

Table S1. List of pesticides used at the 12 orchards sampled in 2017 in Southern Québec, Canada. Information on the active ingredient(s), the usage and the bee toxicity were taken from SAgE pesticides web site [1]. When bee toxicity was unknown, the product was not included in the formula estimating the intensity of pesticide use on a given orchard (see Methods). The last column indicates if the pesticide was only used in orchard without landscape enhancement (Without), only in orchards with landscape enhancement (With) or in both (Both).

Commercial Name	Active Ingredient	Usage	Bee Toxicity	Found in orchards
Acramite ²	Bifenazate	Insecticide	Medium	Without
Agral ²	Nonylphenoxypolyethoxyethanol	Adjuvant	Not Known	Without
Agri-Mek ²	Abamectine	Insecticide	High	Without
Altacor*	Chlorantraniliprole	Insecticide	Low	Both
	Ammonium Sulfate ²	Fertilizer	Low	Without
Apogee ²	Prohexadione-Calcium	Growth Regulator	Not Known	Without
Assail ²	Acetamiprid	Insecticide	Medium	With
Beleaf ¹	Flonicamid	Insecticide	Low	Both
	Potassium Bicarbonate *	Fongicide	Low	Both
	Boron*	Fertilizer	Low	Both
		Fongicide And		Both
	Calcium Polysulfide*	Insecticide	Low	
Caltrac*	Calcium	Fertilizer	Low	Both
Calypso*	Thiacloprid	Insecticide	Low	Both
Captan*	Captan	Fongicide	Low	Both
Clutch ²	Clothianidin	Insecticide	High	Without
	Copper*	Fongicide	Low	Both
Decis ²	Deltamethrin	Insecticide	High	Without
	Bacillus thuringiensis subsp. kurstaki			With
Dipel ¹	Strain ABTS-351	Insecticide	Low	
Entrust*	Spinosad	Insecticide	High	Both
Envidor ²	Spirodiclofen	Acaricide	Low	Without

Exirel ¹	Cyantraniliprole	Insecticide	High	With
Flint ¹	Trifloxystrobin	Fungicide	Low	With
Fontelis*	Penthiopyrad	Fungicide	Low	Both
Fruitone*	1-Naphthaleneacetic Acid	Growth Regulator	Low	Both
Gf-120 Fruit Fly Bait*	Spinosad	Insecticide	High	Both
Glyphos ¹	Glyphosate	Herbicide	Low	With
Imidan*	Phosmet	Insecticide	High	Both
Inspire Super ¹	Cyprodinil / Difenoconazole	Fungicide	Low	With
Isomate ¹	Pheromones	Attractive	Low	With
Kumulus*	Sulfur	Fungicide	Low	Both
Li-700*	Free Fatty Acids And IPA	Adjuvant	Low	Both
Mako ²	Cypermethrin	Insecticide	High	Without
Manganese ¹	Manganese		Low	With
Manzate*	Mancozeb	Fungicide	Low	Both
Movento*	Spirotetramat	Insecticide	Low	Both
Nealta ²	Cyflumetofen	Acaricide	Low	Without
Nova*	Myclobutanil	Fungicide	Low	Both
Polyram*	Metiram	Fungicide	Low	Both
	Potassium Bicarbonate *	Fungicide	Low	Both
	Thifensulfuron-Methyl / Tribenuron-			Both
Retain*	Methyl	Herbicide	Medium	
Ripcord ¹	Cyperméthrin	Insecticide	High	With
Roundup Transorb ¹	Glyphosate	Herbicide	Low	With
Scala*	Pyrimethanil	Fungicide	Low	Both
Sel D'epson*	Magnesium		Low	Both
Sevin ¹	Carbaryl	Insecticide	High	With
Streptomycine*	Streptomycin	Bactericide	Low	Both
Superior 70 Oil*	Mineral Oil	Insecticide	Low	Both
	Urea*	Fertilizer	Low	Both

Virosoft ²	Codling Moth Granolosis Virus	Insecticide	Not Known	Without
Xiameter*	Siloxylated Polyether	Adjuvant	Not Known	Both
	Zinc ²	Fertilizer	Low	Without

Table S2. Formulation of Bayesian hierarchical community occupancy model implemented in JAGS for the bumblebee queen data collected between 2017 and 2019 in southern Québec, Canada.

```

model{
##prior distribution of average occupancy over all species in the community
psi.mean ~ dunif(0, 1)
beta0 <- log(psi.mean) - log(1 - psi.mean)

##prior distribution of average detection over all species in the community
p.mean ~ dunif(0, 1)
alpha0 <- log(p.mean) - log(1 - p.mean)

##prior distribution of beta parameters for covariates on occupancy
mua1 ~ dnorm(0, 0.001) #hyperparameter defining mean of random slope of season
mua2 ~ dnorm(0, 0.001) #hyperparameter defining mean of random slope of
management
mua3 ~ dnorm(0, 0.001) #hyperparameter defining mean of random slope of intensity

##prior distribution of beta parameters for covariates on detection
nub1 ~ dnorm(0, 0.001) #hyperparameter defining mean of random slope of airtemp
nub2 ~ dnorm(0, 0.001) #hyperparameter defining mean of random slope of time of day

##prior distribution of SD of average occupancy
sigma.u ~ dunif(0, 50)

##prior distribution of SD of average detection
sigma.v ~ dunif(0, 50)

##precision (1/variance) of parameters
tau.u <- pow(sigma.u, -2)
tau.v <- pow(sigma.v, -2)

##variance of beta parameters on occupancy
sigma.a1 ~ dunif(0, 50) #hyperparameter defining variance of random slope of season
tau.a1 <- pow(sigma.a1, -2)
sigma.a2 ~ dunif(0, 50) #hyperparameter defining variance of random slope of
management
tau.a2 <- pow(sigma.a2, -2)
sigma.a3 ~ dunif(0, 50) #hyperparameter defining variance of random slope of intensity
tau.a3 <- pow(sigma.a3, -2)

##variance of beta parameters on detection

```

```

sigma.b1 ~ dunif(0, 50) #hyperparameter defining variance of random slope of airtemp
sigma.b2 ~ dunif(0, 50) #hyperparameter defining variance of random slope of time of
day
tau.b1 <- pow(sigma.b1, -2)
tau.b2 <- pow(sigma.b2, -2)

##random effect of site on psi
sigma.psi.site ~ dunif(0, 150)
tau.psi.site <- pow(sigma.psi.site, -2)
for (b in 1:nsiteID){
  alpha.site[b] ~ dnorm(0, tau.psi.site)
}
for (i in 1:nspecies) {

##Create priors for species i from the community level prior distributions
  ##parameters on occupancy
  phi0[i] ~ dnorm(beta0, tau.u) #intercept on occupancy
  a1[i] ~ dnorm(mua1, tau.a1) #beta for season
  a2[i] ~ dnorm(mua2, tau.a2) #beta for management
  a3[i] ~ dnorm(mua3, tau.a3) #beta for intensity (low = 0 vs high = 1)

  ##parameters on detectability
  eta0[i] ~ dnorm(alpha0, tau.v) #intercept on detection
  b1[i] ~ dnorm(nub1, tau.b1) #beta for airtemp
  b2[i] ~ dnorm(nub2, tau.b2) #beta for time of day

##Loop to estimate the Z matrix (true occurrence for species i at site j
  for (j in 1:nsite) {
    logit(psi[j, i]) <- phi0[i] + a1[i]*Season[j] + a2[i]*Management[j] + a3[i]*Intensity[j] +
alpha.site[SiteNum[i]]
    Z[j, i] ~ dbern(psi[j, i]) #prior distribution for latent variable of species i in site j
    ##Loop to estimate detection for species i at site j during sampling period k.
    for (k in 1:nvisit) {
      logit(p[j, k, i]) <- eta0[i] + b1[i]*Airtemp[j, k] + b2[i]*Time[j, k]
      ##if species not present (Z = 0), then p = 0 for species (species cannot be detected)
      mu.p[j,k,i] <- p[j, k, i]*Z[j, i]
      y[j,k,i] ~ dbern(mu.p[j, k, i])
    }
  }
}

##species richness at each site
for(j in 1:nsite){

```

```
sp.rich[j] <- sum(Z[j,]) # Number of species  
}
```

```
}
```

Table S3. Formulation of Bayesian hierarchical generalized linear mixed models for apple quality characteristics as a function of landscape enhancements and intensity of pesticide use implemented in JAGS for the apple data in 2017-2019 in southern Québec, Canada.

```
##linear mixed model for diameter, mass, and sugar level

##Apple condition for Gaussian response

model {
  for (i in 1:nsites){
    alpha.site[i] ~ dnorm(mu.site, tau.site)
  }

  ##hyperparameters for random intercepts
  mu.site ~ dnorm(0, 0.001)
  sigma.site ~ dunif(0, 100)
  tau.site <- 1 / (sigma.site * sigma.site)

  ##fixed effects
  beta.managed ~ dnorm(0, 0.001) #managed = 0, 1
  beta.intensity ~ dnorm(0, 0.001) #intensity <= 48.5 (0), > 48.5 (1)

  ##residual variance
  sigma ~ dunif(0, 100)
  tau <- 1/(sigma * sigma)

  ##likelihood
  for (i in 1:n) {
    Mass[i] ~ dnorm(mu[i], tau)
    mu[i] <- alpha.site[Site.num[i]] + beta.managed * Managed[i] + beta.intensity *
    Intensity[i]
  }

  ##generalized linear mixed model for total number of seeds
  ##Apple condition for Poisson response
  model {
    for (i in 1:nsites){
      alpha.site[i] ~ dnorm(mu.site, tau.site)
```

```
}

##hyperparameters for random intercepts
mu.site ~ dnorm(0, 0.001)
sigma.site ~ dunif(0, 100)
tau.site <- 1 / (sigma.site * sigma.site)

##fixed effects
beta.managed ~ dnorm(0, 0.001) #managed = 0, 1
beta.intensity ~ dnorm(0, 0.001) #intensity <= 48.5 (0), > 48.5 (1)

##likelihood
for (i in 1:n) {
  Seed[i] ~ dpois(lambda[i])
  log(lambda[i]) <- alpha.site[Site.num[i]] + beta.managed * Managed[i] +
beta.intensity * Intensity[i]
}

}
```

References

1. SAgE Pesticides Traitements phytosanitaires et risques associés Available online:
<https://www.sagepesticides.qc.ca/Recherche/RechercheTraitement>.