Effective Pest Treament That Protects Pollinators

https://github.com/shivanikuckreja/CitrolaKuckrejaSaltman_ENV872_EDA_FinalProject/tree/main/Project

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1 Rationale and Research Questions

Pollination is a critical component of agriculture. Honeybees are important pollinators. Our research looks to see if there are exposure methods and chemicals that do not cause significant harm to honeybees while eliminating pests. The goal of our research is to determine potential treatment methods that reduce pests while having little to no impact on pollinators.

Questions:

1. *Is there an exposure type that has less impact on bees than non-bee insects?*
2. *Are there chemicals that have a high mortality rate for non-bee insects and low rate for bees?*

2 Dataset Information

Data Source: The dataset was pulled from a repository created for Environmental Data Analytics at Duke University in 2020. The data collected is from several EPA studies on neonicotinoids and their effects on insects. The data we will be analyzing is the type of chemical administered, how it was administered, and how both of these variables affected insects.

In the wrangling process, we selected the relevant information to our topic. This includes the chemical type, insect species, lifestage and age of the species, exposure type and the effect of the exposure.

Detail	Description
Data Source	EPA ECOTOX Knowledgebase
Retrieved From	https://cfpub.epa.gov/ecotox/help.cfm
Variables Used	Chemical Name, Species Common Name, Organism Lifestage, Organism Age, Exposure Type, Effect, Effect Measurement
Date Range	1982-2019

3 Exploratory Analysis

```
dim(Original_ECOTOX_CSV)
```

```
## [1] 4623   30
```

```
colnames(Original_ECOTOX_CSV)
```

```
##  [1] "CAS.Number"                          "Chemical.Name"
##  [3] "Chemical.Grade"                      "Chemical.Analysis.Method"
##  [5] "Chemical.Purity"                     "Species.Scientific.Name"
##  [7] "Species.Common.Name"                 "Species.Group"
##  [9] "Organism.Lifestage"                  "Organism.Age"
## [11] "Organism.Age.Units"                  "Exposure.Type"
## [13] "Media.Type"                          "Test.Location"
## [15] "Number.of.Doses"                     "Conc.1.Type..Author."
## [17] "Conc.1..Author."                     "Conc.1.Units..Author."
## [19] "Effect"                              "Effect.Measurement"
## [21] "Endpoint"                            "Response.Site"
## [23] "Observed.Duration..Days."            "Observed.Duration.Units..Days."
## [25] "Author"                              "Reference.Number"
## [27] "Title"                               "Source"
## [29] "Publication.Year"                    "Summary.of.Additional.Parameters"
```

```
summary(Original_ECOTOX_CSV)
```

```
##    CAS.Number
##  Min.   : 58842209
##  1st Qu.:138261413
##  Median :138261413
##  Mean   :147651982
##  3rd Qu.:153719234
##  Max.   :210880925
##
##                                                                                Chemi
##  (2E)-1-[(6-Chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine
##  3-[(2-Chloro-5-thiazolyl)methyl]tetrahydro-5-methyl-N-nitro-4H-1,3,5-oxadiazin-4-imi
##  [C(E)]-N-[(2-Chloro-5-thiazolyl)methyl]-N'-methyl-N''-nitroguanidine
##  (1E)-N-[(6-Chloro-3-pyridinyl)methyl]-N'-cyano-N-methylethanimidamide
##  N''-Methyl-N-nitro-N'-[(tetrahydro-3-furanyl)methyl]guanidine
##  [N(Z)]-N-[3-[(6-Chloro-3-pyridinyl)methyl]-2-thiazolidinylidene]cyanamide
##  (Other)
##                                                  Chemical.Grade
##  Not reported                                                :3989
##  Technical grade, technical product, technical formulation: 422
##  Pestanal grade                                              :  93
```

```
##  Not coded                                                       :  53
##  Commercial grade                                                :  27
##  Analytical grade                                                :  15
##  (Other)                                                         :  24
##                                                  Chemical.Analysis.Method
##  Measured                                                        : 230
##  Not coded                                                       :  51
##  Not reported                                                    :   5
##  Unmeasured                                                      :4321
##  Unmeasured values (some measured values reported in article):  16
##
##
##  Chemical.Purity                  Species.Scientific.Name
##  NR     :2502    Apis mellifera               : 667
##  25     : 244    Bombus terrestris            : 183
##  50     : 200    Apis mellifera ssp. carnica  : 152
##  20     : 189    Bombus impatiens             : 140
##  70     : 112    Apis mellifera ssp. ligustica: 113
##  75     :  89    Popillia japonica            :  94
##  (Other):1287    (Other)                      :3274
##            Species.Common.Name
##  Honey Bee            : 667
##  Parasitic Wasp       : 285
##  Buff Tailed Bumblebee: 183
##  Carniolan Honey Bee  : 152
##  Bumble Bee           : 140
##  Italian Honeybee     : 113
##  (Other)              :3083
##                                                        Species.Group
##  Insects/Spiders                                              :3569
##  Insects/Spiders; Standard Test Species                       :  27
##  Insects/Spiders; Standard Test Species; U.S. Invasive Species: 667
##  Insects/Spiders; U.S. Invasive Species                       : 360
##
##
##
##     Organism.Lifestage  Organism.Age             Organism.Age.Units
##  Not reported:2271     NR     :3851   Not reported        :3515
##  Adult       :1222     2      : 111   Day(s)              : 327
##  Larva       : 437     3      : 105   Instar              : 255
##  Multiple    : 285     <24    :  81   Hour(s)             : 241
##  Egg         : 128     4      :  81   Hours post-emergence:  99
##  Pupa        :  69     1      :  59   Year(s)             :  64
##  (Other)     : 211     (Other): 335   (Other)             : 122
##                     Exposure.Type         Media.Type
```

```
##  Environmental, unspecified:1599   No substrate:2934
##  Food                       :1124   Not reported: 663
##  Spray                      : 393   Natural soil: 393
##  Topical, general           : 254   Litter      : 264
##  Ground granular            : 249   Filter paper: 230
##  Hand spray                 : 210   Not coded   :  51
##  (Other)                    : 794   (Other)     :  88
##               Test.Location  Number.of.Doses        Conc.1.Type..Author.
##  Field artificial    :  96   2      :2441    Active ingredient:3161
##  Field natural       :1663   3      : 499    Formulation      :1420
##  Field undeterminable:   4   5      : 314    Not coded        :  42
##  Lab                 :2860   6      : 230
##                              4      : 221
##                              NR     : 217
##                              (Other): 701
##  Conc.1..Author. Conc.1.Units..Author.              Effect
##  0.37/  : 208    AI kg/ha  : 575       Population      :1803
##  10/    : 127    AI mg/L   : 298       Mortality       :1493
##  NR/    : 108    AI lb/acre: 277       Behavior        : 360
##  NR     :  94    AI g/ha   : 241       Feeding behavior: 255
##  1      :  82    ng/org    : 231       Reproduction    : 197
##  1023   :  80    ppm       : 180       Development     : 136
##  (Other):3924    (Other)   :2821       (Other)         : 379
##               Effect.Measurement    Endpoint                   Response.Site
##  Abundance             :1699     NOEL   :1816   Not reported          :4349
##  Mortality             :1294     LOEL   :1664   Midgut or midgut gland:  63
##  Survival              : 133     LC50   : 327   Not coded             :  51
##  Progeny counts/numbers: 120     LD50   : 274   Whole organism        :  41
##  Food consumption      : 103     NR     : 167   Hypopharyngeal gland  :  27
##  Emergence             :  98     NR-LETH:  86   Head                  :  23
##  (Other)               :1176     (Other): 289   (Other)               :  69
##  Observed.Duration..Days.       Observed.Duration.Units..Days.
##  1      : 713             Day(s)               :4394
##  2      : 383             Emergence            :  70
##  NR     : 355             Growing season       :  48
##  7      : 207             Day(s) post-hatch    :  20
##  3      : 183             Day(s) post-emergence:  17
##  0.0417 : 133             Tiller stage         :  15
##  (Other):2649             (Other)              :  59
##                                                                      Author
##  Peck,D.C.                                                             : 208
##  Frank,S.D.                                                            : 100
##  El Hassani,A.K., M. Dacher, V. Gary, M. Lambin, M. Gauthier, and C. Armengaud:  96
##  Williamson,S.M., S.J. Willis, and G.A. Wright                         :  93
##  Laurino,D., A. Manino, A. Patetta, and M. Porporato                   :  88
```

```
##  Scholer,J., and V. Krischik                                                    :  82
##  (Other)                                                                        :3956
##  Reference.Number
##  Min.   :   344
##  1st Qu.:108459
##  Median :165559
##  Mean   :142189
##  3rd Qu.:168998
##  Max.   :180410
##
##
##  Long-Term Effects of Imidacloprid on the Abundance of Surface- and Soil-Active Nonta
##  Reduced Risk Insecticides to Control Scale Insects and Protect Natural Enemies in th
##  Effects of Sublethal Doses of Acetamiprid and Thiamethoxam on the Behavior of the Ho
##  Exposure to Neonicotinoids Influences the Motor Function of Adult Worker Honeybees
##  Toxicity of Neonicotinoid Insecticides on Different Honey Bee Genotypes
##  Chronic Exposure of Imidacloprid and Clothianidin Reduce Queen Survival, Foraging, a
##  (Other)
##                                          Source     Publication.Year
##  Agric. For. Entomol.11(4): 405-419          : 200   Min.   :1982
##  Environ. Entomol.41(2): 377-386             : 100   1st Qu.:2005
##  Arch. Environ. Contam. Toxicol.54(4): 653-661:  96   Median :2010
##  Ecotoxicology23:1409-1418                   :  93   Mean   :2008
##  Bull. Insectol.66(1): 119-126               :  88   3rd Qu.:2013
##  PLoS One9(3): 14 p.                         :  82   Max.   :2019
##  (Other)                                     :3964
##  Summary.of.Additional.Parameters
##  Purity: \xca NR - NR | Organism Age: \xca NR - NR Not reported | Conc 1 (Author): \x
##  Purity: \xca NR - NR | Organism Age: \xca NR - NR Not reported | Conc 1 (Author): \x
##  Purity: \xca NR - NR | Organism Age: \xca NR - NR Not reported | Conc 1 (Author): \x
##  Purity: \xca NR - NR | Organism Age: \xca NR - NR Not reported | Conc 1 (Author): \x
##  Purity: \xca NR - NR | Organism Age: \xca NR - NR Not reported | Conc 1 (Author): \x
##  Purity: \xca NR - NR | Organism Age: \xca NR - NR Not reported | Conc 1 (Author): \x
##  (Other)
```

4 Analysis

4.1 Question 1: Is there an exposure type that has less impact on bees than non-bee insects?

4.2 Question 2: Are there chemicals that have a high mortality rate for non-bee insects and low rate for bees?

5 Summary and Conclusions

6 References

<add references here if relevant, otherwise delete this section>