Appendix C. Parameters used in TIM v3.0

Symbol	Definition	Variable Type*	Units
A	Area of home range	Random	m^2
AE_k	Assimilation efficiency for food item k	Random	none
A_{rate}	Application rate of pesticide	Constant	lb a.i./A
B	Length of in-field spray drift buffer	Constant	m
B_{vol}	Volume-based biotransfer factor; function of Henry's law constant and Log Kow	Constant	µg/L fresh weight leaf/ µg/L air
BW	Body weight	Random	g/bird
$C_{air(t)(drops)}$	Pesticide concentration in a volume of air for the time step immediately following the pesticide application	Constant	µg/mL
$C_{air(t)(vol)}$	Concentration of the pesticide in air at time t (resulting from volatilization)	Random	µg/mL
CH	Height of crop	Constant	m
$C_{k(t)}$	Pesticide concentration on food item k at time t	Random	µg pesticide/g food
$C_{k(t=0)}$	Starting residue concentration on the day of application	Random	µg pesticide/g food
$C_{plant(t)}$	Concentration of the pesticide in crop foliage at time t	Random	mg/kg
$C_{w(dew)(t)}$	Concentration of dissolved pesticide in dew at time t	Random	µg/mL
$C_{w(puddle)(t)}$	Concentration of the pesticide in puddle at time t	Random	µg/mL
D	Fraction of hour where pesticide is applied	Constant	none
d	length of home range	Random	m
d1	portion of d that overlaps with the treated field	Random	m
d2	portion of d that is off of the treated field	Random	m
d3	distance between edge of treated field and edge of home range (that does not overlap with treated field)	Random	m
DAF	Dermal absorption fraction	Constant	none
$D_{contact(t)}$	Incidental Dermal Contact Dose	Random	µg pesticide/g-bw
$D_{dermal(t)}$	Dose through dermal exposure for a pesticide at time t	Random	µg pesticide/g-bw
$D_{dew(t)}$	Dose through drinking dew for a pesticide at time t	Random	µg pesticide/g-bw
$D_{diet(t)}$	Dose through diet for a pesticide at time t	Random	µg pesticide/g-bw
$D_{drinking(t)}$	Dose through drinking water for a pesticide at time t	Random	µg pesticide/g-bw
DF_k	Fraction of diet attributed to food item k	Constant	none
$D_{inhalation(t)}$	Dose through inhalation for a pesticide at time t	Random	µg pesticide/g-bw
$D_{intercept(t)}$	Intercepted Dermal Dose	Random	µg pesticide/g-bw
$d_{non-feeding}$	location of bird during non-feeding hours relative to edge of treated field	Random	m
DPR	Dislodgeable pesticide residues	Constant	mg/m^2
d_{soil}	Depth of soil at equilibrium with water (in puddle)	Constant	cm
$D_{spray(t)}$	Droplet Inhalation Dose	Random	µg pesticide/g-bw
dt	distance from edge of field at time t	Random	m
$D_{total(t)}$	Dose from all exposure routes	Random	µg pesticide/g-bw
$D_{vapor(t)}$	Volatilization inhalation dose; function of pesticide concentration in air, volume of inhaled air, and body weight of the bird	Random	µg pesticide/g-bw
d_w	Depth of puddle water	Random	cm
DWIR	Drinking water intake rate	Random	mL/day
e	Base of natural logarithm (2.7182)	Constant	none
$EEC_{diet(t)}$	Estimated exposure concentration through diet for a pesticide at time t	Random	µg pesticide/g-bw
F_{AM}	Ratio of avian to mammalian pulmonary membrane diffusion rates from USEPA 2004	Constant	none
FC_k	Fraction of food that is contaminated	Constant	none

Symbol	Definition	Variable Type*	Units
F_{dfr}	Dislodgeable foliar residue adjustment factor	Constant	kg/m^2
F_{field}	Fraction of on field exposure	Random	none
$FLUX_{water}$	Total daily water ingestion rate	Random	mL/day
FMA	Food matrix adjustment factor	Constant	none
FMR	Free-living metabolic rate	Random	kcal/bird-day
$f_{oc(soil)}$	Fraction of organic carbon in soil	Constant	none
FOF	Frequency on field	Random	none
F_{re}	Avian route equivalency factor	Constant	none
F_{red}	dermal route equivalency factor	Constant	none
$F_{respired}$	Volumetric fraction of droplet spectrum not exceeding the upper size limit of respired particles for birds	Constant	none
$F_{retained}$	Fraction of pesticide that is retained in the bird from one time step to the next	Constant	none
FW_k	Fraction of water in fresh food item k	Constant	None
G	Gorging factor	Constant	None
GE_k	Gross energy for food item k	Random	kcal/g food
H	Henry's law constant	Constant	$atm/m^3/mol$
$HF_{(t)}$	Hourly fraction of total daily intake rate of food consumed at time t	Random	none
k	Food item	Constant	none
Koc	Organic carbon-water partition coefficient	Constant	mL/g OC
Kow	Octanol-water partition coefficient	Constant	none
LD_{50}	Lethal dose sufficient to kill 50% of exposed individuals	Constant	mg/kg
m_{wax}	Amount of wax per surface area of leaf cuticle	Constant	$Ug/cm2$
ME_k	Metabolizable energy for food item k	Random	kcal/g food
ME_{total}	Total metabolizable energy	Random	kcal/g food
$M_{pesticide}$	Pesticide concentration on the treated field at time t (accounting for dissipation); function of application rate	Random	mg
m_{plant}	Mass of plant per hectare	Constant	kg
m_{wax}	mass of wax per surface area of leaf cuticle	Constant	$\mu g/cm^2$
n	Flock size	Constant	none
P_{00}	Probability that a bird, now off the field, will remain off the field in the next hour	Random	none
P_{01}	Probability that a bird, now off the field, will be on the field in the next hour	Random	none
P_{10}	Probability that a bird, now on the field, will be off the field in the next hour	Random	none
P_{11}	Probability that a bird, now on the field, will be on the field in the next hour	Random	none
P(x)	Probability of mortality to x birds	Constant	none
p	Fraction of total birds that died during simulation	Constant	none
Q	Fidelity factor	Constant	none
R	Universal gas constant (8.205 e^{-5})	Constant	$atm/m^3/mol$-K
r	degradation rate constant	Constant	hour^{-1}
$R_{foliar\ contact}$	Rate of foliar contact	Constant	cm^2foliage/cm^2body surface (per hour)
RH	height of spray release	Constant	m
r_k	Pesticide specific dissipation rate constant (for food item k)	Constant	hour^{-1}
R_{rate}	Respiration rate	Random	L/h
s	Mineau scaling factor	Constant	none

Symbol	Definition	Variable Type*	Units
SA_{total}	Total surface area of bird	Random	cm^2
S_F	Food ingestion scale factor	Random	none
S_I	Inhalation scale factor	Random	none
S_W	Water adjustment scale factor	Random	none
T	Air temperature	Constant	K
t	Time of simulation	Sequential value	hour
$t_{1/2k}$	Dissipation half-life for food item k	Constant	days
TDIR	Total daily intake rate	Random	g food/bird-day
$T_{mortality}$	Individual threshold for mortality	Random	µg pesticide/g-bw
TPR	Total pesticide residues	Constant	mg/kg
V_{air}	Volume of air in 1 ha to a height equal to the height of the crop canopy	Constant	L
$V_{inhalation}$	Volume of air respired	Random	L
$water_{food}$	Daily volume of water consumed by a bird through food	Random	mL/day
x	Number of dead birds (out of predetermined flock); used to determine probability	Constant	none
ε_t	Presence on-field, off-field parameter	Random	none
θ_{soil}	Porosity of soil	Constant	none
ρ_b	Bulk density of soil	Random	kg/L
ρ_p	density of soil particles	Constant	kg/L
ρ_{water}	density of water (1)	Constant	kg/L
ρ_{plant}	Density of the crop tissue assumed as fresh leaf	Constant	kg/L

* "Constant" indicates that the parameter is set to one value. "Random" indicates that the parameter's value varies based on a distribution of possible values.