



Estudio de Caso

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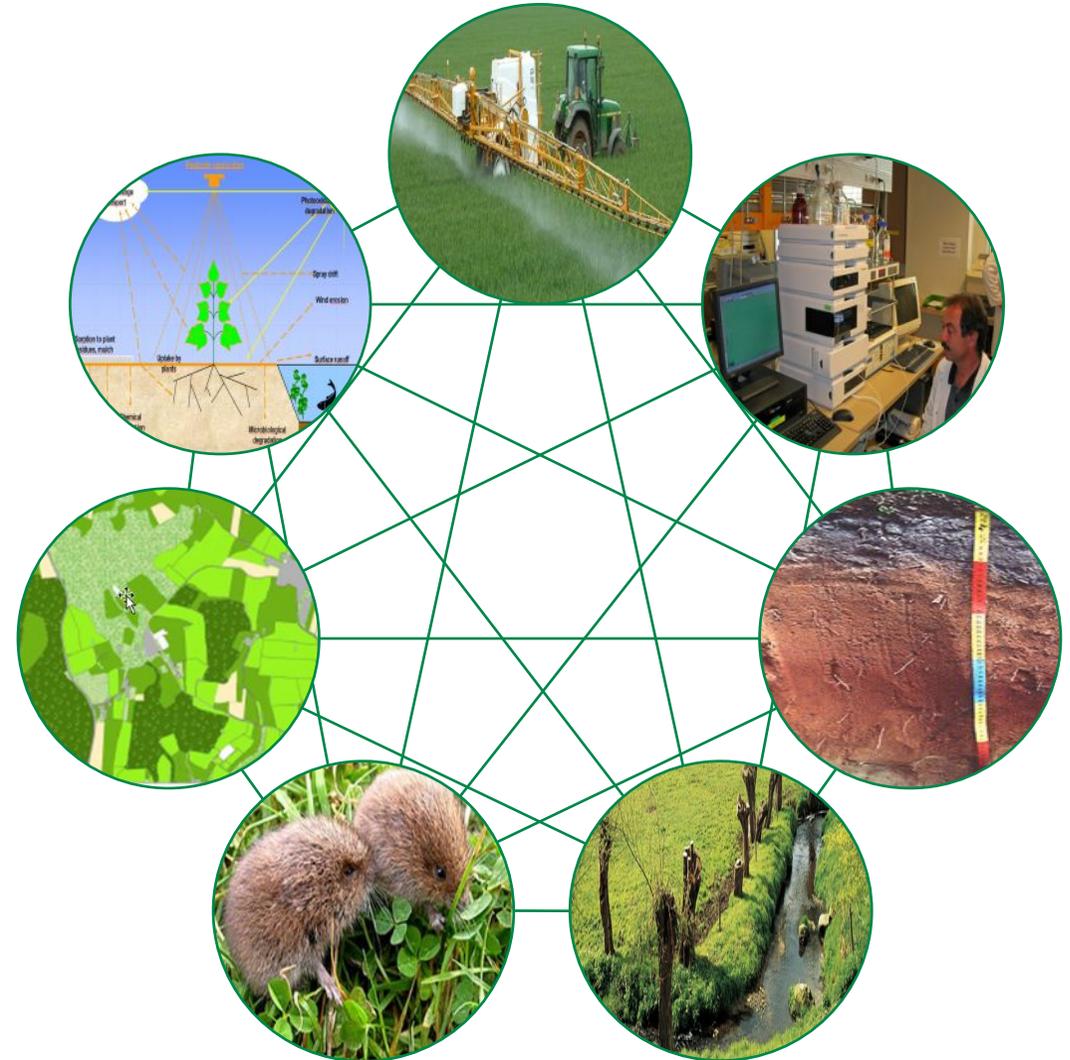
Enero 15, 2026



La evaluación de riesgo ambiental permite entender que ocurriría cuando el plaguicida sea usado



- Que ocurre cuando el producto es aplicado?
- Que ocurre después de la aplicación?
- Hay riesgo para los ecosistemas vecinos?
- Como se transporta el ingrediente activo desde el cultivo a otras áreas fuera del cultivo?
- Cual efecto causa en los organismos no objeto?
- Como interactúan todos estos factores?
- Que es aceptable? (metas a proteger / servicios ecosistémicos)



Evaluación de Riesgo Ambiental Prospectivo



Medidas de Mitigación



Coincidir en tiempo y espacio

Evaluación de Riesgo para Organismos Acuáticos



*Formulación
del problema*



*Caracterización
del Efecto*



*Caracterización
de la
Exposición*



*Caracterización
del Riesgo*



*Mitigación
del Riesgo*

Ejercicio con el Modelo de Exposición Acuática Andina ANDES

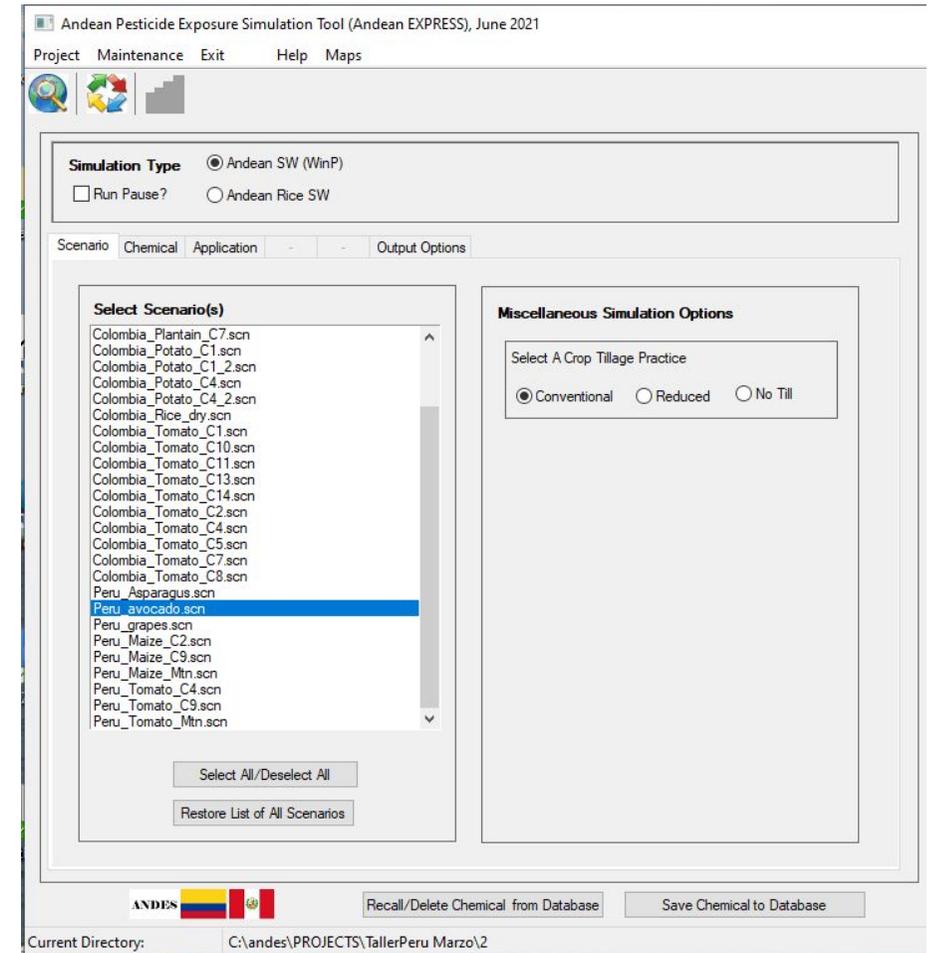
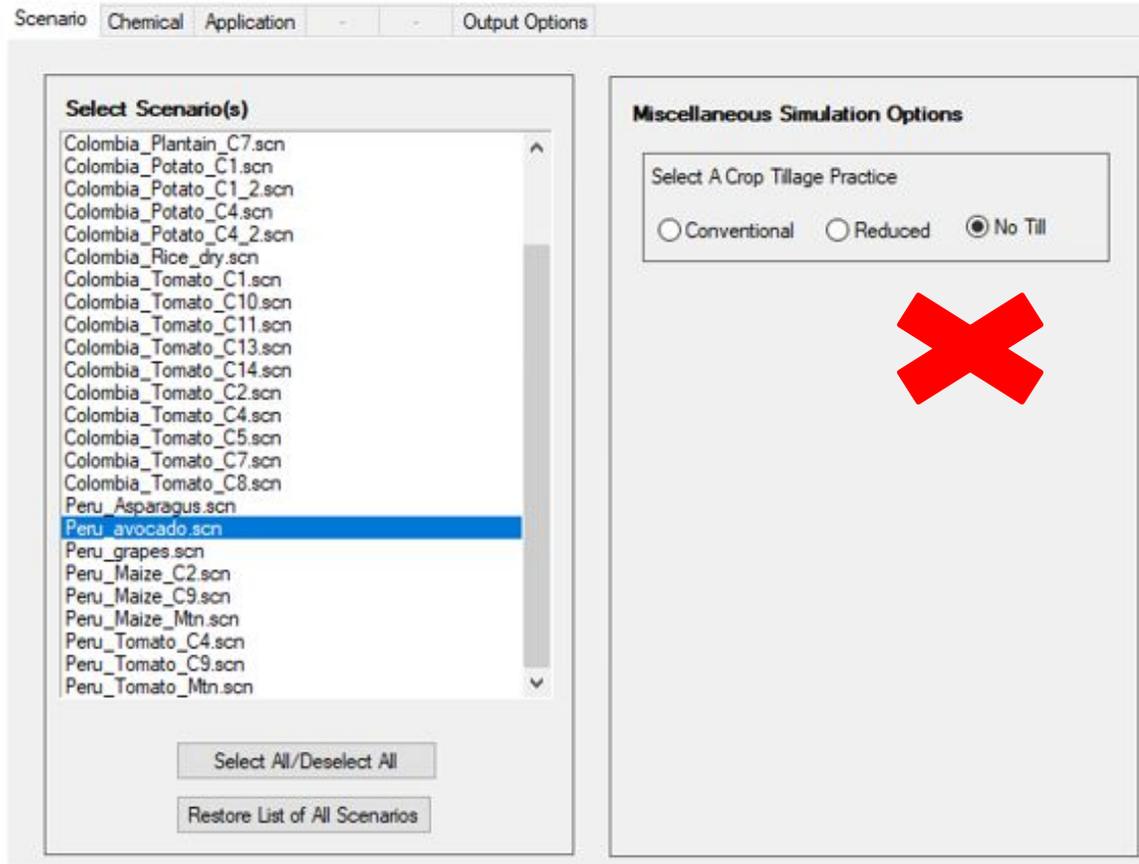
Cultivo: Palto

Dosis de 1.5 kg/ha x 2, intervalo 14 días

Clase:	Insecticida
Grupo químico:	Organofosforado
Formulación:	EC
Concentración	480 g/L
Peso Molecular:	250 g/mol
Constante de Henry:	0.000144
DT50, soil (days)	30 días (media geometrica)
Koc (ml/g)	3000 (media aritmetica)
DT50, total water-sediment system (days)	-
Solubility (mg/L)	1 mg/L a pH 5
	1 mg/L a pH 7
	1 mg/L a pH 9
Aqueous Hydrolysis DT50	-
Aqueous photolysis DT50	20 días
Fish acute - LC50 (mg/L)	Trucha arcoiris: 0.0253 mg/L
Fish chronic - NOEC (mg/L)	Trucha arcoiris (NOEC) : 0.0006 mg/L
Invertebrates acute - EC50 (mg/L)	Daphnia magna: 0.0019 mg/L
Invertebrates chronic - NOEC (mg/L)	Daphnia magna: 0.00004 mg/L
Algae EC50 (mg/L)	1.73 mg/l

Ejercicio 2 con el Modelo ANDES

- **Práctica de labranza: No Labranza “No Till”** (para el escenario Peru_avocado y Peru_grapes tendría que ir “No Till”, puesto que son cultivos perennes y la preparación de terreno se realiza antes de la plantación de los plántones, caso similar para Peru_asparagus)



Ejercicio 2 con el Modelo ANDES

Andean Pesticide Exposure Simulation Tool (Andean EXPRESS), June 2021

Project Maintenance Exit Help Maps

Simulation Type Andean SW (WinP)
 Run Pause? Andean Rice SW

Scenario Chemical Application Output Options

Chemical ejemplo2

Chemical Relationship Parent P -> M1
 P -> M1 -> M2 P -> M1, P -> M2

WINPRZM/RICEWQ

PEARL (Kf,ne/Kf,eq) PRZM (FEQ) OFF

FEQ	0.00	0.00	0.00
Kdes (1/day)	0.00	0.00	0.00
S2 Non-Eq (day)	0.00	0.00	0.00
t1/2 Sorb (day), -9.99 = Diss	0.00	0.00	0.00

Moisture t1/2 Abs Rel (FC) OFF

M. Exponent	0.700	0.700	0.700
M. Content	100.	100.	100.

Molar Formation: Decline Ratio: 1->2, 2->3, 1->3

Water Column	0.00	0.00	0.00
Benthic	0.00	0.00	0.00
Photolysis	0.00	0.00	0.00
Hdrolysis	0.00	0.00	0.00
Soil	0.00	0.00	0.00
Foliar	0.00	0.00	0.00

Universal Inputs

	Chm1 (P)	Chm2 (M1)	Chm3 (M2)
<input checked="" type="radio"/> Koc <input type="radio"/> Kd Sorption Coeff (mL/g)	0.300E+04	0.00	0.00
Water Column Metabolism Half-life	30.0	0.00	0.00
Water Reference Temperature (C)	25.0	25.0	25.0
Benthic Metabolism Half-life (day)	30.0	0.00	0.00
Benthic Reference Temperature (C)	25.0	25.0	25.0
Aqueous Photolysis Half-life (day)	20.0	0.00	0.00
Photolysis Ref Latitude (Deg)	0.00	0.00	0.00
Hydrolysis Half-life (day)	0.00	0.00	0.00
Soil Half-life (day)	30.0	0.00	0.00
Soil Reference Temperature (C)	20.0	20.0	20.0
<input checked="" type="checkbox"/> Temperature t1/2?, Q10 Factor	2.58	2.58	2.58
Foliar Half-life (day)	0.00	0.00	0.00
Molecular Weight (g/mol)	250.	0.00	0.00
<input checked="" type="radio"/> Torr <input type="radio"/> mPa <input type="radio"/> atm Vapor Pressure	0.00	0.00	0.00
Solubility (mg/l)	1.00	0.00	0.00
<input type="checkbox"/> Estimate Henry K Henry's Constant	0.00	0.00	0.00
Air Diffusion Coefficient (cm ² /day)	0.00	0.00	0.00
Enthalpy of Vaporization (kcal/mol)	0.00	0.00	0.00
<input checked="" type="checkbox"/> Freundlich Exponent (1/n)	0.900	0.900	0.900

ANDES 

Recall/Delete Chemical from Database Save Chemical to Database

Current Directory: C:\andes\PROJECTS\TallerPeru Marzo\2

Segundo: Se ingresa la información de propiedades físico – químicas activo “Activo1”

Scenario Chemical Application Output Options

Chemical Activo1

Chemical Relationship Parent P -> M1
 P -> M1 -> M2 P -> M1, P -> M2

WINPRZM/RIC

PEARL (Kf,ne/Kf,eq) PRZM (FEQ) OFF

FEQ	0.00	0.00	0.00
Kdes (1/day)	0.00	0.00	0.00
S2 Non-Eq (day)	0.00	0.00	0.00
t1/2 Sorb (day), -9.99 = Diss	0.00	0.00	0.00

Moisture t1/2 Abs Rel (FC) OFF

M. Exponent	0.700	0.700	0.700
M. Content	100.	100.	100.

Molar Formation: Decline Ratio: 1->2, 2->3, 1->3

Water Column	0.00	0.00	0.00
Benthic	0.00	0.00	0.00
Photolysis	0.00	0.00	0.00
Hdrolysis	0.00	0.00	0.00
Soil	0.00	0.00	0.00
Foliar	0.00	0.00	0.00

Universal Inputs

	Chm1 (P)	Chm2 (M1)	Chm3 (M2)
<input checked="" type="radio"/> Koc <input type="radio"/> Kd Sorption Coeff (mL/g)	0.300E+04	0.00	0.00
Water Column Metabolism Half-life	0.00	0.00	0.00
Water Reference Temperature (C)	25.0	25.0	25.0
Benthic Metabolism Half-life (day)	0.00	0.00	0.00
Benthic Reference Temperature (C)	25.0	25.0	25.0
Aqueous Photolysis Half-life (day)	20.0	0.00	0.00
Photolysis Ref Latitude (Deg)	0.00	0.00	0.00
Hydrolysis Half-life (day)	40.0	0.00	0.00
Soil Half-life (day)	30.0	0.00	0.00
Soil Reference Temperature (C)	20.0	20.0	20.0
<input checked="" type="checkbox"/> Temperature t1/2?, Q10 Factor	2.58	2.58	2.58
Foliar Half-life (day)	0.00	0.00	0.00
Molecular Weight (g/mol)	250.	0.00	0.00
<input type="radio"/> Torr <input checked="" type="radio"/> mPa <input type="radio"/> atm Vapor Pressure	1.43	0.00	0.00
Solubility (mg/l)	1.00	0.00	0.00
<input type="checkbox"/> Estimate Henry K Henry's Constant	0.144E-03	0.00	0.00
Air Diffusion Coefficient (cm ² /day)	22.0	0.00	0.00
Enthalpy of Vaporization (kcal/mol)	0.430E+04	0.00	0.00
<input checked="" type="checkbox"/> Freundlich Exponent (1/n)	0.900	0.900	0.900

Molar Formation: Decline Ratio: 1->2, 2->3, 1->3

Water Column	0.00	0.00	0.00
Benthic	0.00	0.00	0.00
Photolysis	0.00	0.00	0.00
Hdrolysis	0.00	0.00	0.00
Soil	0.00	0.00	0.00
Foliar	0.00	0.00	0.00

Ejercicio 2 con el Modelo ANDES

Andean Pesticide Exposure Simulation Tool (Andean EXPRESS), June 2021

Project Maintenance Exit Help Maps

Simulation Type Andean SW (WinP) Andean Rice SW

Scenario Chemical Application - - - Output Options

Application Timing Relative to Emergence Absolute Date(s)

Number of Applications 2

Uniform Application Interval 14 day(s)

Application occur every 1 year(s)

Application Start Year First

Currently Selected Application Row 1

Copy Application Data to All Selected Scenarios

Copy Application Data to Currently Selected Scenarios

Drift Tool for Pond

Distance to Pond (m) 10

Ground - High, Fine (Default)

Apply Drift to Current Appl. Row

Runoff/Erosion % Reduction based on flow through Vegetative Filter Strip (VFS) buffer 40% - (5-10 m)

Days Since Emergence (kg/ha) (cm) Env. 1

	Day	Mon.	Rate	App. Method	Depth	T-Band	Eff	Drift	-	-	-	-
1	40	0	1.50	CAM 2-Above Crop	4.000	0.00	0.990	0.024	1.0	0.0	1.0	0.0
2	54	0	1.50	CAM 2-Above Crop	4.000	0.00	0.990	0.024	1.0	0.0	1.0	0.0

App. Method Help

ANDES  

Recall/Delete Chemical from Database Save Chemical to Database

Current Directory: C:\andes\PROJECTS\22

Tercero: Se ingresa la información de aplicación del producto al cultivo objetivo

- Luego de ingresar los datos de aplicación, damos clic a Copy Application Data to All Selected Scenarios o Copy Application Data to Currently Selected Scenarios. Para el ejemplo da igual puesto que solo seleccionamos un escenario (Peru_avocado.scn)

Scenario Chemical Application - - - Output Options

Application Timing Relative to Emergence Absolute Date(s)

Number of Applications 2

Uniform Application Interval 14 day(s)

Application occur every 1 year(s)

Application Start Year First

Currently Selected Application Row 2

Copy Application Data to All Selected Scenarios

Copy Application Data to Currently Selected Scenarios

Drift Tool for Pond

Distance to Pond (m) 10

Ground - High, Fine (Default)

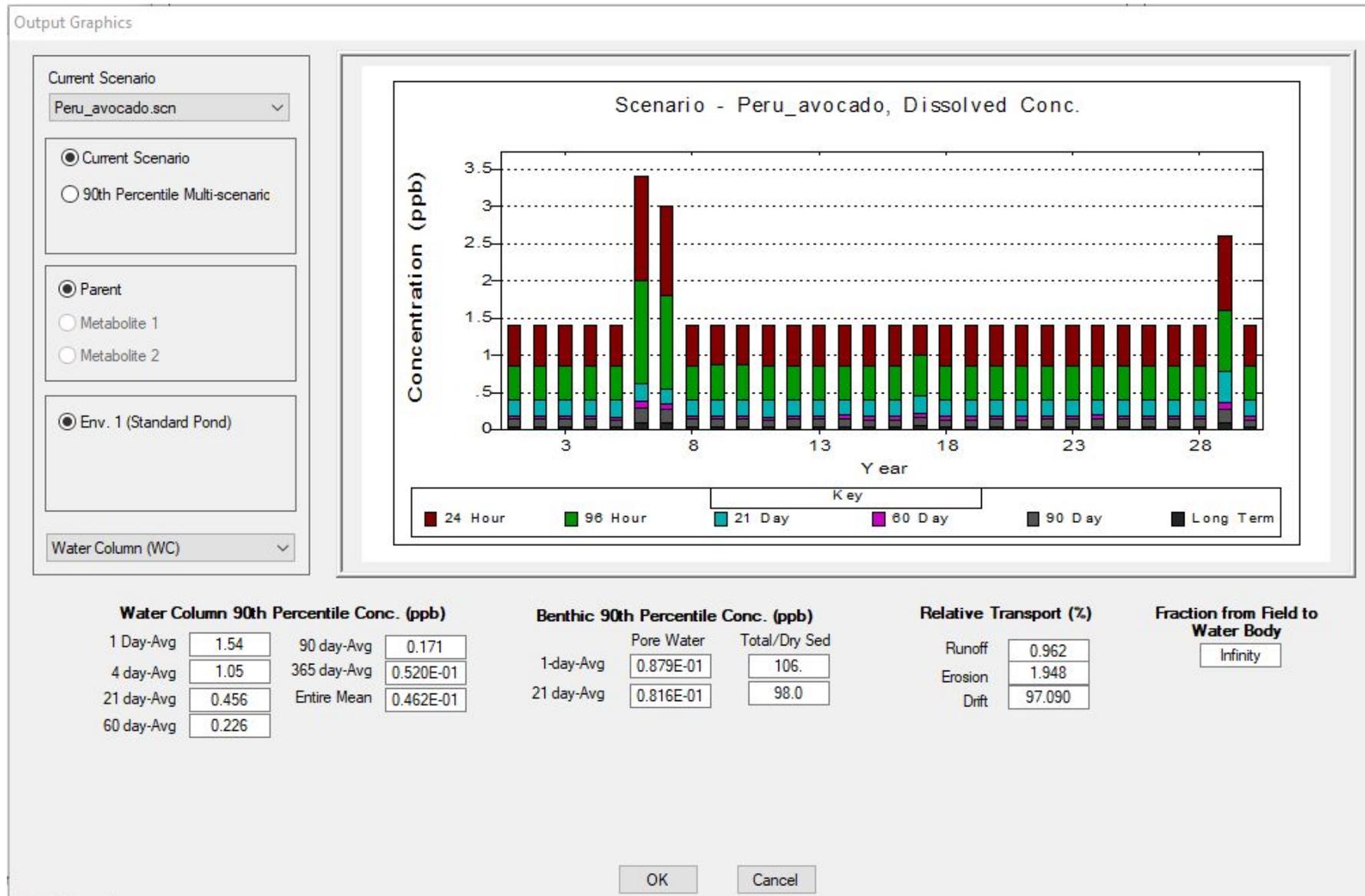
Apply Drift to Current Appl. Row

Runoff/Erosion % Reduction based on flow through Vegetative Filter Strip (VFS) buffer 0% - (0-5 m)

Days Since Emergence (kg/ha) (cm) Env. 1

	Day	Mon.	Rate	App. Method	Depth	T-Band	Eff	Drift	-	-	-	-
1	-1	0	1.50	CAM 2-Above Crop	4.000	0.00	0.990	0.032	1.0	0.0	1.0	0.0
2	13	0	1.50	CAM 2-Above Crop	4.000	0.00	0.990	0.032	1.0	0.0	1.0	0.0

Ejercicio 2 con el Modelo ANDES



Ejercicio 2 con el Modelo ANDES

Estudio & Especies	Endpoint (ug/L)	EEC ug/L	RQ
Trucha arcoiris agudo	96 h LC50 = 25.3	1.54 (pico)	0.06
Daphnia magna agudo	96 h LC50 = 1.9		0.81
P. subcapitata crecimiento	96 h LC50 = 1730	1.05	0.0006
Trucha arcoiris ELS	35 d NOEC = 0.6	0.456 (21d)	0.76
Daphnia magna cronico	21 d NOEC = 0.04		11.4

Opciones

- Refinamiento en efecto
- Implementación de medidas de mitigación adicionales



Ejercicio con la Herramienta Acuática

CROPLIFE ANDEAN AQUATIC SCREENING TOOL
Tier II risk assessment

Formulation information	
Formulation Name	xxx
Formulation Type	Liquid
A.I. Name	xxx
A.I. Concentration (%)	48

Environmental Fate endpoints		Ecotoxicological endpoints	
DT50, soil (days)	30	Fish acute - LC50 (mg/L)	0.0253
Koc (ml/g)	3000	Fish chronic - NOEC (mg/L)	0.0006
DT50, total water-sediment system (days)	60	Invertebrates acute - EC50 (mg/L)	0.0019
Solubility (mg/L)	1	Invertebrates chronic - NOEC (mg/L)	0.00004
Aqueous Hydrolysis DT50 (optional)	0	Algae EC50 (mg/L)	1.73
Aqueous photolysis DT50 (optional)	20		

Run Tier-II Ecotox Tool

Intended use information										
Crop name	N° Appl.	Appl. rate (g_ai/ha/application)	Appl. Interval (days)	Crop Interception (fraction)	Application technique	Droplet Size	Spray Drift Distance (m)	VFS (m)	Tillage	Solubility Refinement
avocado	2	1500	14	0.40	HandheldHandwandHigh	Fine - Medium/Coarse	0.0	0.0	Conventional	Yes
avocado	2	1500	14	0.40	TractorGroundHighBoom	Fine - Medium/Coarse	0.0	0.0	Conventional	Yes
avocado	2	1500	14	0.40	HandheldHandwandHigh	Fine - Medium/Coarse	10.0	10.0	Conventional	Yes
avocado	2	1500	14	0.40	TractorGroundHighBoom	Fine - Medium/Coarse	10.0	10.0	Conventional	Yes

< > Short_Manual **Inputs** Output_Ecotox_1 AGASAE_DataX +

Ejercicio con la Herramienta Acuática

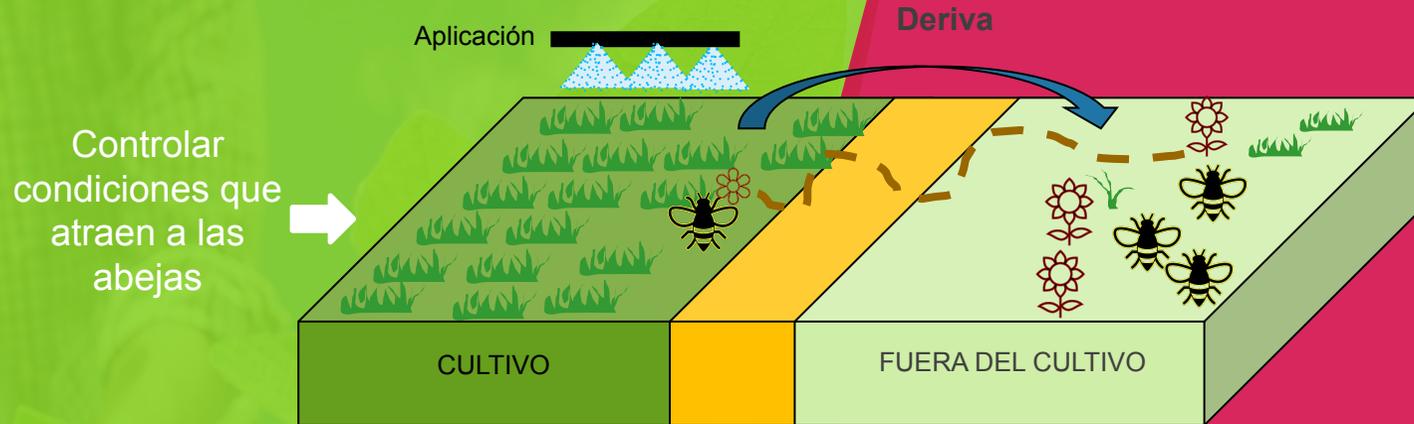
Results of the Tier II risk assessment for Aquatic organisms

GAP summary	Fish				Invertebrates				Algae	
	EECsw Acute (microg/L)	RQ Acute (-)	EECsw chronic 21d (microg/L)	RQ chronic (-)	EECsw Acute (microg/L)	RQ Acute (-)	EECsw chronic 21d (microg/L)	RQ chronic (-)	EECsw Acute (microg/L)	RQ Acute (-)
avocado - 2x1500 - 0.4 - HandheldHandwandHigh - Fine - Medium/Coa	1.7	0.07	1.6	2.70	1.7	0.91	1.6	40.54	1.7	0.00
avocado - 2x1500 - 0.4 - TractorGroundHighBoom - Fine - Medium/Coa	1.7	0.07	1.6	2.70	1.7	0.91	1.6	40.54	1.7	0.00
avocado - 2x1500 - 0.4 - HandheldHandwandHigh - Fine - Medium/Coa	0.6	0.02	0.6	0.97	0.6	0.32	0.6	14.48	0.6	0.00
avocado - 2x1500 - 0.4 - TractorGroundHighBoom - Fine - Medium/Coa	0.6	0.02	0.6	0.97	0.6	0.32	0.6	14.48	0.6	0.00
- 0x0 - 0 - - - 0m - 0m -										
- 0x0 - 0 - - - 0m - 0m -										
- 0x0 - 0 - - - 0m - 0m -										
- 0x0 - 0 - - - 0m - 0m -										
- 0x0 - 0 - - - 0m - 0m -										
- 0x0 - 0 - - - 0m - 0m -										
- 0x0 - 0 - - - 0m - 0m -										

Formulación del problema – Entendiendo las rutas probables de exposición

Agroecosistema

Ecosistemas vecinos



Abejas adultas de forrajeo:

Abejas dentro de una colmena:

Exposición por contacto directo: Aplicación en cultivo

Exposición por contacto indirecto: Deriva por aspersión o tratamiento de semilla

Exposición oral: Ingestión de néctar, polen

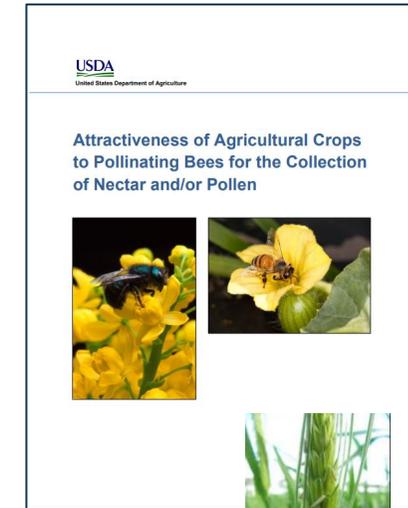


Exposición oral: Ingestión de néctar, polen

➔ Principales rutas de exposición

¿Hay exposición a abejas?

- Se debe hacer una determinación inicial sobre si existe un potencial razonable de exposición de las abejas al pesticida en cuestión:
 1. ¿Es el cultivo objetivo atractivo para las abejas?
* Consultar la Guía USDA Attractiveness Crop
 2. ¿El cultivo se cosechó antes de la floración?
- **Si no hay exposición**, se presume que la probabilidad de efectos adversos (es decir, riesgo) es baja y **no se justifica una evaluación adicional – la evaluación se concluye como riesgo aceptable** 



Guía USDA:

https://www.ars.usda.gov/ARUserFiles/OPMP/Attractiveness%20of%20Agriculture%20Crops%20to%20Pollinating%20Bees%20Report-FINAL_Web%20Version_Jan%203_2018.pdf



BBCH Stage	00 - 10	11 - 59	61-69	71-89	91-99
Main Crop Stage	Germination	Leaf Development to Inflorescence Visibility	Flowering	First fruit ready to Fully Ripening	Harvested Product

Aplicativo BeeRex

Vistazo a los campos con parametros de entrada y salida

Parámetros de entrada:

→ uso del producto

→ datos de toxicidad

A	B	C	D	E	F	G	H	I	J
1	Table 1. User inputs (related to exposure)		Table 5. Results (highest RQs)						
2	Description	Value	Exposure	Adults	Larvae				
3	Application rate		Acute contact	#DIV/0!	NA				
4	Units of app rate	lb a.i./A	Acute dietary	#DIV/0!	#DIV/0!				
5	Application method	foliar spray	Chronic dietary	#DIV/0!	#DIV/0!				
6									
7									
8									
9									
10	Are empirical residue data available?	no							
11									
12									
13									
14	Table 2. Toxicity data								
15	Description	Value (µg a.i./bee)							
16	Adult contact LD50								
17	Adult oral LD50								
18	Adult oral NO&E								
19	Larval LD50								
20	Larval NOAEL								
21									
22									
23	Table 3. Estimated concentrations in pollen and nectar								
24	Application method	EECs (mg a.i./kg)	ECs (µg a.i./mg)						
25	foliar spray	0	0						
26	soil application	NA	NA						
27	seed treatment	NA	NA						
28	tree trunk	NA	NA						
29									
30	Table 4. Daily consumption of food, pesticide dose and resulting dietary RQs for all bees								
31	Life stage	Caste or task in hive	Average age (in days)	Jelly (mg/day)	Nectar	Pollen	Total dose (µg a.i./bee)	Acute RQ	Chronic RQ
32	Larval	Worker	1	1.9	0	0	0	#DIV/0!	#DIV/0!
33			2	9.4	0	0	0	#DIV/0!	#DIV/0!
34			3	19	0	0	0	#DIV/0!	#DIV/0!
35			4	0	60	1.8	0	#DIV/0!	#DIV/0!
36			5	0	120	3.6	0	#DIV/0!	#DIV/0!
37		Drone	6+	0	130	3.6	0	#DIV/0!	#DIV/0!
38		Queen	1	1.9	0	0	0	#DIV/0!	#DIV/0!
39			2	9.4	0	0	0	#DIV/0!	#DIV/0!
40			3	23	0	0	0	#DIV/0!	#DIV/0!
41			4+	141	0	0	0	#DIV/0!	#DIV/0!
42	Adult	Worker (cell cleaning and capping)	0-10	0	60	6.85	0	#DIV/0!	#DIV/0!
43		Worker (brood and queen tending, nurse)	6 to 17	0	140	9.6	0	#DIV/0!	#DIV/0!
44		Worker (comb building, cleaning and food handling)	11 to 18	0	60	1.7	0	#DIV/0!	#DIV/0!
45		Worker (foraging for pollen)	>18	0	43.5	0.041	0	#DIV/0!	#DIV/0!
46		Worker (foraging for nectar)	>18	0	292	0.041	0	#DIV/0!	#DIV/0!
47		Worker (maintenance of hive in winter)	0-90	0	29	2	0	#DIV/0!	#DIV/0!
48		Drone	>10	0	235	0.0002	0	#DIV/0!	#DIV/0!
49	Queen (laying 1500 eggs/day)	Entire lifespan	525	0	0	0	#DIV/0!	#DIV/0!	
50									

Parametro de salida:

← cociente de riesgo

◻ Campos utilizados en el modelo aplicado a toxicidad aguda unicamente

Dosis de Aplicación (Foliar): 1500 g a.i./ha en tomate

Datos de toxicidad aguda: Adulto DL₅₀ contacto= 100 µg a.i./abeja, DL₅₀ oral= 98.3 µg a.i./abeja

Table 1. User inputs (related to exposure)

Description	Value
Application rate	1.5
Units of app rate	kg a.i./ha
Application method	foliar spray
Are empirical residue data available?	no

Table 2. Toxicity data

Description	Value (µg a.i./bee)
Adult contact LD50	100
Adult oral LD50	98.3
Adult oral NOAEL	27.38
Larval LD50	69.6
Larval NOAEL	78.6

Table 3. Estimated concentrations in pollen and nectar

Application method	EECs (mg a.i./kg)	EECs (µg a.i./mg)
foliar spray	147	0.147
soil application	NA	NA
seed treatment	NA	NA

Table 5. Results (highest RQs)

Exposure	Adults	Larvae
Acute contact	0.0360	NA
Acute dietary	0.4367	0.2611
Chronic dietary	1.5679	0.2312

Riesgo Aceptable para via exposición por contacto,
Riesgo por via oral - Refinamiento del Riesgo Necesario

	Bee-REX (highest RQs)		LOC
	Adults		
Acute contact	0.036		≥0.4
Acute dietary	0.43		≥0.4

Ejercicio

Producto insecticida: Morbudis SC (100 g ia/L)

Cultivo: Tomate

Dosis: 0.5 – 0.6 L/ha para control de pulgón. Realizar 3 aplicaciones con un espaciamento de 10 a 14 días cuando la plaga aparece

Parametro	Dato
Grupo químico:	Neonicotinoide
Formulación:	SC
Concentración	100 g/L
Peso Molecular:	350 g/mol
Presión de vapor (Pa)	4×10^{-10}
Log P _{ow}	0.57
DT50, soil (days)	150 días (media geométrica)
Koc (ml/g)	350 (media aritmetica)
DT50, total water-sediment system (days)	Fase acuosa – 19 dias Sistema completa – 90 dias
Solubility water (mg/L)	600 mg/L a pH 5, pH 7 y pH 9
Aqueous Hydrolysis DT50	Estable
Aqueous photolysis DT50	4 días

Parametro	Dato
Fish acute LC50 (mg/L)	Trucha arcoiris: 100 mg/L
Fish ELS (mg/L)	Trucha arcoiris (NOEC) : 9 mg/L
Invertebrates acute - EC50 (mg/L)	Daphnia magna: 1.5 µg/L
Invertebrates chronic - NOEC (mg/L)	Daphnia magna: 0.001 µg/L
Algae EC50 (mg/L)	>100 mg/l

Parametro	Dato
Bee acute oral LD 50 (µg/abeja)	0.01
Bee acute contact LD50(µg/abeja)	0.01

Parametro	Dato
Bird acute oral LD50 (mg/kg)	>2000
Subacute avian LC50 (mg/kg)	2500
Avian reproduction 20 w dietary (mg/kg/d) NOAEL	10

Preguntas

- Se identifico algún riesgo, alguna preocupación?
- Se requiere alguna medida de mitigación? Cual?

T-REX Grupo 1
Paula Ahumada
Juan Ignacio Pina
Sandra Carrasco
Michelle Pomareda
Tania Rivera
Paula Hernández
Maria José Hernández
Pablo Reyes
Cristobal Araya
Francisca Zuñiga
Francisco Rivas
Brian Elphick

ANDEAN AQUATIC SCREENING TOOL Grupo 2
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Gabriela Osorio
Barbara Cubillos
Ana Silva
Paul Foix
María Eugenia Rioja
Nicole Undurraga
Constanza Avello
Lucia Valenzuela
Yuditza Gutierrez
Carolina Cuevas
María José Palomera
Pamela Garcia

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