	96	>0.5	0.5	41063574	core
Bluegreen alga *Anabaena flos-aquae*	96	>0.5	0.5	41063574	core

EC_{50}: Effective concentration for 50% inhibition
NOAEC: No observed adverse effect concentration

EXPOSURE ASSESSMENT

Terrestrial Avian and Mammalian Exposure Assessment

For pesticides applied as a nongranular product (*e.g.*, liquid, dust), the estimated environmental concentrations (EECs) on food items following product application are compared to LC50 values to assess risk. The predicted 0-day maximum and mean residues of a pesticide that may be expected to occur on selected avian or mammalian food items immediately following a direct single application at 1 lb ai/A are in Table 19.

Table 19. Estimated Environmental Concentrations for Avian and Mammalian Food Items (ppm) Following a Single Application at 1 lb ai/A)

Food Items	EEC (ppm) Predicted Maximum Residue[1]	EEC (ppm) Predicted Mean Residue[1]
Short grass	240	85
Tall grass	110	36
Broadleaf/forage plants and small insects	135	45
Fruits, pods, seeds, and large insects	15	7

[1] Predicted maximum and mean residues are for a 1 lb ai/a application rate and are based on Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994).

The residues predicted for an application at 1 lb ai/acre are modified by multiplying by the actual application rate for the subject active ingredient. Table 20 presents the estimated environmental concentrations (EECs) used in the avian and mammalian risk assessments. It should be noted that EFED elected to use the maximum annual application rate as a worst-case assessment of exposure to terrestrial mammals and birds for the Paramount™ product. This decision is predicated on the possibility of a short interval between applications (minimum 14 days), a mechanism of action that suggests the compound crosses leaf surfaces, observations that the compound can be accumulated in plants across the root, stability to hydrolysis aerobic soil metabolism, and the uncertainty surrounding the stability of the compound to photolysis.

Table 20. Estimated Environmental Concentrations (EECs) of Quinclorac for Avian and Mammalian Food Items (ppm)[1]

Product	Application Rate (lb ai/acre)	Food Item	Predicted Maximum Residue (ppm) at 1 lb ai/acre	Predicted Maximum Residue (ppm) at Labeled Application Rate[2]
Paramount™	0.75	Short grass	240	180.0
		Tall grass	110	82.5
		Broadleaf/forage plants and small insects	135	101.3
		Fruits, pods, seeds, and large insects	15	11.3
Paramount™BW	0.25	Short grass	240	60.0
		Tall grass	110	27.5
		Broadleaf/forage plants and small insects	135	33.8
		Fruits, pods, seeds, and large insects	15	3.8

[1] single application is conservatively assumed to be at maximum annual application rate
[2] residue = (residue @ 1 lb ai/acre)(labeled application rate)

For the assessment of avian risks, exposures were based directly on the dietary concentrations summarized in Table 20 because toxicity endpoints are expressed as concentrations in diet. However, the mammalian toxicity endpoints selected as the basis for assessing risks are expressed as either a single or daily oral dose. Therefore, the dietary concentrations in Table 20 must be converted to an oral dose before comparison with the toxicity endpoints can be made. EFED elected to use the most conservative mammalian model commonly used in assessing pesticide risks, that of a 15 g (0.015 kg) herbivore/insectivore that daily consumes 95% of its bodyweight as fresh-weight diet (0.0143 kg). The resulting equation for conversion to daily oral dose is as follows:

$$\text{conservative mammal daily oral dose} = (\text{EEC mg/kg})(0.0143\ \text{kg})/0.015\ \text{kg}$$

Table 21 summarizes the mammalian exposures converted to daily oral dose.

Table 21. Estimated Mammalian Oral Dose Levels[1]

Product	Application Rate (lb ai/acre)	Food Item	Predicted Maximum Residue (ppm) at Labeled Application Rate	Oral Dose (mg/kg-bw/day)
Paramount™	0.75	Short grass	180.0	171.6
		Tall grass	82.5	78.7
		Broadleaf/forage plants and small insects	101.3	96.5
		Fruits, pods, seeds, and large insects	11.3	10.7
Paramount™BW	0.25	Short grass	60.0	57.2
		Tall grass	27.5	26.2
		Broadleaf/forage plants and small insects	33.8	32.2
		Fruits, pods, seeds, and large insects	3.8	3.6

[1] single application is conservatively assumed to be at maximum annual application rate

Aquatic Organism Exposure Assessment

The GENEEC estimated environmental concentrations (EECs) serve as the exposure estimates for freshwater, estuarine, and marine organisms. The peak EEC is selected to represent exposures for acute effect risks. The 56-day and 21-day average EECs serve as the exposures for chronic effects to fish and invertebrates, respectively. These values are summarized in Table 22.

The Paramount™ values are based on an assumption of two applications of quinclorac (0.375 lb ai/acre) with an interval of 3 months (90 days) or an interval of 14 days between applications. The 3-month interval was assumed to be the typical interval, based on continuous sorghum propagation. Taking Kansas as an example state for sorghum propagation, planting typically occurs in June and harvesting occurs in October (*Usual Planting and Harvesting Dates for U.S. Field Crops*, United States Department of Agriculture, Agriculture Handbook Number 628).

Because quinclorac is to be used from emergence to crop height of 12 inches, the first application may occur as late as July. Because quinclorac must be used post harvest for bindweed control before the first frost, the second annual application was assumed to occur late in September. The 14-day interval was based on a rare but conservative scenario (personal communication between E. Odenkirchen, OPP and Nelsen, BASF, January 21, 1999) in which two closely spaced applications of Paramount™ were necessary for weed control on the post-emergent sorghum crop.

The Paramount™ BW values are based on an assumption of one annual application of quinclorac (0.245 lb ai/acre).

Table 22. Estimated Environmental Concentrations for Aquatic Organisms

Product/ Application Method	Interval (days)	Peak (µg/L)	21 days (µg/L)	56 days (µg/L)
Paramount™/Aerial	90	40.28	40.23	40.17
	14	40.28	40.23	40.17
Paramount™/ Ground Spray	90	40.20	40.16	40.10
	14	40.20	40.16	40.10
Paramount™ BW/ Aerial	none	13.16	13.14	13.11
Paramount™ BW/ Ground Spray	none	13.13	13.12	13.10

Exposure to Nontarget Plants

Dry and Semi-aquatic Areas

Terrestrial plants inhabiting dry and semi-aquatic areas may be exposed to pesticides from runoff, spray drift or volatilization. Semi-aquatic areas are those low-lying wet areas that may be dry at certain times of the year. EFED's runoff scenario is: (1) based on a pesticide's water solubility and the amount of pesticide present on the soil surface and its top one inch, (2) characterized as "sheet runoff" (one treated acre to an adjacent acre) for dry areas, (3) characterized as "channelized runoff" (10 treated acres to a distant low-lying acre) for semi-aquatic areas, and (4) based on fraction of application as runoff values of 0.01, 0.02, and 0.05 for water solubility of <10 ppm, 10-100 ppm, and >100 ppm, respectively.

Spray drift exposure from ground application is assumed to be 1% of the application rate. Spray drift from aerial, air blast, forced-air, and chemigation applications is assumed to be 5% of the application rate.

Because the water solubility of quinclorac is within the range of 10-100 ppm, the current EFED policy dictates that the fraction of application as runoff used in modeling exposures to non-target plants is 0.02. Note: this policy assumes that runoff is directly related to water solubility.

For the purposes of this risk assessment, EECs are calculated for unincorporated ground applications and aerial applications. EFED policy has established the following formulas for calculating EECs for dry areas adjacent to treatment sites and EECs for semi-aquatic areas follows

Calculating EECs for terrestrial plants inhabiting dry (upland) areas adjacent to treatment sites

Unincorporated ground application:
Runoff (sheet) = maximum application rate (lb ai/A) x runoff value
Drift = maximum application rate x 0.01
EEC for comparison to seedling emergence endpoints = runoff (lb ai/acre) + drift (lb ai/A)
EEC for comparison to vegetative vigor endpoints = drift (lb ai/A)

Aerial applications
Runoff (sheet) = maximum application rate (lb ai/A) x 0.6 (60% application efficiency) x runoff value
Drift = maximum application rate (lb ai/A) x 0.05
EEC for comparison to seedling emergence endpoints = runoff (lb ai/acre) + drift (lb ai/A)
EEC for comparison to vegetative vigor endpoints = drift (lb ai/A)

Calculating EECs for terrestrial plants inhabiting semi-aquatic low-lying areas

Unincorporated ground application:
Runoff (channelized) = maximum application rate (lb ai/A) x runoff value x 10 acres
Drift = maximum application rate x 0.01
EEC for comparison to seedling emergence endpoints = runoff (lb ai/acre) + drift (lb ai/A)
EEC for comparison to vegetative vigor endpoints = drift (lb ai/A)

Aerial application:
Runoff (channelized) = maximum application rate (lbs ai/acre) x 0.6 (60% application efficiency assumed) x runoff value x 10 acres
Drift = maximum application rate (lbs ai/A) x 0.05
EEC for comparison to seedling emergence endpoints = runoff (lb ai/acre) + drift (lb ai/A)
EEC for comparison to vegetative vigor endpoints = drift (lb ai/A)

Estimated environmental concentrations for dry and semi-aquatic areas are in Table 23.

Table 23. Estimated Environmental Concentrations (lbs ai/A) For Upland and Semi-Aquatic Areas for a Single Application

Product/ Application Method/ Rate of Application in lbs ai/acre[1]	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Runoff (lbs ai/A)	Channelized Runoff (lbs ai/A)	Drift (lbs ai/A)	EEC Total Loading to Upland Adjacent Area (Sheet Runoff+ Drift)	EEC Total Loading to Semi-aquatic Area (Channel Runoff+ Drift)
Paramount™							
Unincorporated Ground Spray							
0.75	0	0.02	0.015	0.15	0.0075	0.0225	0.16
Aerial							
0.75	0	0.02	0.009	0.054	0.0375	0.0465	0.09
Paramount™BW							
Unincorporated Ground Spray							
0.25	0	0.02	0.005	0.05	0.0025	0.0075	0.0525
Aerial							
0.25	0	0.02	0.003	0.018	0.0125	0.0155	0.0305

[1] The rate of application is assumed to be the maximum annual rate of the active ingredient in each product because of the stability of the compound to hydrolysis, photolysis, and both aerobic and anaerobic metabolism.

Aquatic Plants

Exposure for aquatic plants is based on the same GENEEC model Peak EEC outputs as for aquatic organisms described in the section pertaining to aquatic animal exposures above (see Table 22).

RISK ASSESSMENT and CHARACTERIZATION

Risk Quotient (RQ) and the Levels of Concern (LOC)

Risk characterization integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects. The means of this integration is called the quotient method. Risk quotients (RQs) are calculated by dividing acute and chronic exposure estimates by toxicity values.

RQ = EXPOSURE/TOXICITY

RQs are then compared to OPP's levels of concern (LOCs). These LOCs are used by OPP to analyze potential risk to nontarget organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories: (1) acute high -- potential for acute risk is high; regulatory action may be warranted in addition to restricted use classification, (2) acute restricted use -- the potential for acute risk is high, but may be mitigated through restricted use classification, (3) acute endangered species - endangered species may be adversely affected, and (4) chronic risk - the potential for chronic risk is high, regulatory action may be warranted. Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to nontarget insects, or chronic risk from granular/bait formulations to birds or mammals.

The ecotoxicity test values (measurement endpoints) used in the acute and chronic risk quotients are derived from required studies. Examples of ecotoxicity values derived from short-term laboratory studies that assess acute effects are: (1) LC50 (fish and birds), (2) LD50 (birds and mammals), (3) EC50 (aquatic plants and aquatic invertebrates) and (4) EC25 (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic exposure-related effects are: (1) LOAEC (birds, fish, and aquatic invertebrates) and (2) NOAEC (birds, fish and aquatic invertebrates). For birds and mammals, the NOAEC generally is used as the ecotoxicity test value in assessing chronic exposure risks, although other values may be used when justified. Generally, the NOAEC is used as the ecotoxicity test value in assessing chronic exposure risks to fish and aquatic invertebrates.

Risk presumptions and the corresponding RQs and LOCs, are tabulated below.

Risk Presumptions for Terrestrial Animals

Risk Presumption	RQ	LOC
Birds		
Acute High Risk	EEC[1]/LC50 or LD50/sqft[2] or LD50/day[3]	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOEC	1
Wild Mammals		
Acute High Risk	EEC/LC50 or LD50/sqft or LD50/day	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2

Risk Presumptions for Terrestrial Animals

Risk Presumption	RQ	LOC
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOEC	1

[1] abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items
[2] mg/ft² / LD50 * wt. of bird [3] mg of toxicant consumed/day / LD50 * wt. of bird

Risk Presumptions for Aquatic Animals

Risk Presumption	RQ	LOC
Acute High Risk	EEC[1]/LC50 or EC50	0.5
Acute Restricted Use	EEC/LC50 or EC50	0.1
Acute Endangered Species	EEC/LC50 or EC50	0.05
Chronic Risk	EEC/MATC or NOEC	1

[1] EEC = (ppm or ppb) in water

Risk Presumptions for Plants

Risk Presumption	RQ	LOC
	Terrestrial and Semi-Aquatic Plants	
Acute High Risk	EEC[1]/EC25	1
Acute Endangered Species	EEC/EC05 or NOEC	1
	Aquatic Plants	
Acute High Risk	EEC[2]/EC50	1
Acute Endangered Species	EEC/EC05 or NOEC	1

[1] EEC = lbs ai/A
[2] EEC = (ppb/ppm) in water

Risk Assessment for Nontarget Terrestrial Animals

Avian Acute and Chronic Risks

The acute and chronic risk quotients for broadcast applications of quinclorac formulations are listed in Tables 24 and 25. Even under a conservative assumption of maximum annual application rates, no EFED levels of concern (LOCs) are exceeded under the exposure scenarios assessed.

Table 24. Avian Acute Risk Quotients for Single Application of Quinclorac Products (Aerial and Ground Spray) Based on a Northern Bobwhite Quail LC50 of >5000 mg/kg-diet

Product[1]	Application Rate (lbs ai/A)	Food Items	Maximum EEC (mg/kg-diet)	LC_{50} (mg/kg-diet)	Acute RQ (EEC/LC_{50})
Paramount™	0.75	Short grass	180	>5000	<0.036
		Tall grass	82.5	>5000	<0.017
		Broadleaf plants/Insects	101.3	>5000	<0.020
		Seeds	11.3	>5000	<0.002
Paramount™ DW	0.25	Short grass	60.0	>5000	<0.012
		Tall grass	27.5	>5000	<0.006
		Broadleaf plants/Insects	33.8	>5000	<0.007
		Seeds	3.8	>5000	<0.001

[1] Risks for Paramount™BW are for the quinclorac component alone, no assessment has been performed for the 2,4-D component of this product.

Table 25. Avian Chronic Risk Quotients for Single Application of Quinclorac Products (Aerial and Ground Spray Based on a Northern Bobwhite Quail NOAEC of 500 mg/kg-diet)

Product[1]	Application Rate (lbs ai/A)	Food Items	Maximum EEC (mg/kg-diet)	NOAEC (mg/kg-diet)	Chronic RQ (EEC/NOAEC)
Paramount™	0.75	Short grass	180	500	0.36
		Tall grass	82.5	500	0.17
		Broadleaf plants/Insects	101.3	500	0.20
		Seeds	11.3	500	0.02
Paramount™BW	0.25	Short grass	60.0	500	0.12
		Tall grass	27.5	500	0.06
		Broadleaf plants/Insects	33.8	500	0.07
		Seeds	3.8	500	0.01

[1] Risks for Paramount™BW are for the quinclorac component alone, no assessment has been performed for the 2,4-D component of this product.

Mammalian Acute and Chronic Risks

Mammalian acute risk quotients were calculated using the daily oral dose estimates for a 15 g mammal consuming 95% of its bodyweight as diet and the LD50 for laboratory rats. The results of these calculations are expressed in terms of LD_{50}s per day. Table 26 summarizes the results of these risk quotient calculations. None of the acute risk quotient results exceed EFED levels of concern.

Table 26. Mammalian Acute Risk Quotients for Application of Quinclorac Products (Aerial and Ground Spray Based on a Laboratory Rat LD50 of 2190 mg/kg-bw

Product[1]	Application Rate (lbs ai/A)	Food Items	Daily Oral Dose (mg/kg-bw/day)	LD_{50} (mg/kg-bw)	Acute RQ (LD50/day or Dose/LD_{50})
Paramount™	0.75	Short grass	171.6	2190	0.08
		Tall grass	78.7	2190	0.04
		Broadleaf plants/Insects	96.5	2190	0.04
		Seeds	10.7	2190	0.005
Paramount™DW	0.25	Short grass	57.2	2190	0.03
		Tall grass	26.2	2190	0.01
		Broadleaf plants/Insects	32.2	2190	0.01
		Seeds	3.6	2190	0.002

[1] Risks for Paramount™BW are for the quinclorac component alone, no assessment has been performed for the 2,4-D component of this product.

Mammalian chronic risk quotients were calculated using the daily oral estimates for the same 15 g mammal and the daily oral dose corresponding to the NOAEL for reproduction effects in laboratory rats. Table 27 summarizes the results of these risk quotients calculations. In all cases, save for consumption of short grass (RQ = 1.07), the EFED level of concern was not exceeded. The significance of the single excursion above the EFED level of concern is discueed in the risk characterization.

Risk to Nontarget Plants

Terrestrial (Upland) and Semi-Aquatic Plant Risks

The acute terrestrial (upland) and semi-aquatic risk quotients are summarized in Tables 32 and 33. The EFED level of concern (LOC = 1) for toxic effects to terrestrial (upland) or semiaquatic plants is exceeded for all application scenarios modeled.

Aquatic Plant Risks

An aquatic plant risk assessment for acute high risk is usually made for aquatic vascular plants from the surrogate duckweed *Lemna gibba*. Non-vascular acute aquatic plant risk assessments are performed using either algae or a diatom, whichever is the most sensitive species. An aquatic plant risk assessment for acute-endangered species is usually made for aquatic vascular plants from the surrogate duckweed *Lemna gibba* NOAEC. To date there are no known non-vascular plant species on the endangered species list. Runoff and drift exposure is computed from GENEEC. The risk quotient is determined by dividing the pesticide's initial or peak concentration in water by the plant EC50 value or the NOAEC.

The aquatic plant risk quotients are summarized in Table 34. No calculated risk quotients exceeded the EFED level of concern.

Table 32. Terrestrial (Upland) Non-Target Plant Risk Quotients

Product[1]/ Application Method/ Rate of Application in lbs ai/A	Terrestrial Nonendangered Vegetative Vigor Threshold EC25 (lb/acre)	Terrestrial Endangered Vegetative Vigor Threshold NOAEL (lb/acre)	Terrestrial Nonendangered Emergence Threshold EC25 (lb/acre)	Terrestrial Endangered Emergence Threshold NOAEC (lb/acre)	Drift Loading Adjacent Area (lb/acre)	Total Loading Adjacent Area (lb/acre)	Terrestrial Non-endangered Vegetative Vigor RQ[2]	Terrestrial Endangered Vegetative Vigor RQ[3]	Terrestrial Non-endangered Emergence RQ[4]	Terrestrial Endangered Emergence RQ[5]
Paramount™										
Unincorporated Ground Spray										
0.75	0.007	0.005	0.004	<0.004	0.0075	0.0225	1.1	1.5	5.6	>5.6
Aerial										
0.75	0.007	0.005	0.004	<0.004	0.0375	0.0465	5.4	7.5	11.6	>11.6
Paramount™BW										
Unincorporated Ground Spray										
0.25	0.007	0.005	0.004	<0.004	0.0025	0.0075	0.4	0.5	1.9	>1.9
Aerial										
0.25	0.007	0.005	0.004	<0.004	0.0125	0.0155	1.8	2.5	3.9	>3.9

[1] Risks for Paramount™BW are for the quinclorac component alone, no assessment has been performed for the 2,4-D component of this product.
[2] terrestrial non-endangered vigor threshold/loading from drift
[3] terrestrial endangered vigor threshold/loading from drift
[4] terrestrial non-endangered emergence threshold/total loading
[5] terrestrial endangered emergence threshold/total loading

Table 33. Semi-Aquatic Non-Target Plant Risk Quotients

Product[1]/ Application Method/ Rate of Application in lbs ai/acre	Semi-Aquatic Nonendangered Vegetative Vigor Threshold EC25 (lb/acre)	Semi-Aquatic Endangered Vegetative Vigor Threshold NOAEL (lb/acre)	Semi-Aquatic Nonendangered Emergence Threshold EC25 (lb/acre)	Semi-Aquatic Endangered Emergence Threshold NOAEC (lb/acre)	Drift Loading Adjacent Area (lb/acre)	Total Loading Adjacent Area (lb/acre)	Semi-Aquatic Non-endangered Vegetative Vigor RQ[2]	Semi-Aquatic Endangered Vegetative Vigor RQ[3]	Terrestrial Nonendangered Emergence RQ[4]	Terrestrial Endangered Emergence RQ[5]
Paramount™										
Unincorporated Ground Spray										
0.75	0.007	0.005	0.004	<0.004	0.0075	0.16	1.1	1.5	40.0	>5.6
Aerial										
0.75	0.007	0.005	0.004	<0.004	0.0375	0.09	5.4	7.5	22.5	>11.6
Paramount™BW										
Unincorporated Ground Spray										
0.25	0.007	0.005	0.004	<0.004	0.0025	0.0525	0.4	0.5	13.1	>1.9
Aerial										
0.25	0.007	0.005	0.004	<0.004	0.0125	0.0305	1.8	2.5	7.6	>3.9

[1] Risks for Paramount™BW are for the quinclorac component alone, no assessment has been performed for the 2,4-D component of this product.
[2] terrestrial non-endangered vigor threshold/loading from drift
[3] terrestrial endangered vigor threshold/loading from drift
[4] terrestrial non-endangered emergence threshold/total loading
[5] terrestrial endangered emergence threshold/total loading

Table 34. Aquatic Plant Risk Quotients

Product[1]/ Application Method	Peak EEC (µg/L)	Alga EC_{50} (µg/L)	*Lemna gibba* EC_{50} (µg/L)	*Lemna gibba* NOAEC (µg/L)	Algal RQ[2]	Acute Aquatic Vascular Plant RQ[3]	Endangered Aquatic Plant RQ[4]
Paramount™/Aerial 90 and 14-day intervals	40.28	>500	>500	500	<0.081	<0.081	0.0806
	40.28	>500	>500	500	<0.081	<0.081	0.0806
Paramount™/ Ground Spray 90 and 14-day intervals	40.20	>500	>500	500	<0.080	<0.080	0.0804
	40.20	>500	>500	500	<0.080	<0.080	0.0804
Paramount™ BW/ Aerial	13.16	>500	>500	500	<0.026	<0.026	0.0263
Paramount™ BW/ Ground Spray	13.13	>500	>500	500	<0.026	<0.026	0.0263

[1] Risks for Paramount™BW are for the quinclorac component alone, no assessment has been performed for the 2,4-D component of this product.
[2] EEC/alga EC_{50}
[3] EEC/*Lemna gibba* EC_{50}
[4] EEC/*Lemna gibba* NOAEC

Endangered Species

Assessment of potential risks to avian and mammalian endangered species is limited by the receptor species selection process incorporated into this risk assessment. Direct application of the risk quotients calculated for avian receptors should be limited to endangered species of similar bodyweights and similar dietary habits. To this end, the calculated risk quotients suggest little potential for acute and chronic risks to endangered avian species that may (if any) utilize wheat and sorghum fields. However, even though no quinclorac exposures trigger acute mammalian risk concerns for endangered species, the short grass exposure estimate for Paramount™ applications results in a risk quotient that exceeds the chronic level of concern. For reasons discussed in the Risk Characterization section below, the minor excursion above mammal chronic levels of concern was concluded to be insignificant in this risk assessment. No aquatic EECs suggest the potential for run-off from sorghum and wheat fields treated with quinclorac to adversely affect endangered aquatic organisms.

Risks to endangered upland soil and semiaquatic plants both for seedling emergence and vegetative vigor toxicity endpoints are triggered by the estimated exposures for quinclorac application to wheat and sorghum fields under all application scenarios. Appendix B contains a listing of threatened and endangered plants known to occur in the wheat and sorghum-growing counties of the states label-listed for quinclorac use. This list shows 64 endangered species in these wheat and/or sorghum growing counties. A comparison of the Appendix B endangered plant species list to the label prohibitions for drift on certain plant families including *Solanaceae*, *Umbelliferae*, *Leguminosae*, *Convolvulaceae*, *Malvaceae*, *Chenopodiaceae*, *Cucurbitaceae*, and *Compositae*, reveals the following:

1. There is at least one species of endangered plant from the *Leguminosae* in each of the following states: Colorado, Oregon, Texas, and Utah.

2. There are two endangered plant species from the *Malvaceae* family in Washington, and one species in Oregon and Texas.

3. There are three endangered plant species from the *Compositae* family in Texas, two species in Utah, and 1 species in Oregon.

Any risk management Interpretation of these findings should be cognizant of the fact that occurrence in the state does not necessarily indicate suitable habitat for the species is in proximity to wheat or sorghum cultivation areas. Such an assessment of habitat locations is beyond the scope of this assessment.

Endangered species LOCs are exceeded for terrestrial and semi-aquatic plants when applying quinclorac at proposed application rates of 0.375 and 0.245 lb ai/acre. Endangered species must be protected from exposure to quinclorac. Sites where endangered species may be located must be identified and steps must be taken to protect the species from the labeled use of quinclorac. The registrant may choose to join the industry's Endangered Species Task Force to help identify these sites, in lieu of identifying and protecting the sites prior to registration

Risk Characterization

Applicability of the Risk Assessment to Geographical Areas of Proposed Use

The labels for Paramount™ and Paramount BW suggest that uses on wheat and sorghum will be limited to the following states: Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, Washington, and Wyoming. However, sorghum is grown in a number of other states. It should be noted that the assessment of the potential risks to wild plants (including endangered species) has not been extended to states not specifically listed on the product labels. Should additional states be proposed for inclusion on the labels, it is strongly suggested that additional analyses be performed to determine the extent of potentially impacted plant species in those states.

Acute and Chronic Freshwater Aquatic Organism Risks (Confounding Factors in Toxicity Testing)

The risk assessment indicates that both acute and chronic risk levels of concern for freshwater aquatic organisms are not exceeded by the GENEEC-based EECs. However, there appear to be one or more factors confounding the toxicity assessment for effects from acute and chronic exposures in freshwater invertebrates. Referring to the acute and chronic invertebrate toxicity tables, it is evident that the acute effect threshold is lower than the threshold for chronic exposure for *Daphnia magna*. One possible explanation for the disparate toxicity in these studies may lie with the fact that the acute test was performed in soft water with a surfactant present, while the chronic study was performed in relatively harder water with no surfactant reported. In addition, the effects threshold for chronic exposure, originating from a study considered core by EFED, results in an endpoint (NOAEC 110 ppm) that exceeds the solubility of the compound in bi-distilled water (64 ppm). If the presence of the surfactant in the acute test resulted in overestimation of acute toxicity, the risk quotients presented in this risk assessment would tend to over predict the potential for effects. In the case of chronic exposures, the risk quotients are so low (approximately 10^{-4}) that adjustment for the solubility limit of the compound would not alter the conclusion of no direct effects.

Estuarine and Marine Animal Chronic Risks

The use areas defined on the labels for quinclorac include the coastal states of Oregon, Texas and Washington. However, while the absence of chronic exposure toxicity data precludes a direct and quantitative assessment of chronic risks to estuarine and marine organisms, two factors suggest that such risks would not likely be in the realm of EFED levels of concern. First, the extremely low risk quotients derived for freshwater animals suggests that estuarine/marine organisms would have to be over 1000 times more sensitive than freshwater organisms for the risk quotients to trigger EFED levels of concern. Second, the comparable acute exposure toxicity endpoints for freshwater and marine fish and invertebrates suggest that differences in chronic exposure sensitivity are not likely to be great between freshwater and estuarine/marine animals.

Mammalian Chronic Risk Assessment (Consideration of Dissipation on Wildlife Food Items, Animal Intake Rates, and Exposure Requirements for Effects)

The risk assessment indicates that the EFED level of concern for chronic exposure (RQ=1) is exceeded by quinclorac exposures estimated from predicted residues on short grass following two applications totaling 0.75 lb ai/acre (RQ =1.07). This apparent minimal excursion from the level of concern is associated with uncertainties regarding the potential dissipation of quinclorac residues in wildlife food items, intake rates of wildlife food items by small mammals, and exposure durations required to produce the effects of concern observed in toxicity studies.

EFED estimated residues on the short grass as the sum of time-zero residues for two closely spaced applications (0.375 lb ai/acre) of quinclorac to sorghum (interval of 14 days). Modeled mammalian oral exposures for a single application of 0.375 lb ai/acre would result in a chronic RQ of roughly 0.5, below the EFED level of concern, illustrating the importance of assumed strict additivity for residues of closely timed applications. While EFED is not aware of any definitive residue decline studies for quinclorac on wildlife food items, available fate data do indicate that the compound is stable to hydrolysis, soil microbial degradation, and soil photolysis. In addition, the compound likely crosses the leaf surface barrier and can be incorporated into plants from soil (MRID 41432101). Given the known fate characteristics and the uncertainty regarding aqueous photolysis, EFED concluded that the available data could only support an assumption that residues in wildlife food items were stable to the extent that closely-timed applications would result in additive residues (i.e., no appreciable dissipation in food item residues between applications). Applications to pre-plant and post-harvest wheat or wheat/sorghum rotations, are likely to result in more protracted application intervals (approximately 90 days). It is possible that these intervals will result in some dissipation of the residues in standing vegetation. In such circumstances, the oral dose estimates for mammals presented in this assessment may be overestimated. However, the magnitude of this estimation cannot be determined on the basis of information available at this time.

It should be noted that the chronic risks to mammals in this assessment assume a fresh weight vegetative matter ingestion rate of 95% of bodyweight. This assumption holds true for a 15 g mammal, based on the allometric equations of Nagy (1987), and a fresh weight water content of forage of 80%. However, as bodyweight increases, the relative percentage of bodyweight that is consumed decreases. For example, a 35 g small mammal would consume only 66% of its bodyweight, resulting in risk quotient values below the EFED level of concern (LOC = 1). In addition, the risk quotients calculated in the assessment for mammals consuming short grass assume that 100% of the diet consists of this fresh vegetation. Adult small mammals consuming 100% leafy vegetation (including stems) in any season are commonly larger (e.g., microtine rodents, USEPA 1993) than the conservative small mammal modeled, with body weights on the order of 20 to 50 g compared with the modeled 15 g organism. Therefore, the assumption of 100 % short grass ingestion at a daily rate of 95% of the bodyweight for a 15 g herbivore is likely to be overly conservative for adults and may be limited to consideration of juveniles of herbivorous species.

Non-Target Plant Effects (Effects of Alternate Assumptions of Application Rate)

The risk assessment suggests that all wheat and sorghum uses of quinclorac, (Paramount™ and Paramount BW products) pose risks to endangered and non-endangered non-target plants. Both upland and semi-aquatic plant communities are at risk of effects on both the emergence of seedlings and the vigor of established plants. It should be noted that risk quotients for terrestrial plants for the Paramount™ product are based on an assumed combined residue effect from two applications totaling 0.75 lb ai/acre. However, even if the applications are evaluated individually (i.e., a single application of 0.375 lb ai/acre) the resultant exposures would be roughly half those presented in Tables 32 and 33 and would still trigger endangered and non-endangered concerns for upland and semiaquatic terrestrial plants.

Non-Target Plant Effects (Drift Implications for Risks to Non-Target Crops and Wild Plants)

The labels of both quinclorac products include prohibitions of use of the herbicide in areas where drift will impact selected families of non-target crops including *Solanaceae*, *Umbelliferae*, *Leguminosae*, *Convolvulaceae*, *Malvaceae*, *Chenopodiaceae*, *Cucurbitaceae*, and *Compositae*. Inclusion of this prohibition on the label raises three important issues. The first issue centers on how far away must non-target crops be located from quinclorac use sites. Second, are there non-target crops located in areas where wheat and sorghum uses of quinclorac would be expected? The third issue is the extent to which these concerns for sensitive crops can be extrapolated to wild plants (endangered and non-endangered).

With respect to the first issue, it is clear that both drift and runoff have the potential to transport quinclorac off-site to impact non-target plants. Primary drift from both aerial and ground spray contributes to the modeled off-site non-target plant exposures. In all but the 0.25 lb ai/acre ground spray scenario, primary off-site drift (as modeled) alone can account for plant exposures in excess of EFED levels of concern.

There are additional data that suggest the effects of primary drift may occur at considerable distances downwind from the target site and effect commercial yields of sensitive crops. One study of off-site drift impacts to tomatoes for aerial applications of quinclorac (0.38 lb ai/acre, equivalent to a single application of Paramount™), indicates that drift effects (foliar injury) may extend up to 1980 feet from the field's edge (no MRID, DP Bar Code D250179). At this distance, tomatoes exhibited up to 30% foliar injury. It is interesting to note that the vegetative vigor study for tomatoes showed a 25% effect at a quinclorac application equivalent to 0.007 lb ai/acre (equivalent to an off site aerial drift assumption of less than 2% of the single application rate of Paramount™ on wheat and sorghum), which is less than half the drift assumed for upland plant modeling. In addition, a simulated aerial drift study with quinclorac has demonstrated reduced commercial crop yields (Snipes et al. 1992). In this study, aerial application of as little as 0.008 lb ai/acre, equivalent to 2% of the single application rate for use on sorghum and wheat (again note that the non-target plant aerial spray exposure model assumes 5% drift) resulted in in-field phytotoxicity (leaf strapping and malformation of reproductive structures) and reduced crop yields. It is important to note that malformation of reproductive structures has implications for the crop productivity for a variety of crops based on commercialization of seed and fruit production.

The reader should note that the nature of the experimental designs for the studies discussed above limits the application of the data to consideration of primary drift only. There still exists uncertainty as to the contribution of volatilization, and resuspension of herbicide in wind-transported soil particles to off-site non-target plants. EFED is aware that allegations have been made that non-target crop damage has occurred following quinclorac treatments on rice fields, and that some of these impacts are alleged to occur at distances beyond normal primary drift effects would be anticipated. In a report to OPP Management, Dennis Szuhay (RD/HB) described a meeting attended by he and and Diana Hind (EPA Region 6) with the Arkansas Plant Board on September 3, 1998, during which commercial and home tomato growers had the opportunity to provide testimony on alleged injury to their crops from the application of quinclorac to rice. These alleged effects continued despite efforts made at the state level to mitigate for damage through the use of buffer zones, formulation changes, and reduced wind speed restrictions. The report to OPP Management continued that another meeting with the Texas and Louisiana departments of agriculture revealed similar allegations in Texas and occasional alleged incidents of home-grower tomato damage in Louisiana. EFED possesses insufficient information to determine the validity of such allegations of non-target damage. However, EFED is aware that agreements have been made with the registrant to provide analytical support in an effort to determine if quinclorac is a causal factor in incidents of quinclorac damage following rice applications (personal communication between Edward Odenkirchen, EFED and Dennis Szuhay, RD, January 28, 1999). EFED believes that concerns regarding secondary transport of quinclorac off the site of application may be particularly important in areas of wheat and sorghum cultivation involving large continuous quinclorac-treated tracts of cultivated land. It is recommended that the registrant take steps to develop an appropriate program of investigation to determine if similar long-range impacts on non-target crops can be expected for quinclorac use on wheat and sorghum. The reader should note that quinclorac is formulated with 2,4-D in the Paramount™ BW product. Any documentation of non-target plant damage caused by quinclorac would be confounded by the presence of the herbicide 2,4-D in chemical analysis, which produces closely analagous damage to plants and is a herbicide of widespread use.

With respect to the question of presence of nontarget crops in areas of wheat and sorghum cultivation, Table 35 presents information on the presence of other crops within the selected families of non-target crops for which labels prohibit drift including *Solanaceae*, *Umbelliferae*, *Leguminosae*, *Convolvulaceae*, *Linaceae*, *Malvaceae*, *Chenopodiaceae*, *Cucurbitaceae*, and *Compositae* in counties where wheat or sorghum are grown. The table indicates that sensitive crops are highly co-located with wheat and sorghum areas at a county level of resolution.

Table 35. Cultivation of Sensitive Crop Families in States Proposed for Quinclorac Use on Wheat or Sorghum[1]

State	Do wheat and sorghum cultivation occur in the same counties as sensitive crop plant families?								
	Solanaceae	*Umbelliferae*	*Leguminosae*	*Linaceae*	*Convolvulaceae*	*Chenopodiaceae*	*Malvaceae*	*Cucurbitaceae*	*Compositae*
Colorado	yes	yes	yes	no[2]	no	yes	no	yes	yes
Idaho	yes	no	yes	no	no	yes	no	yes	no
Kansas	yes	no	yes	no	no	no	no	yes	yes
Montana	yes	no	yes	no	no	yes	no	yes	no
Nebraska	yes	no	yes	no	no	yes	no	yes	yes
New Mexico	yes	yes	yes	no	no	no	no	yes	yes
North Dakota	yes	no	yes	yes	no	yes	no	yes	yes
Oklahoma	yes	no	yes	no	yes	yes	yes	yes	yes
South Dakota	yes	no	yes	yes	no	no	no	yes	yes
Texas	yes	yes	yes	no	yes	yes	yes	yes	yes
Utah	yes	no	yes	no	no	no	no	yes	no
Washington	yes	yes	yes	no	no	no	no	yes	yes
Wyoming	yes	no	yes	no	yes	yes	no	no	yes

[1] Data source: 1992 Census of Agriculture, U.S. Department of Commerce, Economics and Statistics Administration

[2] "no" entries should be viewed with caution as they signify no county-specific data for crop occurrence and are limited to the following crops by family:
Solanaceae (tomato, potato, tobacco, eggplant, peppers (*Capsicum*))
Umbelliferae (celery, parsley, carrots)
Leguminosae (alfalfa, green bean)
Convolvulaceae (sweet potato)
Chenopodiaceae (spinach, sugar beet)
Malvaceae (okra)
Cucurbitaceae (watermelon, cantaloupe, squash, pumpkin)
Compositae (lettuce, sunflowers, among others)
Linaceae (flax)

Considering the third issue, potential of effects in wild plants, it is evident that there are many wild plants belonging to one or more of the families listed as sensitive to quinclorac and represented by the available plant toxicity tests. The plant families listed on the label are highly represented in the United States by both economically important crops and wild species. For example, using the United States Department of Agriculture Natural Resources Conservation Service PLANTS database (www.plants.usda.goc/plantproj/plants), the number of species in Kansas within each of the plant families listed on the quinclorac product labels for which drift is prohibited include the following:

Plant Family	Number of Species Known in Kansas
Solanaceae	41
Cucurbitaceae	9
Convolvulaceae	19
Chenopodiaceae	46
Linaceae	12
Malvaceae	23
Leguminosae (as *Fabaceae*)	179
Umbelliferae (as *Apiaceae*)	48
Compositae (as *Asteraceae*)	338

From this information, it can be concluded that the number of non-target plant species, within registrant-indicated plant families sensitive to quinclorac and at risk from of-site drift and runoff is substantial. However, it must be recognized that the extrapolation of the existing toxicological dataset to the myriad wild plant species extant in the proposed areas of use is highly uncertain. The existng data set is limited to only a very few plant species, all of which are herbaceous. For example, the dataset does not allow reliable extrapolation of effects thresholds to woody plants. Should quinclorac be as toxic or more toxic to woody vegetation as it has proven to be to herbaceous species, ecologically significant effects in forested shelter belts, and wind breaks adjacent to treated fields might be expected.

Non-Target Plant Effects (Irrigation Impacts to Non-Target Crops)

The exposure calculations for terrestrial (upland) plants indicated that surface runoff may be an important source of quinclorac contamination to off-site non-target plants. However, the standard exposure scenario does not present the potential risks associated with the use of quinclorac-contaminated surface water and groundwater as overhead irrigation sources to non-target crops.

To estimate overhead exposure from irrigation, a 2 inch/acre irrigation was assumed for a crop field. The total mass and volume of water necessary to achieve this irrigation rate is as follows:

62.36 lb water/ft^3 x 43,560 ft^2/acre x 0.167 ft depth (two inches) = 453,639 lb water irrigated/acre
453,639 lb water irrigated/acre X 0.45359 kg/lb = 205766 kg/acre= 205,766 L/acre

Using this volume of water per acre, one can calculate the mass of quinclorac applied per acre if the concentration of quinclorac in the irrigation water source is known:

EEC μg ai/L X 205,766 L/acre = μg ai/acre
μg ai/acre X 2.2 E-09 lb/μg = lb ai/acre

Tables 36 and 37 present the effective quinclorac application rates for two acre-inches of irrigation, based on the 4-day average GENEEC EEC and the SCI-GROW groundwater EEC. It should be noted that, due to the stability of quinclorac, selection of the 4-day average water concentration over peak concentrations or averaged concentrations for more protracted averaging periods does not substantially alter the irrigation exposures in non-target corps

Table 36. Estimated Irrigation Applications of Quinclorac to Non-Target Crops via Use of Contaminated Surface Water

Product/ Application Method	Interval (days)	4-day GENEEC EEC (μg/L)	Effective Irrigation Application Rate of Quinclorac (lb ai/acre)
Paramount™/Aerial	90	40.27	0.0182
	14	40.27	0.0182
Paramount™/ Ground Spray	90	40.20	0.0182
	14	40.20	0.0182
Paramount™ BW/ Aerial	none	13.15	0.0060
Paramount™ BW/ Ground Spray	none	13.13	0.0059

Table 37. Estimated Irrigation Applications of Quinclorac to Non-Target Crop via Use of Contaminated Ground Water

SCI-GROW EEC (ug/L)	Effective Irrigation Application Rate of Quinclorac (lb ai/acre)
164.8	0.0746

The effective overhead irrigation applications of surface water contaminated by all uses of quinclorac products exceed either the vegetative vigor or seedling emergence toxicity thresholds for non-target plants. In addition, comparing these effective irrigation application rates with the vegetative vigor and seedling emergence EC_{25} thresholds for all the tested crop plants in Table 17, suggests that irrigation with surface waters contaminated with quinclorac from Paramount™ results in exposures to the chemical above toxic thresholds for lettuce, tomatoes, carrots, and cucumbers. Similarly, groundwater estimates of quinclorac contamination result in effective irrigation application rates of quinclorac in excess of the vegetative vigor or seedling emergence toxicity thresholds for non-target plants and exceed at least one individual toxic thresholds for carrots and tomatoes.

Importance of Non-Target Plants

Aside from the obvious potential for quinclorac drift, runoff, and irrigation impacts to non-target crops and areas of threatened or endangered plant species, EFED is concerned with impacts to wild plants and the animals dependant upon these plants for food and cover. Shelter belts, potholes, wetlands, surface water riparian areas, and remnant prairie lands are all important wildlife habitat. Widespread use of quinclorac has the potential to reduce the biodiversity of terrestrial and semiaquatic habitats through direct toxic action on sensitive plants and through indirect modification of the habitats of dependant animals.

Issues Regarding the Mechanism of Action

Although quinclorac is commonly considered to achieve herbicidal activity through the mimicry of the plant hormone auxin, there exist data to suggest that another mechanism may be operational for this compound. Available data indicate that quinclorac promotes plant production of 1-aminocyclopropane-1-carboxylic acid (ACC) (Liebl 1997). Plant metabolism of ACC results in the production of ethylene and cyanide. It has been suggested that accumulation of endogenous cynaide is responsible for quinclorac herbicidal activity. Supporting this mechanism is the finding that quinclorac produces effects in barnyard grass similar to effects produced by exposure th KCN (Grossman and Jacek 1995). Further, research has been conducted with the sensitive plant receptor, tomatoes, that indicates that chemical or enetic interruption of the formation of ACC or its metabolism to ethylene is protective of the herbicidal activity of quinclorac (Grosman and Schmulling 1995).

The present risk assessment deals only with exposure to quinclorac. No attempt has been made to determine if accumulation of cyanide in quinclorac-exposed plants poses a toxicological risk to wildlife. EFED recommends that the standard set of plant residue studies be conducted with the standard plant test species to determine the levels of cyanide endogenously produced at quinclorac exposure levels anticipated for both on-field and adjacent to treated fields.

Importance of Formulations with 2,4-D

It is important to note that the Paramount™ BW formulation contains 60% 2,4-D. This herbicide is also an auxin mimic by mechanism of action. EFED has no toxicity data regarding this mixture of quinclorac and 2,4-D. This represents a considerable uncertainty in the risk assessment for the product mixture. The present lack of toxicity data precludes an assessment of the potential for additive or synergistic effects when organisms are exposed to quinclorac and 2,4-D combined. EFED recommends aquatic and terrestrial plant toxicity testing for the Paramount™ BW formulation.

LABELING AND MITIGATION

The labels for both quinclorac products for use on wheat and sorghum prohibit the use of aerial application in Idaho, Oregon, and Washington. No explanation for this prohibition is provided in the label language. However, this risk assessment demonstrates that the greatest plant risks (both commercial crop and non-target wild plants) are associated with aerial applications, with primary drift assumed to be highest for aerial applications and drift alone accounting for toxicologically significant exposure levels. It is therefore recommended that, at the very least, aerial application of quinclorac to wheat and/or sorghum not be allowed in any state. Furthermore, EFED believes that the label statement prohibiting drift onto selected sensitive plant families with important crop species is not effective mitigation for drift onto non-target crops. Drift is an unavoidable consequence of spray applications and technical mitigation must be employed to minimize its impact. One mitigation method that should be considered is label language requiring course droplet spectra spray nozzles for all applications. The results of studies of drift from aerial and ground spray applications, conducted by the Spray Drift Task Force, suggest that droplet size is a significant determinant of off-field drift, with course droplets generally producing the lowest drift off-field.

An additional mitigation measure could be the establishment of buffer zones. While no definitive drift study is available, data from one study with tomatoes as a non-target crop (no MRID, DP Bar Code D250179) suggest that primary drift effects on sensitive non-target crops may extend as far as 1,980 feet from the field edge. EFED believes that a buffer of at least this size would be required for avoiding non-target crop damage from primary drift.

EFED also has concerns for non-target crop impacts as a result of overhead irrigation using groundwater or surface waters receiving runoff or infiltrate from quinclorac-treated fields. EFED believes that the risks from such irrigation exposures could be effectively eliminated by a prohibition of quinclorac use in areas of where irrigation water is used on non-target crops within the label-specified crop families.

EFED is concerned with quinclorac runoff and drift risks to emergent semiaquatic and terrestrial wild plants. EFED believes that the label language "drift or runoff may adversely affect nontarget plants" should be changed to state "normal agricultural use of this herbicide may result in drift and runoff that could adversely affect non-target plants off-field including vegetation in shelter belts, wetlands, potholes, remnant prairie lands, and any other sensitive terrestrial, or semi-aquatic habitat."

The persistence of quinclorac in soils suggests that consecutive years of application may result in accumulation of quinclorac on treated fields. EFED believes that such accumulations may contribute to off-field exposures to quinclorac as a result of secondary transport mechanisms (e.g., soil particle transport with wind). To mitigate for the possible increased exposures from secondary transport off of treated fields, EFED recommends that a prohibition of treatments in consecutive years be considered.

Because of the potential for quinclorac contamination of surface water may impacts non-target crops through irrigation and runoff may adversely impact vegetation of semiaquatic habitats, the following label statement should be considered for inclusion on the labels of products containing quinclorac:

> Quinclorac can contaminate surface water through spray drift. Under some conditions, quinclorac may also have a high potential for runoff into surface water (primarily via dissolution in runoff water), for several months post-application. These include poorly draining or wet soils with readily visible slopes toward adjacent surface waters, frequently flooded areas, areas over-laying extremely shallow ground water, areas with in-field canals or ditches that drain to surface water, areas not separated from adjacent surface waters with vegetated filter strips, and areas over-laying tile drainage systems that drain to surface water.

OUTSTANDING DATA REQUIREMENTS

The status of the environmental fate data requirements for quinclorac use on wheat and sorghum is summarized below. The environmental fate data requirement status table indicates that the Field Accumulation in Rotation crops (165-2) data requirement is not fulfilled. EFED defers a decision on the need to fulfill this data requirement to the Health Effects Division.

EFED has identified two quinclorac metabolites present both in the aerobic soil metabolism studies and terrestrial field dissipation studies (BH514-2-OH and BH514-Me ester). Data are needed to confirm the mobility of these metabolites in soil. Therefore EFED requests that guideline (163-1) leaching adsorption/desorption studies be performed on these two metabolites.

The environmental persistence of quinclorac, its potential to enter groundwater as modeled by SCI-GROW and indicated in terrestrial field studies, and the potential for groundwater impacts to non-target crops via contaminated groundwater all suggest the need for a small scale prospective groundwater contamination study for the compound under the expected conditions of use in wheat and sorghum.

Environmental Fate
Data Requirements

Study	Status	MRID Number
Degradation		
161-1 Hydrolysis	Fulfilled	40320816
161-2 Photo. - water	Fulfilled	41063560
161-3 Photo. - soil	Fulfilled	41781409
161-4 Photo. - air	Not required[1]	
Metabolism		
162-1 Aerobic soil	Fulfilled	44084503
162-2 Anaerobic soil	Not required	
162-3 Anaerobic aquatic	Fulfilled	42294104 42786401
162-4 Aerobic aquatic	Fulfilled	42294102-03
Mobility		
163-1 Leaching, Ads./ Desorption	Fulfilled (for parent) Required for selected metabolites	41063562 4106356
163-2 Volatility-lab	Waived	No MRID
163-3 Volatility-field	Not Required	
Dissipation		
164-1 Soil	Fulfilled	44342906 44129203
164-2 Aquatic	Fulfilled	42294106 42294107 42786402
164-3 Forest	Not required	
164-5 Soil, long term	Not required	
Accumulation		
165-1 Confined rotat. crop	Fulfilled	42294108
165-2 Field rotat. crop	Not fulfilled	41063569, -71 41781429
165-4 Fish	Fulfilled	40320819
Spray Drift		
201-1 Drop size spec.	Not submitted	
202-1 Drift field eval.	Not submitted	

The status of Environmental Effects Data Requirements for quinclorac alone are presented below. Based on the outcome of the risk assesment, EFED is concerned with the potential for non-target vegetation impacts associated with off-site transport of quinclorac from wheat and sorghum fields. In addition, there exist allegations from three states (Arkansas, Louisiana, and Texas) that off-site transport of quinclorac has resulted in damage to sensitive crops. EFED believes that additional investigation of the potential for near-field and far-field quinclorac induced non-target crop damage is warranted. EFED is open to discussion with the registrant on the nature and extent of such investigation, with the possibility of expanding the current analytical support provided for documenting crop damage from rice uses to other crop uses of quinclorac as one component of the investigation.

EFED is also concerned by the lack of plant toxicity data for the mixture of quinclorac and 2,4-D present in the Paramount™ BW formulation. This lack of data represents an important unceertainty in the current risk assessment. To address this uncertainty, EFED recommends that the registrant conduct terrestrial and aquatic plant toxicity testing with the Paramount™ BW formulation.

ECOLOGICAL EFFECTS
DATA REQUIREMENTS

Data Requirements	Composition[1]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	MRID	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
6 Basic Studies in Bold.				
71-1(a) Acute Avian Oral, Quail/Duck	98%	yes	41063547	no
71-1(b) Acute Avian Oral, Quail/Duck	98%	yes	40320810	no
71-2(a) Acute Avian Diet, Quail	96%	yes	40320812	no
71-2(b) Acute Avian Diet, Duck	96%	yes	40320811	no
71-3 Wild Mammal Toxicity		no		
71-4(a) Avian Reproduction Quail	99.19%	yes	44129201	no
71-4(b) Avian Reproduction Duck	99.19%	yes	44084501	no
71-5(a) Simulated Terrestrial Field Study		no		no
71-5(b) Actual Terrestrial Field Study		no		no
72-1(a) Acute Fish Toxicity Bluegill	96%	yes	4103555	no
72-1(b) Acute Fish Toxicity Bluegill		no		no
72-1(c) Acute Fish Toxicity Rainbow Trout	96%	yes	41063548	no
72-1(d) Acute Fish Toxicity Rainbow Trout		no		no

ECOLOGICAL EFFECTS
DATA REQUIREMENTS

Data Requirements	Composition[1]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	MRID	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
72-2(a) Acute Aquatic Invertebrate Toxicity	96%	yes	41063556	no
72-2(b) Acute Aquatic Invertebrate Toxicity		no		no
72-3(a) Acute Estu/Mari Tox Fish	96%	yes	41063549	no
72-3(b) Acute Estu/Mari Tox Mollusk	96%	yes	41063552	no
72-3(c) Acute Estu.Mari Tox Shrimp	96%	yes	41063553	no
72-3(d) Acute Estu/Mari Tox Fish		no		no
72-3(e) Acute Estu/Mari Tox Mollusk		no		no
72-3(f) Acute Estu/Mari Tox Shrimp		no		no
72-4(a) Early Life-Stage Fish	technical	yes	44084502	no
72-4(b) Live-Cycle Aquatic Invertebrate	technical	yes	44129202	no
72-5 Life-Cycle Fish		no		no
72-6 Aquatic Org. Accumulation		yes		no
72-7(a) Simulated Aquatic Field Study		no		no
72-7(b) Actual Aquatic Field Study		no		no
122-1(a) Seed Germ./Seedling Emerg.	96%	yes	41403501	no
122-1(b) Vegetative Vigor	96%	yes	41403503	no
122-2 Aquatic Plant Growth	96%	yes	41063574	no
123-1(a) Seed Germ./Seedling Emerg.	96%	yes	41403501	no
123-1(b) Vegetative Vigor	96%	yes	41403503	no
123-2 Aquatic Plant Growth	96%	yes	41063574	no
124-1 Terrestrial Field Study		no		(Recommend additional investigation into off-site drift impacts to non-target crops)
124-2 Aquatic Field Study		no		no
141-1 Honey Bee Acute Contact	98%	yes	41063575	no
141-2 Honey Bee Residue on Foliage		no		no
141-5 Field Test for Pollinators		no		no

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Appendix A
Revised Drinking Water Document

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

OFFICE OF PREVENTION, PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

March 5, 1999

SUBJECT: Revised Water Resource Assessment for Quinclorac Use on Grain Sorghum and Wheat

FROM: Richard J. Mahler, Hydrologist
Environmental Risk Branch 1

TO: Joanne Miller, PM 23
Herbicide Branch
Registration Division(7505C)

DP Barcode: 250225
Chemical No: 128974

CONCLUSIONS

ERB1/EFED believes that quinclorac appears to have the potential for movement into groundwater. Furthermore, since quinclorac is not tightly bound to the soil, this compound will be available to runoff in surface water as well as by erosion to surface water in broadcast use conditions.

Based on two applications at a rate of 0.375 lb ai/A on grain sorghum[1], the peak GENEEC estimated environmental concentration (EEC) of quinclorac in surface water is 40.28 ppb (Table 1). Drinking water exposure through ground water is estimated to be 164.8 ppb (Table 3) using the SCI-GROW screening model developed in EFED (Barrett, 1997). Since the application to wheat is 0.17 lb ai/A, the drinking water numbers for wheat will be approximately half the sorghum water numbers.

SURFACE WATER ASSESSMENT

The GENEEC model was used to estimate surface water concentrations for quinclorac. The modeling results indicate that quinclorac has the potential to move into surface waters, especially in areas with large amounts of annual rainfall and the potential for runoff.

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[1]EFED notes that the highest registered use rate (0.5 lb ai/A) is on rice; however, we do not have an approved GENEEC model for rice for estimating environmental concentrations of pesticides.

Table 1 presents the results of GENEEC modeling for aerial and ground spray applications of quinclorac for both the Paramount™ and Paramount™ BW products applications. The Paramount™ values are based on an assumption of two applications of quinclorac (0.375 lb ai/acre) with an interval of 3 months (90 days) or an interval of 14 days between applications. The 3-month interval was assumed to be the typical interval, based on continuous sorghum propagation. Taking Kansas as an example state for sorghum propagation, planting typically occurs in June and harvesting occurs in October (*Usual Planting and Harvesting Dates for U.S. Field Crops*, United States Department of Agriculture, Agriculture Handbook Number 628). Because quinclorac is to be used from emergence to crop height of 12 inches, the first application may occur as late as July. Because quinclorac must be used post harvest for bindweed control before the first frost, the second annual application was assumed to occur late in September. The 14-day interval was based on a rare but conservative scenario (personal communication between E. Odenkirchen, OPP and T. Nelsen, BASF, January 21, 1999) in which two closely spaced applications of Paramount™ were necessary for weed control on the post-emergent sorghum crop. The Paramount™ BW values are based on an assumption of one annual application of quinclorac (0.245 lb ai/acre).

The input values for GENEEC are listed in Table 2. GENEEC version 1.2 dated May 3, 1995 was used for the calculations.

Table 1. Estimated Environmental Concentrations in Water

Product/ Application Method	Interval (days)	Peak (μg/L)	4 days (μg/L)	21 days (μg/L)	56 days (μg/L)
Paramount™/Aerial	90	40.28	40.27	40.23	40.17
	14	40.28	40.27	40.23	40.17
Paramount™/ Ground Spray	90	40.20	40.20	40.16	40.10
	14	40.20	40.20	40.16	40.10
Paramount™ BW/ Aerial	none	13.16	13.15	13.14	13.11
Paramount™ BW/ Ground Spray	none	13.13	13.13	13.12	13.10

Table 2. GENEEC Environmental Fate Input Parameters for Quinclorac

Input Parameter	Value	Data Assessment	Source
Method of Application	Both products: aerial or ground spray	Verified	Label
Application Rate	Paramount™ 0.375 lb ai/A Paramount DW 0.245 lb ai/A	Verified	Label
Maximum Number of Applications	Paramount™: 2 Paramount DW: 1	Verified	Label
Interval Between Applications	Paramount™ 14 and 90 days	Verified	Label
Batch Equilibrium (Koc)	13 ml/g	Acceptable	MRID 41063562
Aerobic Soil Metabolism	Stable (input set at 0)	Acceptable	MRID 41247301
Solubility	891 ppm	Acceptable	Reported by registrant
Aerobic Aquatic Metabolism	Stable (input set at 0)	Acceptable	MRID 42294102
Hydrolysis	Stable (input set at 0)	Acceptable	MRID 40320816
Photolysis	Stable (input set at 0)	Acceptable	MRID 41063560 41781406

GROUND WATER ASSESSMENT

No data on quinclorac residues in ground water are readily available. No Maximum Contamination Limit (MCL) or Health Advisory (HA) has been established for quinclorac residues in drinking water (USEPA, 1996).

Table 3 shows the input parameter values used in SCI-GROW for quinclorac as well as the resulting estimated groundwater concentration.

Table 3. SCI-GROW Environmental Fate Input Parameters for Quinclorac

Input Parameter	Value
Median K_{oc} (l/kg)	38.0
Application Rate (lb a.i. $acre^{-1}$)	0.375
Number of Applications	2
Use Rate (Maximum total/season)	0.75
Aerobic Soil Metabolism half-life (days)	1500[1]
Estimated Groundwater Concentration (ppb)	164.8

[1] A value of 1500 is predicated on acceptable studies suggesting compound stability and a recommendation by the EFED Risk Review Panel that a value of 1500 represents a conservative maximum assumption of stability in the model.

EFED estimates a drinking water exposure concentration of 164.8 ppb for quinclorac as predicted by SCI-GROW modeling results.

There may be exceptional circumstances under which groundwater concentrations could exceed the SCI-GROW estimates. However, such exceptions should be quite rare since the SCI-GROW model is based exclusively on maximum groundwater concentrations from studies conducted at sites and under conditions which are most likely to result in groundwater contamination. The groundwater concentrations generated by SCI-GROW are based on the largest 90-day average recorded during the sampling period. Since there is relatively little temporal variation in groundwater concentrations compared to surface water, the concentration (164.88 ppb) can be considered as both the acute and chronic values.

REFERENCES

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Appendix B
Endangered Plant Species in Selected Wheat and Sorghum Cultivation Counties

CHELAN WA

SPECIES	GROUP	STATUS	KNOWN
CHECKER-MALLOW, WENATCHEE MOUNTAINS Sidalcea pedata Family: Malvaceae	PLANT	E	POSSIBLE

CLARK WA

SPECIES	GROUP	STATUS	KNOWN
HOWELLIA, WATER Howellia aquatilis Family: Campanulaceae	PLANT	T	POSSIBLE

COWLITZ WA

SPECIES	GROUP	STATUS	KNOWN
CHECKER-MALLOW, NELSON'S Sidalcea nelsoniana Family: Malvaceae	PLANT	T	KNOWN

ISLAND WA

SPECIES	GROUP	STATUS	KNOWN
PAINTBRUSH, GOLDEN Castilleja levisecta Family: Scrophulariaceae	PLANT	T	POSSIBLE

SPOKANE WA

SPECIES	GROUP	STATUS	KNOWN
HOWELLIA, WATER Howellia aquatilis Family: Campanulaceae	PLANT	T	POSSIBLE

BENTON OR

SPECIES	GROUP	STATUS	KNOWN
CHECKER-MALLOW, NELSON'S Sidalcea nelsoniana Family: Malvaceae	PLANT	T	KNOWN
LOMATIUM, BRADSHAW'S Lomatium bradshawii Family: Apiaceae	PLANT	E	KNOWN

CLACKAMAS OR

SPECIES	GROUP	STATUS	KNOWN
CHECKER-MALLOW, NELSON'S Sidalcea nelsoniana Family: Malvaceae	PLANT	T	KNOWN

COOS OR

SPECIES	GROUP	STATUS	KNOWN
LILY, WESTERN Lilium occidental Family: Liliaceae	PLANT	E	POSSIBLE

DOUGLAS OR

SPECIES	GROUP	STATUS	KNOWN
POPCORNFLOWER, ROUGH	PLANT	E	POSSIBLE

HARNEY OR

SPECIES	GROUP	STATUS	KNOWN
WIRE-LETTUCE, MALHEUR Stephanomeria malheurensis Family: Asteraceae	PLANT	E,CH	KNOWN

KLAMATH OR

SPECIES	GROUP	STATUS	KNOWN
MILK-VETCH, APPLEGATE'S Astragalus applegatei Family: Fabaceae	PLANT	E	KNOWN

LANE OR

SPECIES	GROUP	STATUS	KNOWN
LOMATIUM, BRADSHAW'S Lomatium bradshawii Family: Apiaceae	PLANT	E	KNOWN

LINN OR

SPECIES	GROUP	STATUS	KNOWN
CHECKER-MALLOW, NELSON'S Sidalcea nelsoniana Family: Malvaceae	PLANT	T	KNOWN

LOMATIUM, BRADSHAW'S Lomatium bradshawii Family: Apiaceae	PLANT	E	KNOWN

MARION OR

SPECIES	GROUP	STATUS	KNOWN
CHECKER-MALLOW, NELSON'S Sidalcea nelsoniana Family: Malvaceae	PLANT	T	KNOWN
LOMATIUM, BRADSHAW'S Lomatium bradshawii Family: Apiaceae	PLANT	E	KNOWN

POLK OR

SPECIES	GROUP	STATUS	KNOWN
CHECKER-MALLOW, NELSON'S Sidalcea nelsoniana Family: Malvaceae	PLANT	T	KNOWN
LOMATIUM, BRADSHAW'S Lomatium bradshawii Family: Apiaceae	PLANT	E	KNOWN

WALLOWA OR

SPECIES	GROUP	STATUS	KNOWN
FOUR-O'CLOCK, MACFARLANE'S Mirabilis macfarlanei Family: Nyctaginaceae	PLANT	T	KNOWN

WASHINGTON OR

SPECIES	GROUP	STATUS	KNOWN
CHECKER-MALLOW, NELSON'S Sidalcea nelsoniana Family: Malvaceae	PLANT	T	KNOWN

YAMHILL OR

SPECIES	GROUP	STATUS	KNOWN
CHECKER-MALLOW, NELSON'S Sidalcea nelsoniana Family: Malvaceae	PLANT	T	KNOWN

BANDERA TX

SPECIES	GROUP	STATUS	KNOWN
CACTUS, TOBUSCH FISHHOOK Ancistrocactus tobuschii Family: Cactaceae	PLANT	E	KNOWN

BRAZOS TX

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, NAVASOTA Spiranthes parksii Family: Orchidaceae	PLANT	E	KNOWN

BURLESON TX

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, NAVASOTA Spiranthes parksii Family: Orchidaceae	PLANT	E	KNOWN

COKE TX

SPECIES	GROUP	STATUS	KNOWN
POPPY-MALLOW, TEXAS Callirhoe scabriuscula Family: Malvaceae	PLANT	E	KNOWN

EL PASO TX

SPECIES	GROUP	STATUS	KNOWN
CACTUS, SNEED PINCUSHION Coryphantha sneedii var. sneedii Family: Cactaceae	PLANT	E	KNOWN

FORT BEND TX

SPECIES	GROUP	STATUS	KNOWN
DAWN-FLOWER, TEXAS PRAIRIE (=TEXAS BITTERWEED Hymenoxys texana Family: Asteraceae	PLANT	E	KNOWN
FLOWER, TEXAS PRAIRIE DAWN	PLANT	E	KNOWN

FREESTONE TX

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, NAVASOTA Spiranthes parksii Family: Orchidaceae	PLANT	E	KNOWN
SAND-VERBENA, LARGE-FRUITED Abronia macrocarpa Family: Nyctaginaceae	PLANT	E	KNOWN

HARRIS TX

SPECIES	GROUP	STATUS	KNOWN
DAWN-FLOWER, TEXAS PRAIRIE (=TEXAS BITTERWEEDPLANT Hymenoxys texana Family: Asteraceae		E	KNOWN
FLOWER, TEXAS PRAIRIE DAWN	PLANT	E	KNOWN

HAYS TX

SPECIES	GROUP	STATUS	KNOWN
WILD-RICE, TEXAS Zizania texana Family: Poaceae	PLANT	E,CH	KNOWN

HUDSPETH TX

SPECIES	GROUP	STATUS	KNOWN
CACTUS, LLOYD'S HEDGEHOG Echinocereus lloydii Family: Cactaceae	PLANT	E	KNOWN
CACTUS, SNEED PINCUSHION Coryphantha sneedii var. sneedii Family: Cactaceae	PLANT	E	KNOWN

JIM WELLS TX

SPECIES	GROUP	STATUS	KNOWN
CACTUS, BLACK LACE Echinocereus reichenbachii (=melanocentrus) var. albertii Family: Cactaceae	PLANT	E	KNOWN

KERR TX

SPECIES	GROUP	STATUS	KNOWN
CACTUS, TOBUSCH FISHHOOK Ancistrocactus tobuschii Family: Cactaceae	PLANT	E	KNOWN

KIMBLE TX

SPECIES	GROUP	STATUS	KNOWN
CACTUS, TOBUSCH FISHHOOK Ancistrocactus tobuschii Family: Cactaceae	PLANT	E	KNOWN
SNOWBELLS, TEXAS Styrax texanus Family: Styracaceae	PLANT	E	KNOWN

KLEBERG TX

SPECIES	GROUP	STATUS	KNOWN
AMBROSIA, SOUTH TEXAS Ambrosia cheiranthifolia Family: Asteraceae	PLANT	E	KNOWN
AYENIA, TEXAS Ayenia limitaris Family: Sterculiaceae	PLANT	E	POSSIBLE
CACTUS, BLACK LACE Echinocereus reichenbachii (=melanocentrus) var. albertii Family: Cactaceae	PLANT	E	KNOWN
RUSH-PEA, SLENDER Hoffmannseggia tenella Family: Fabaceae	PLANT	E	KNOWN

LEON TX

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, NAVASOTA Spiranthes parksii Family: Orchidaceae	PLANT	E	KNOWN
SAND-VERBENA, LARGE-FRUITED Abronia macrocarpa Family: Nyctaginaceae	PLANT	E	KNOWN

LIVE OAK TX

SPECIES	GROUP	STATUS	KNOWN
SPIDERLING, MATHIS	PLANT	E	KNOWN

MADISON TX

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, NAVASOTA Spiranthes parksii Family: Orchidaceae	PLANT	E	KNOWN

MITCHELL TX

SPECIES	GROUP	STATUS	KNOWN
POPPY-MALLOW, TEXAS Callirhoe scabriuscula Family: malvaceae	PLANT	E	KNOWN

NUECES TX

SPECIES	GROUP	STATUS	KNOWN
AMBROSIA, SOUTH TEXAS Ambrosia cheiranthifolia Family: Asteraceae	PLANT	E	KNOWN
AYENIA, TEXAS Ayenia limitaris Family: Sterculiaceae	PLANT	E	POSSIBLE
RUSH-PEA, SLENDER Hoffmannseggia tenella Family: Fabaceae	PLANT	E	KNOWN

PECOS TX

SPECIES	GROUP	STATUS	KNOWN
CACTUS, LLOYD'S HEDGEHOG Echinocereus lloydii Family: Cactaceae	PLANT	E	KNOWN

REFUGIO TX

SPECIES	GROUP	STATUS	KNOWN
CACTUS, BLACK LACE Echinocereus reichenbachii (=melanocentrus) var. albertii Family: Cactaceae	PLANT	E	KNOWN

ROBERTSON TX

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, NAVASOTA Spiranthes parksii Family: Orchidaceae	PLANT	E	KNOWN
SAND-VERBENA, LARGE-FRUITED Abronia macrocarpa Family: Nyctaginaceae	PLANT	E	KNOWN

RUNNELS TX

SPECIES	GROUP	STATUS	KNOWN
POPPY-MALLOW, TEXAS Callirhoe scabriuscula Family: malvaceae	PLANT	E	KNOWN

SAN PATRICIO TX

SPECIES	GROUP	STATUS	KNOWN
SPIDERLING, MATHIS	PLANT	E	KNOWN

STARR TX

SPECIES	GROUP	STATUS	KNOWN
CACTUS, STAR Astrophytum asterias Family: Cactaceae	PLANT	E	KNOWN
DOGWEED, ASHY Thymophylla tephroleuca Family: Asteraceae	PLANT	E	KNOWN
FRANKENIA, JOHNSTON'S Frankenia johnstonii Family: Frankeniaceae	PLANT	E	KNOWN
MANIOC, WALKER'S Manihot walkerae Family:	PLANT	E	POSSIBLE

UVALDE TX

SPECIES	GROUP	STATUS	KNOWN
CACTUS, BLACK LACE Echinocereus reichenbachii (=melanocentrus) var. albertii Family: Cactaceae	PLANT	E	KNOWN
CACTUS, TOBUSCH FISHHOOK Ancistrocactus tobuschii Family: Cactaceae	PLANT	E	KNOWN
SNOWBELLS, TEXAS Styrax texanus Family: Styracaceae	PLANT	E	KNOWN

WASHINGTON TX

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, NAVASOTA Spiranthes parksii Family: Orchidaceae	PLANT	E	KNOWN

BENNETT SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

BROOKINGS SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

BROWN SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

CLAY SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

CODINGTON SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

DAY SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

DEUEL SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

GRANT SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

LINCOLN SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

MINNEHAHA SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

MOODY SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

ROBERTS SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

TODD SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

TURNER SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

UNION SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

YANKTON SD

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

RANSOM ND

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

RICHLAND ND

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

BOULDER CO

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	KNOWN

DELTA CO

SPECIES	GROUP	STATUS	KNOWN
CACTUS, SPINELESS HEDGEHOG Echinocereus triglochidiotus Family: Cactaceae	PLANT	E	KNOWN
CACTUS, UINTA BASIN HOOKLESS Sclerocactus glaucus Family: Cactaceae	PLANT	T	KNOWN
WILD-BUCKWHEAT, CLAY-LOVING Eriogonum pelinophilum Family: Polygonaceae	PLANT	E,CH	KNOWN

GARFIELD CO

SPECIES	GROUP	STATUS	KNOWN
CACTUS, UINTA BASIN HOOKLESS Sclerocactus glaucus Family: Cactaceae	PLANT	T	KNOWN

JEFFERSON CO

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	KNOWN

LA PLATA CO

SPECIES	GROUP	STATUS	KNOWN
CACTUS, KNOWLTON Pediocactus knowltonii Family: Cactaceae	PLANT	E	KNOWN

MESA CO

SPECIES	GROUP	STATUS	KNOWN
CACTUS, SPINELESS HEDGEHOG Echinocereus triglochidiotus Family: Cactaceae	PLANT	E	KNOWN

CACTUS, UINTA BASIN HOOKLESS Sclerocactus glaucus Family: Cactaceae	PLANT	T	KNOWN

MONTEZUMA CO

SPECIES	GROUP	STATUS	KNOWN
CACTUS, MESA VERDE Sclerocactus mesae-verdae Family: Cactaceae	PLANT	T	KNOWN
MILK-VETCH, MANCOS Astragalus humillimus Family: Fabaceae	PLANT	E	KNOWN

MONTROSE CO

SPECIES	GROUP	STATUS	KNOWN
CACTUS, SPINELESS HEDGEHOG Echinocereus triglochidiotus Family: Cactaceae	PLANT	E	KNOWN
CACTUS, UINTA BASIN HOOKLESS Sclerocactus glaucus Family: Cactaceae	PLANT	T	KNOWN
WILD-BUCKWHEAT, CLAY-LOVING Eriogonum pelinophilum Family: Polygonaceae	PLANT	E,CH	KNOWN

MORGAN CO

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	POSSIBLE

RIO BLANCO CO

SPECIES	GROUP	STATUS	KNOWN
BLADDERPOD, DUDLEY BLUFFS Lesquerella congesta Family: Brassicaceae	PLANT	T	KNOWN
TWINPOD, DUDLEY BLUFFS Physaria obcordata Family:	PLANT	T	KNOWN

SAN MIGUEL CO

SPECIES	GROUP	STATUS	KNOWN

CACTUS, SPINELESS HEDGEHOG Echinocereus triglochidiotus Family: Cactaceae	PLANT	E	KNOWN

WELD CO

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	POSSIBLE

CACHE UT

SPECIES	GROUP	STATUS	KNOWN
PRIMROSE, MAGUIRE Primula maguirei Family: Primulaceae	PLANT	T	KNOWN

CARBON UT

SPECIES	GROUP	STATUS	KNOWN
CACTUS, UINTA BASIN HOOKLESS Sclerocactus glaucus Family: Cactaceae	PLANT	T	KNOWN

DUCHESNE UT

SPECIES	GROUP	STATUS	KNOWN
CACTUS, UINTA BASIN HOOKLESS Sclerocactus glaucus Family: Cactaceae	PLANT	T	KNOWN
CRESS, TOAD-FLAX Glaucocarpum suffrutescens Family: Brassicaceae	PLANT	E	POSSIBLE
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	KNOWN
REED-MUSTARD, SHRUBBY Schoenocrambe suffrutescens Family: Brassicaceae	PLANT	E	KNOWN
RIDGE-CRESS (=PEPPER-CRESS), BARNEBY Lepidium barnebyanum Family:	PLANT	E	KNOWN

EMERY UT

SPECIES	GROUP	STATUS	KNOWN
CACTUS, SAN RAFAEL Pediocactus despainii Family: Cactaceae	PLANT	E	KNOWN
CACTUS, WRIGHT FISHHOOK Sclerocactus wrightiae Family: Cactaceae	PLANT	E	KNOWN
CYCLADENIA, JONES Cycladenia humilis var. jonesii Family: Apocynaceae	PLANT	T	KNOWN
DAISY, MAGUIRE Erigeron maguirei Family: Asteraceae	PLANT	T	KNOWN
REED-MUSTARD, BARNEBY Schoenocrambe barnebyi Family: Brassicaceae	PLANT	E	KNOWN
TOWNSENDIA, LAST CHANCE Townsendia aprica Family: Asteraceae	PLANT	T	KNOWN

GARFIELD UT

SPECIES	GROUP	STATUS	KNOWN
BUTTERCUP, AUTUMN Ranunculus acriformis var. aestivalis Family: Ranunculaceae	PLANT	E	KNOWN
CYCLADENIA, JONES Cycladenia humilis var. jonesii Family: Apocynaceae	PLANT	T	KNOWN
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	KNOWN

KANE UT

SPECIES	GROUP	STATUS	KNOWN
BLADDERPOD, KODACHROME Lesquerella tumulosa Family: Brassicaceae	PLANT	E	KNOWN

CACTUS, SILER PINCUSHION Pediocactus sileri Family: Cactaceae	PLANT	T	KNOWN
CYCLADENIA, JONES Cycladenia humilis var. jonesii Family: Apocynaceae	PLANT	T	KNOWN
MILKWEED, WELSH'S Asclepias welshii Family: Asclepiadaceae	PLANT	T,CH	KNOWN
PEPPER-GRASS, KODACHROME	PLANT	E	POSSIBLE

SALT LAKE UT

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	KNOWN

SAN JUAN UT

SPECIES	GROUP	STATUS	KNOWN
CACTUS, SPINELESS HEDGEHOG Echinocereus triglochidiotus Family: Cactaceae	PLANT	E	KNOWN
SEDGE, NAVAJO Carex specuicola Family:Cyperaceae	PLANT	T,CH	KNOWN

SANPETE UT

SPECIES	GROUP	STATUS	KNOWN
MILK-VETCH, HELIOTROPE Astragalus montii Family: Fabaceae	PLANT	E,CH	KNOWN

SEVIER UT

SPECIES	GROUP	STATUS	KNOWN
CACTUS, WRIGHT FISHHOOK Sclerocactus wrightiae Family: Cactaceae	PLANT	E	KNOWN
MILK-VETCH, HELIOTROPE Astragalus montii Family: Fabaceae	PLANT	E,CH	KNOWN

TOWNSENDIA, LAST CHANCE Townsendia aprica Family: Asteraceae	PLANT	T	KNOWN

TOOELE UT

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	KNOWN

UINTAH UT

SPECIES	GROUP	STATUS	KNOWN
CACTUS, UINTA BASIN HOOKLESS Sclerocactus glaucus Family: Cactaceae	PLANT	T	KNOWN
CRESS, TOAD-FLAX Glaucocarpum suffrutescens Family: Brassicaceae	PLANT	E	POSSIBLE
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	KNOWN
REED-MUSTARD, CLAY Schoenocrambe argillacea Family: Brassicaceae	PLANT	E	KNOWN
REED-MUSTARD, SHRUBBY Schoenocrambe suffrutescens Family: Brassicaceae	PLANT	E	KNOWN

UTAH UT

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	KNOWN
PHACELIA, CLAY Phacelia argillacea Family: Hydrophyllaceae	PLANT	E	KNOWN

WASHINGTON UT

SPECIES	GROUP	STATUS	KNOWN
BEAR-POPPY, DWARF Arctomecon humilis Family: Papaveraceae	PLANT	E	KNOWN

CACTUS, PURPLE-SPINED HEDGEHOG Echincerus engelmannii Family: Cactaceae	PLANT	E	KNOWN
CACTUS, SILER PINCUSHION Pediocactus sileri Family: Cactaceae	PLANT	T	KNOWN

WAYNE UT

SPECIES	GROUP	STATUS	KNOWN
CACTUS, WRIGHT FISHHOOK Sclerocactus wrightiae Family: Cactaceae	PLANT	E	KNOWN
DAISY, MAGUIRE Erigeron maguirei Family: Asteraceae	PLANT	T	POSSIBLE
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	KNOWN
REED-MUSTARD, BARNEBY Schoenocrambe barnebyi Family: Brassicaceae	PLANT	E	KNOWN
TOWNSENDIA, LAST CHANCE Townsendia aprica Family: Asteraceae	PLANT	T	KNOWN

WEBER UT

SPECIES	GROUP	STATUS	KNOWN
LADIES'-TRESSES, UTE Spiranthes diluvialis Family: Orchidaceae	PLANT	T	KNOWN

CHOCTAW OK

SPECIES	GROUP	STATUS	KNOWN
ORCHID, EASTERN PRAIRIE FRINGED Platanthera leucophaea Family: Orchidaceae	PLANT	T	KNOWN

CRAIG OK

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

ROGERS OK

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

IDAHO ID

SPECIES	GROUP	STATUS	KNOWN
FOUR-O'CLOCK, MACFARLANE'S Mirabilis macfarlanei Family: Nyctaginaceae	PLANT	T	KNOWN

KOOTENAI ID

SPECIES	GROUP	STATUS	KNOWN
HOWELLIA, WATER Howellia aquatilis Family: Campanulaceae	PLANT	T	POSSIBLE

LATAH ID

SPECIES	GROUP	STATUS	KNOWN
HOWELLIA, WATER Howellia aquatilis Family: Campanulaceae	PLANT	T	POSSIBLE

ALLEN KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN

ANDERSON KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

ATCHISON KS

SPECIES	GROUP	STATUS	KNOWN

ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

BOURBON KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN

COFFEY KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

CRAWFORD KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

DOUGLAS KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

FRANKLIN KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii	PLANT	T	KNOWN

Family: Asclepiadaceae

ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

JACKSON KS

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

JEFFERSON KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

JOHNSON KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

LEAVENWORTH KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

LINN KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S	PLANT	T	KNOWN

Asclepias meadii
Family: Asclepiadaceae

LYON KS

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

MIAMI KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN

NEOSHO KS

SPECIES	GROUP	STATUS	KNOWN
MILKWEED, MEAD'S Asclepias meadii Family: Asclepiadaceae	PLANT	T	KNOWN

OSAGE KS

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

POTTAWATOMIE KS

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

RILEY KS

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	POSSIBLE

SHAWNEE KS

SPECIES	GROUP	STATUS	KNOWN

ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

LAKE MT

SPECIES	GROUP	STATUS	KNOWN
HOWELLIA, WATER Howellia aquatilis Family: Campanulaceae	PLANT	T	POSSIBLE

MISSOULA MT

SPECIES	GROUP	STATUS	KNOWN
HOWELLIA, WATER Howellia aquatilis Family: Campanulaceae	PLANT	T	POSSIBLE

BOX BUTTE NE

SPECIES	GROUP	STATUS	KNOWN
PENSTEMON, BLOWOUT Penstemon haydenii Family: Scrophulariaceae	PLANT	E	KNOWN

CHERRY NE

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN
PENSTEMON, BLOWOUT Penstemon haydenii Family: Scrophulariaceae	PLANT	E	KNOWN

GARDEN NE

SPECIES	GROUP	STATUS	KNOWN
PENSTEMON, BLOWOUT Penstemon haydenii Family: Scrophulariaceae	PLANT	E	KNOWN

HALL NE

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara	PLANT	T	KNOWN

Family: Orchidaceae

LANCASTER NE

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

MORRILL NE

SPECIES	GROUP	STATUS	KNOWN
PENSTEMON, BLOWOUT Penstemon haydenii Family: Scrophulariaceae	PLANT	E	KNOWN

SEWARD NE

SPECIES	GROUP	STATUS	KNOWN
ORCHID, WESTERN PRAIRIE FRINGED Platanthera praeclara Family: Orchidaceae	PLANT	T	KNOWN

SHERIDAN NE

SPECIES	GROUP	STATUS	KNOWN
PENSTEMON, BLOWOUT Penstemon haydenii Family: Scrophulariaceae	PLANT	E	KNOWN

CHAVES NM

SPECIES	GROUP	STATUS	KNOWN
CACTUS, KUENZLER HEDGEHOG Echinocereus fendleri var. kuenzleri Family: Cactaceae	PLANT	E	KNOWN

DONA ANA NM

SPECIES	GROUP	STATUS	KNOWN
CACTUS, SNEED PINCUSHION Coryphantha sneedii var. sneedii Family: Cactaceae	PLANT	E	KNOWN

EDDY NM

SPECIES	GROUP	STATUS	KNOWN
CACTUS, LEE PINCUSHION	PLANT	T	KNOWN

Coryphantha sneedii var. leei
Family: Cactaceae

CACTUS, LLOYD'S HEDGEHOG Echinocereus lloydii Family: Cactaceae	PLANT	E	KNOWN
WILD-BUCKWHEAT, GYPSUM Eriogonum gypsophilum Family: Polygonaceae	PLANT	T,CH	KNOWN

SAN MIGUEL NM

SPECIES	GROUP	STATUS	KNOWN
IPOMOPSIS, HOLY GHOST Ipomopsis sancti-spiritus Family:	PLANT	E	POSSIBLE