

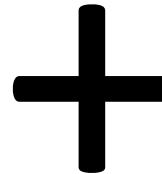
# The Good, The Bad, And The Buzzy: The Impacts Of Pesticides On Pollinators And How To Protect Them

Riley Reed

# Who cares about pollinators?

- Required for 13 crops
- Increase yield in an additional 78 crops

(Klein et al, 2007)



# More Than Just Honey Bees



# More Than Just Honey Bees



# More Than Just Honey Bees



# More Than Just Honey Bees



# More Than Just Honey Bees



# More Than Just Honey Bees



# The 4 P's



## PESTS

Varroa Mites



## PATHOGENS

Virus, Fungus, etc.



## POOR NUTRITION

Where are the flowers?



## PESTICIDES

Necessary Exposure

Sandhill Crane Festival

# Why are bees so susceptible?



(Claudianos et al. 2006)

Bee kills in the news

# The largest native bee kill to date.



<https://xerces.org/wilsonville-bee-kill>

Treated seed was not restricted by the same disposal rules as pesticides



Photo: USDA-NRCS/Lance Cheung

# Nebraska ethanol plant



Photo: Judy Wu-Smart

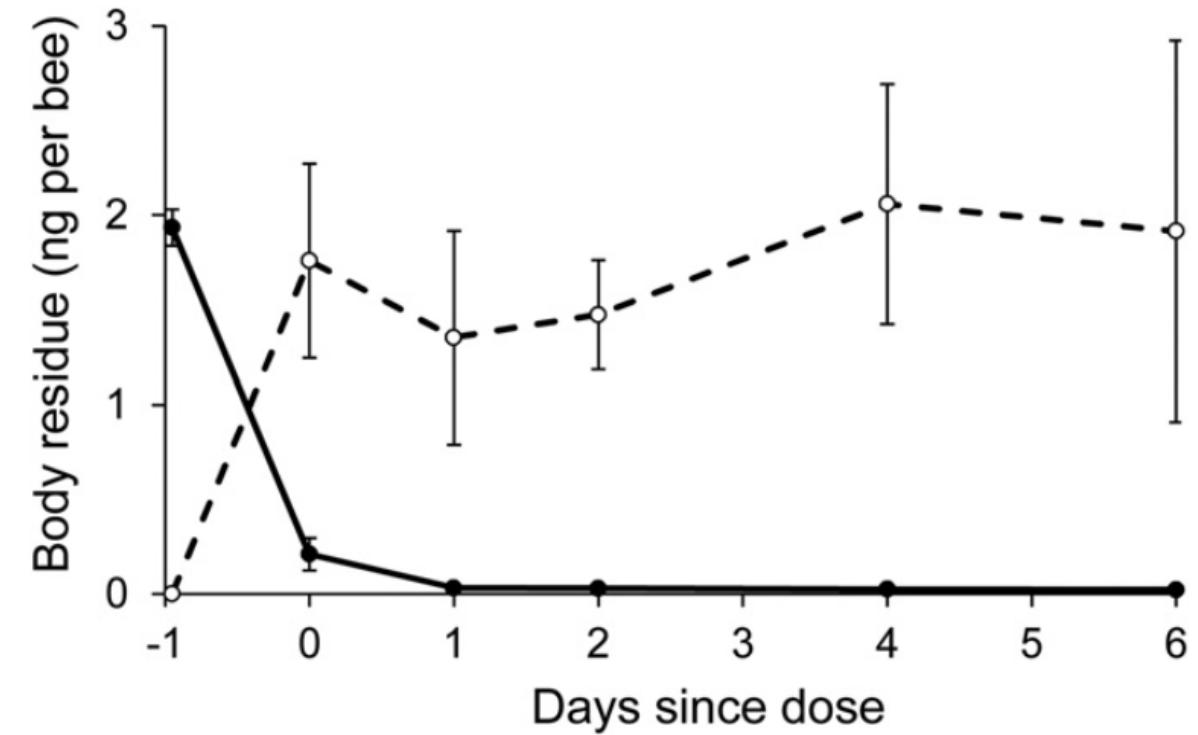
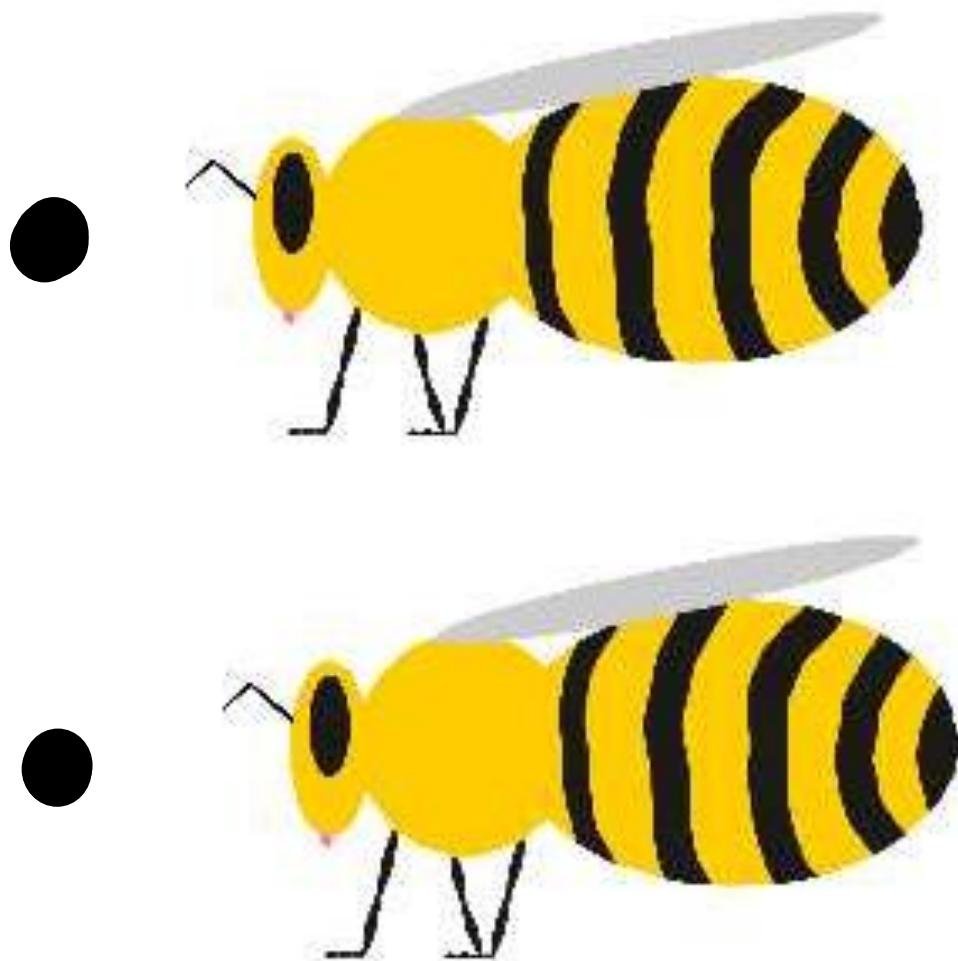
# Excessive dust from corn planting poisoned over 11,500 German hives



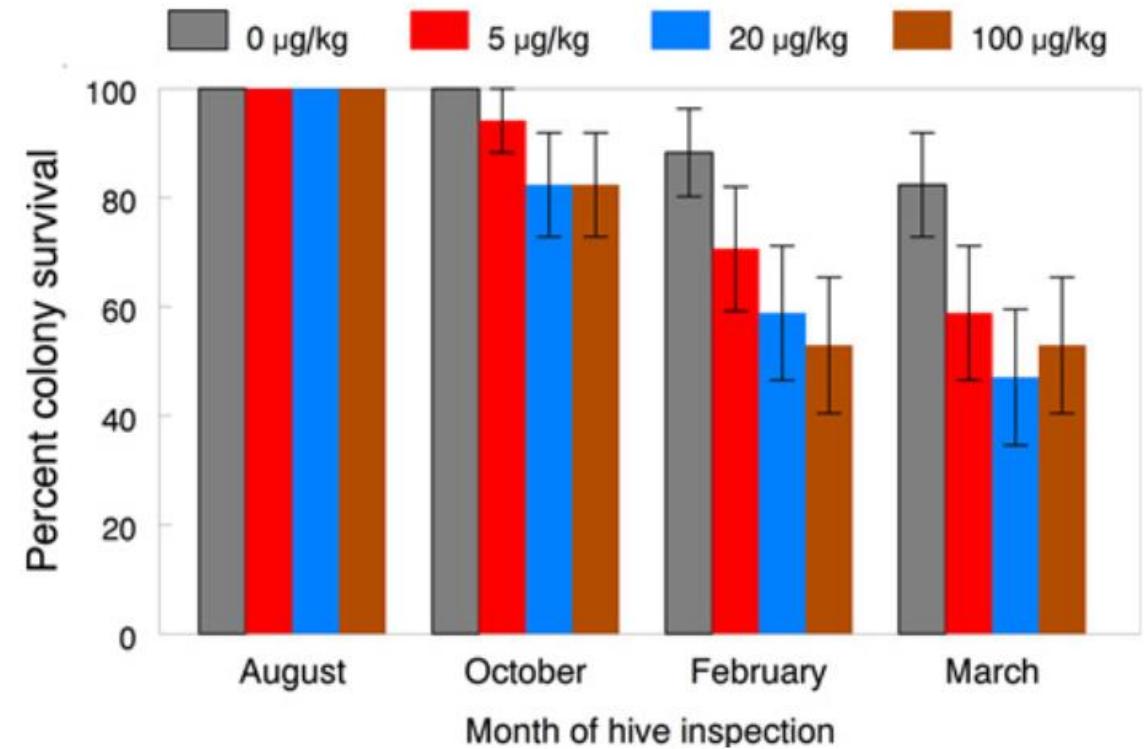
(Nikolakis et al., 2009; Pistorius et al., 2009)

Lethal and sublethal effects

# Fipronil metabolites effectively bioaccumulates in honey bees.



# Chronic exposure to imidacloprid can decrease winter survival



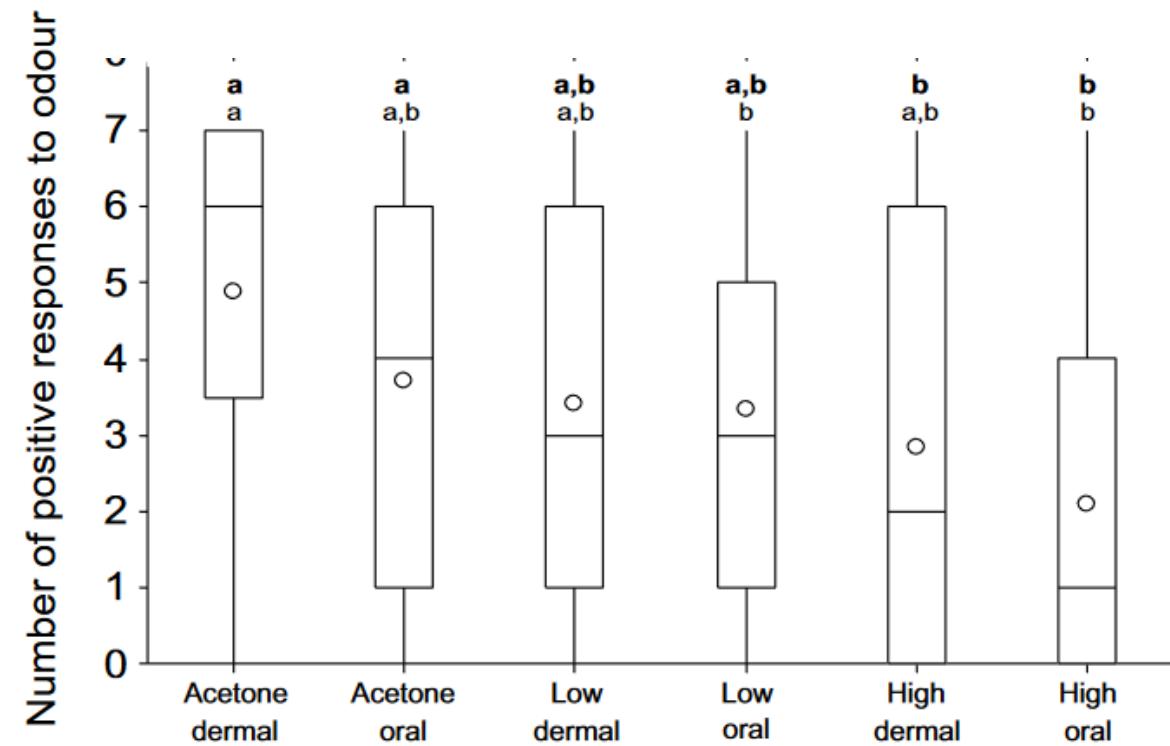
# Learning and memory is vital to honey bee survival.



# Tau-fluvalinate negatively impacts learning and memory in honey bees.



(Matsumoto et al. 2012)

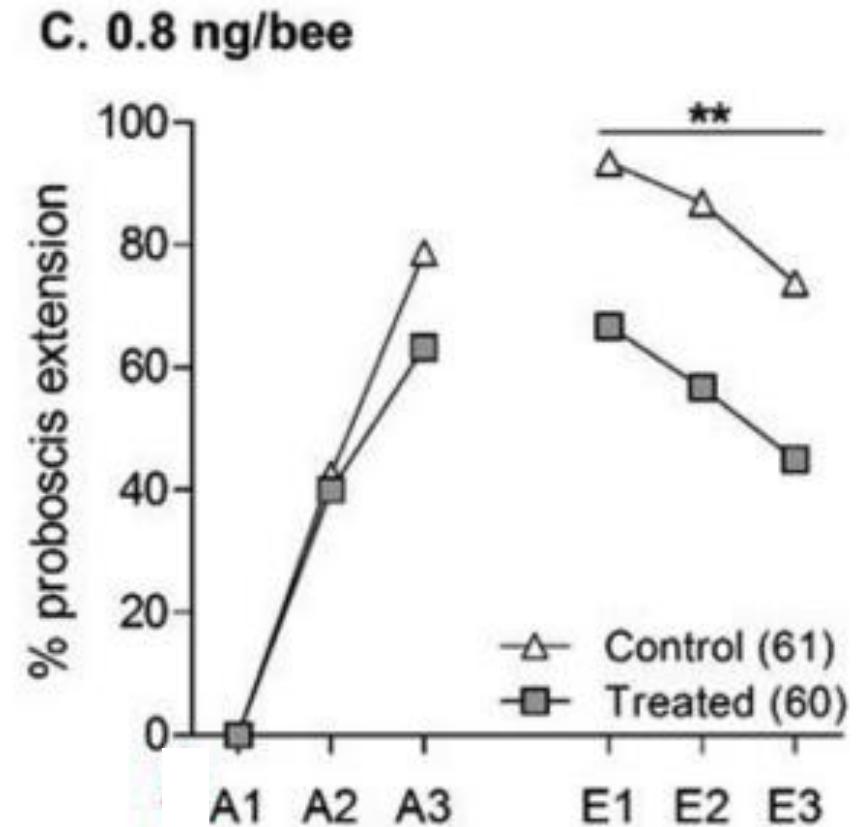


(Frost et al. 2013)

# Clothianidin also negatively impacts honey bee learning and memory.

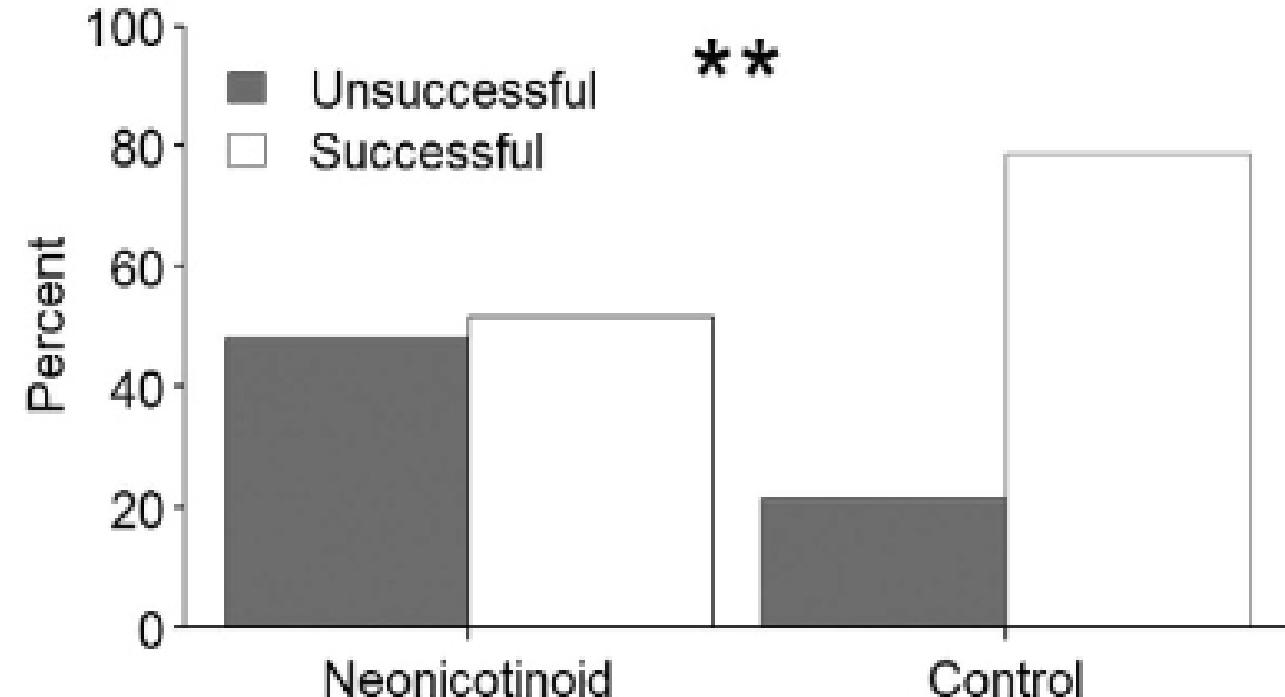


(Matsumoto et al. 2012)



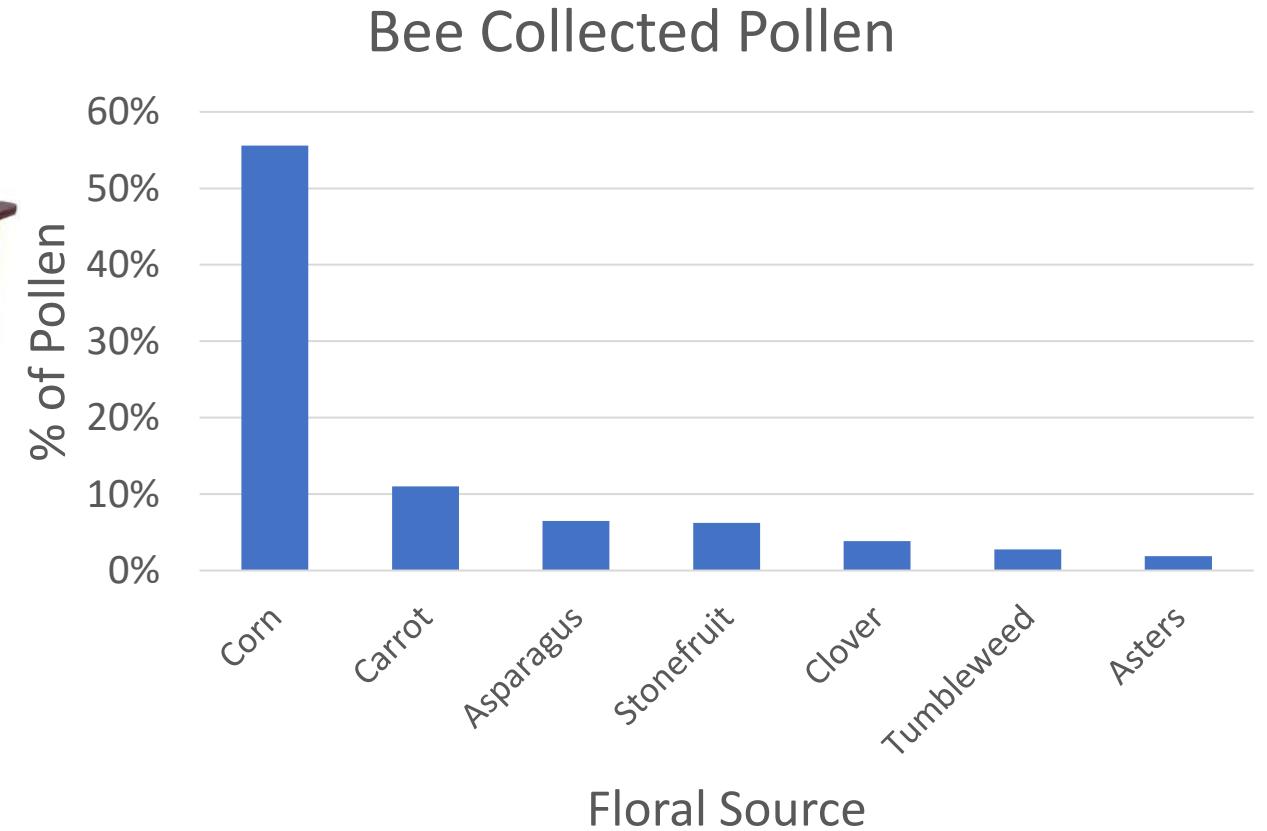
(Tison et al, 2019)

# Exposure to thiamethoxam and clothianidin can negatively impact queen success

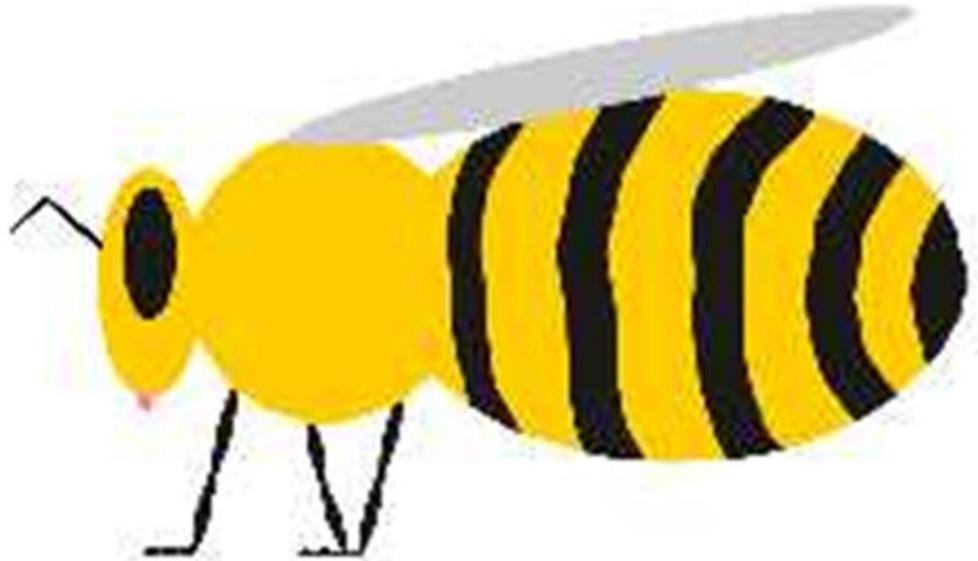
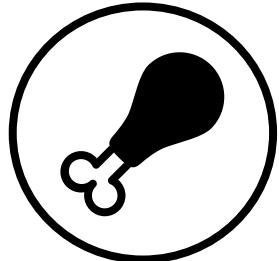


(Williams et al, 2015)

Bees will also visit wind pollinated crops when resources are low.



Bees mistook microencapsulated parathion for pollen, storing it in their hives.

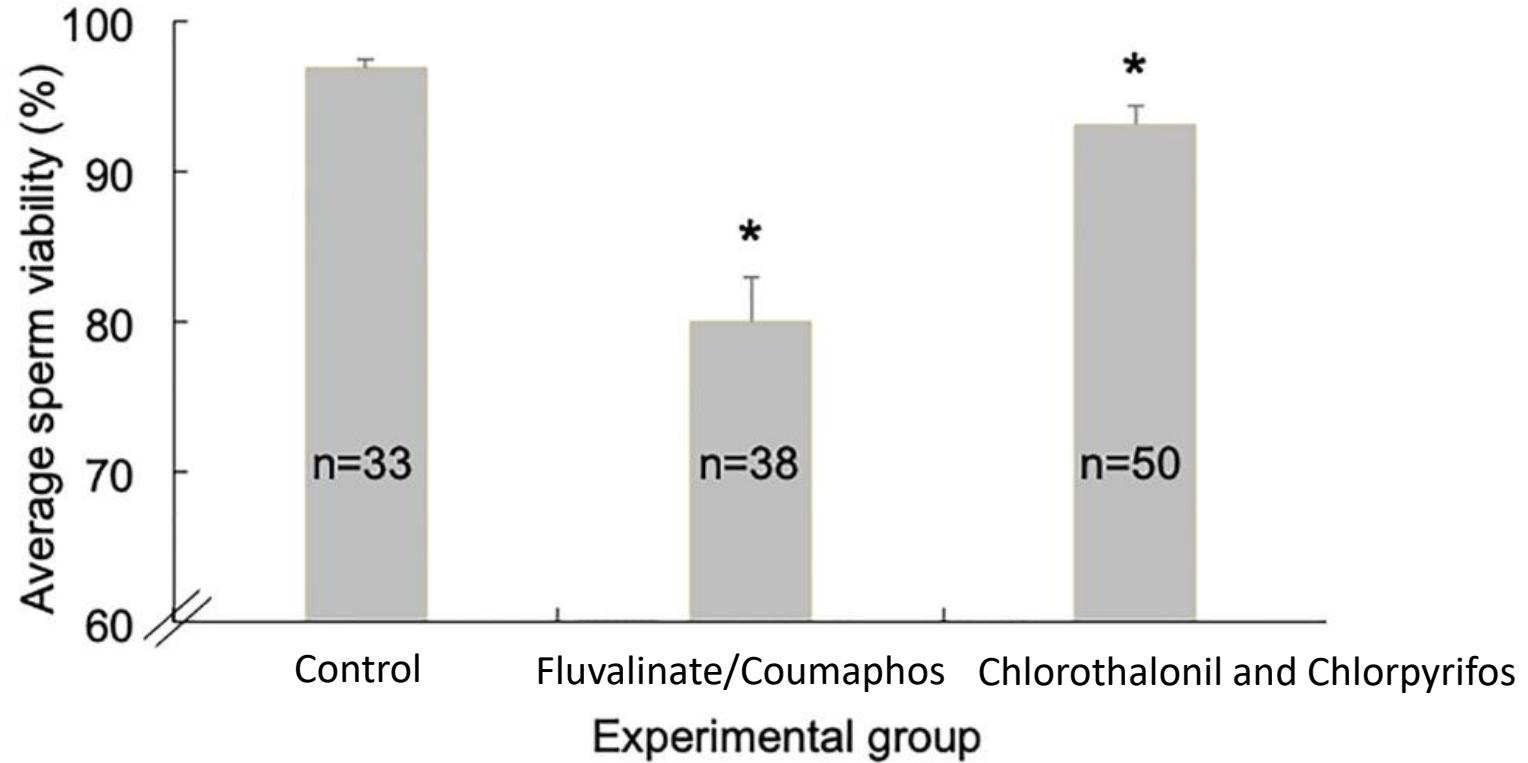


(Burgett & Fisher 1980)

# Beeswax 101

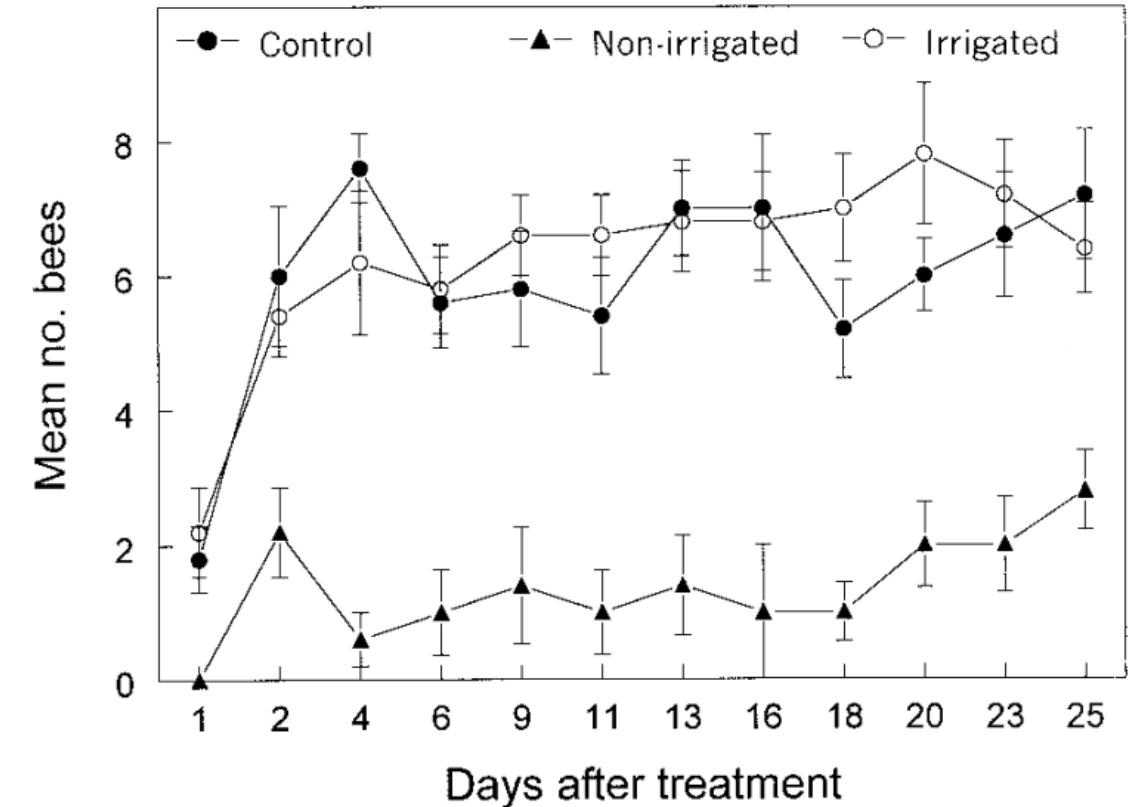
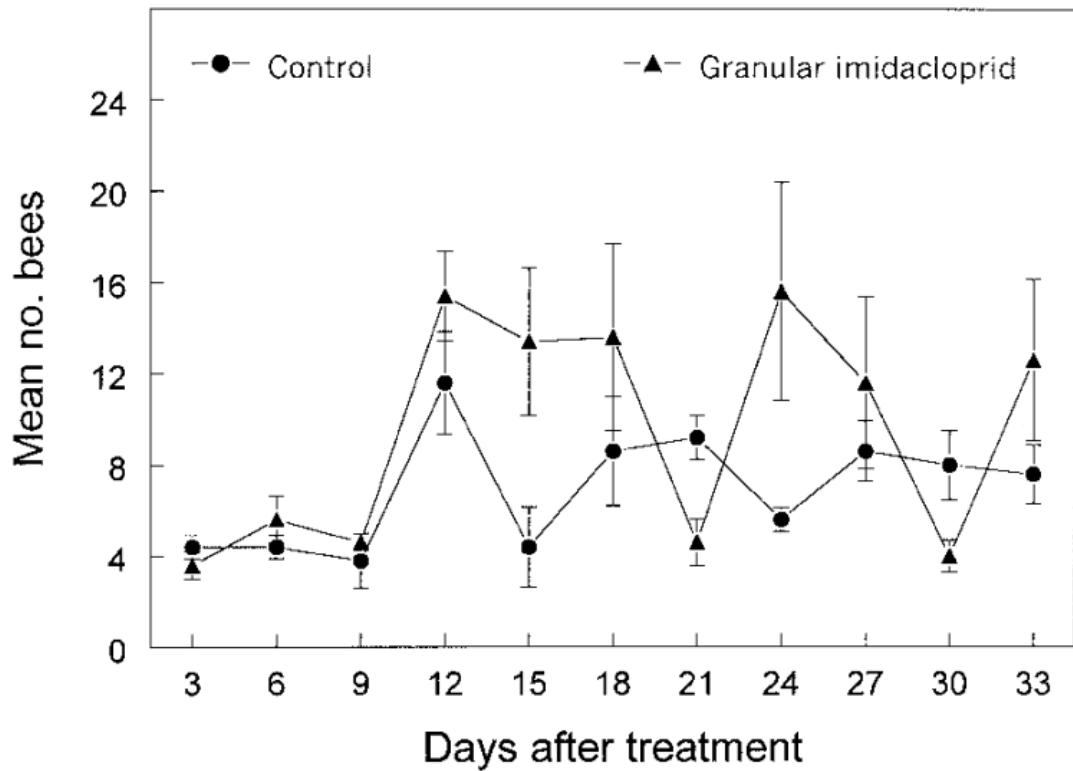


# Chronic exposure through wax decreases sperm viability.



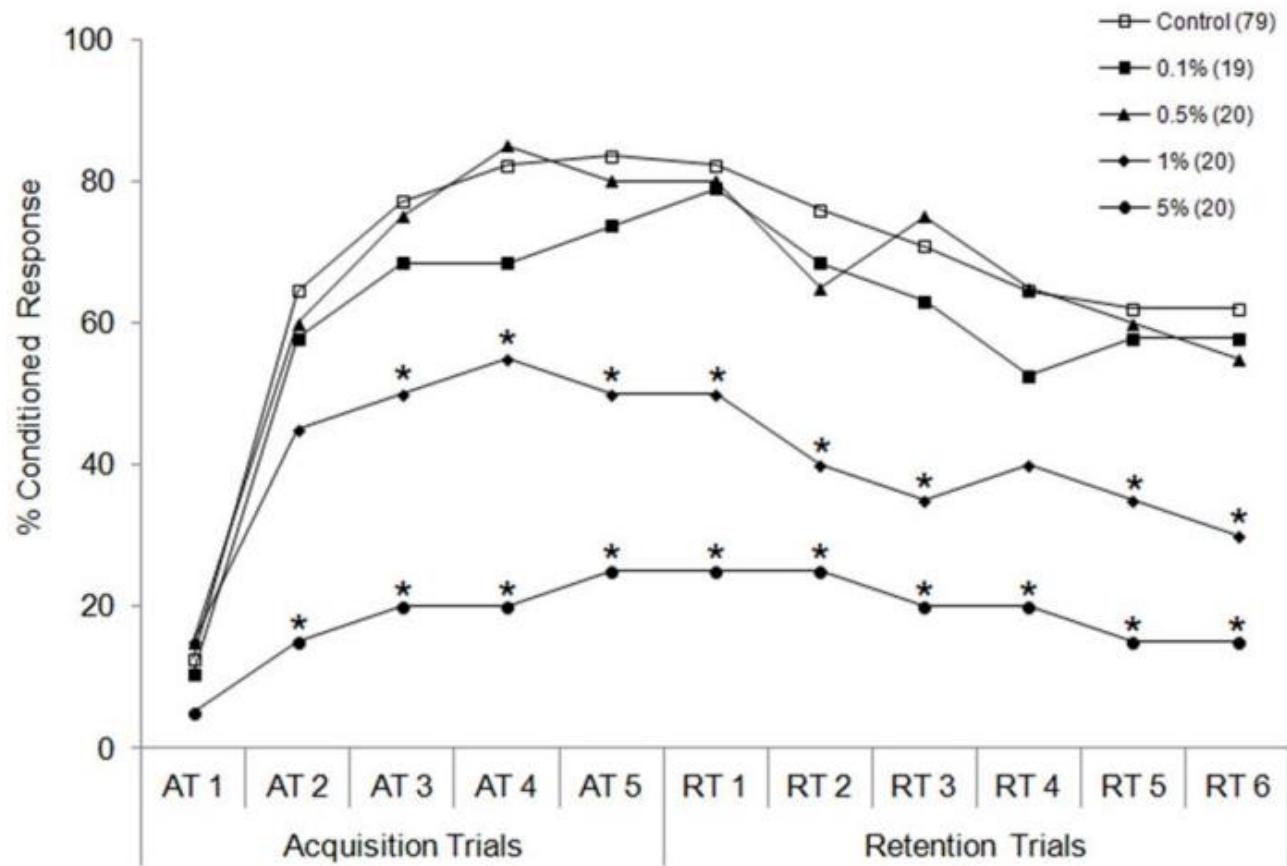
(Bischoff et al., 2023; Fisher II & Rangel, 2018)

# Granular application and post treatment irrigation decrease hazard to bumble bees



(Gels et al., 2002)

# Organosilicone surfactants negatively impact honey bee learning.

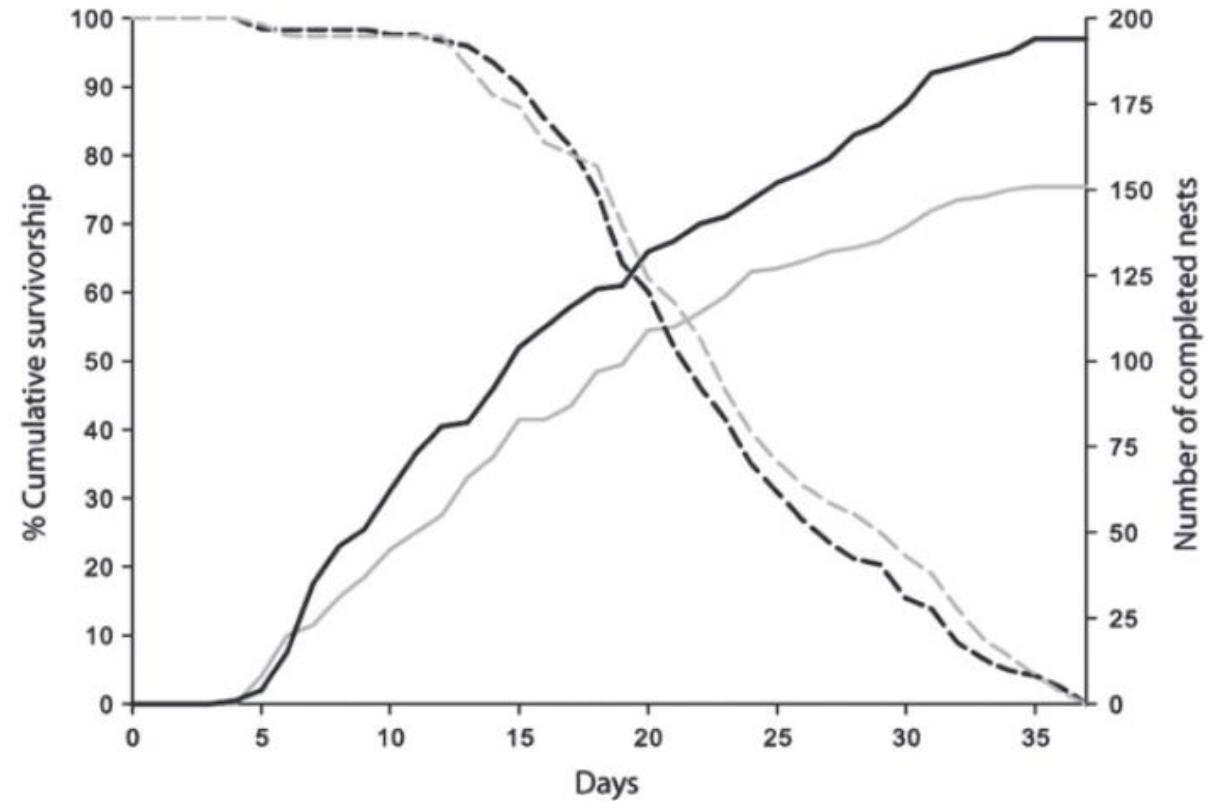


(Ciarlo et al., 2012)

# Red mason bees exposed to neonicotinoids have less reproductive success

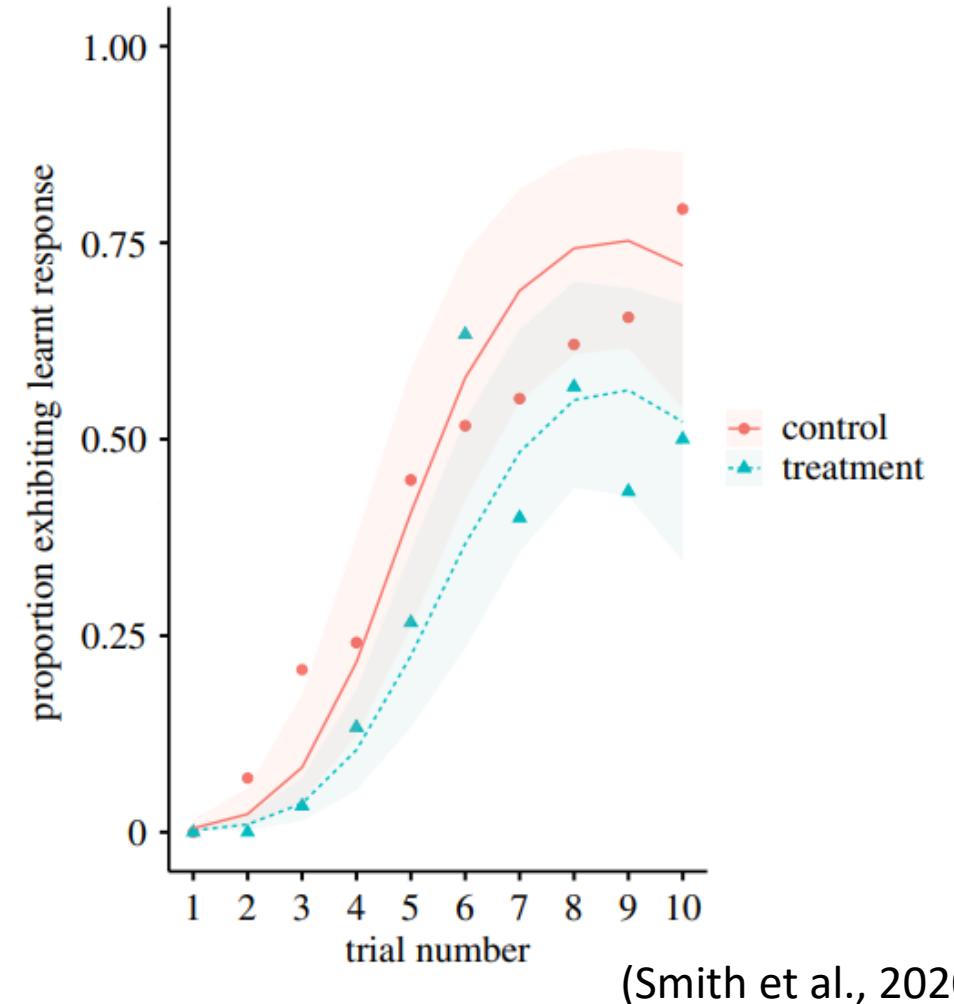
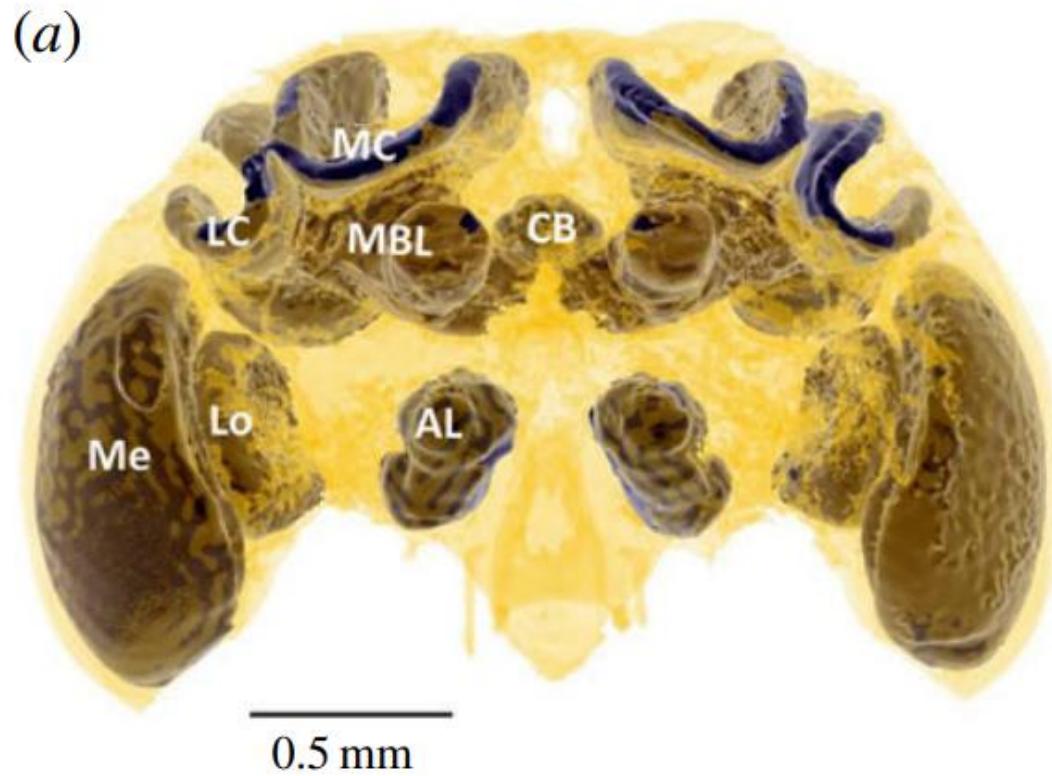


Photo courtesy of <https://www.gardenia.net/guide/mason-bees>

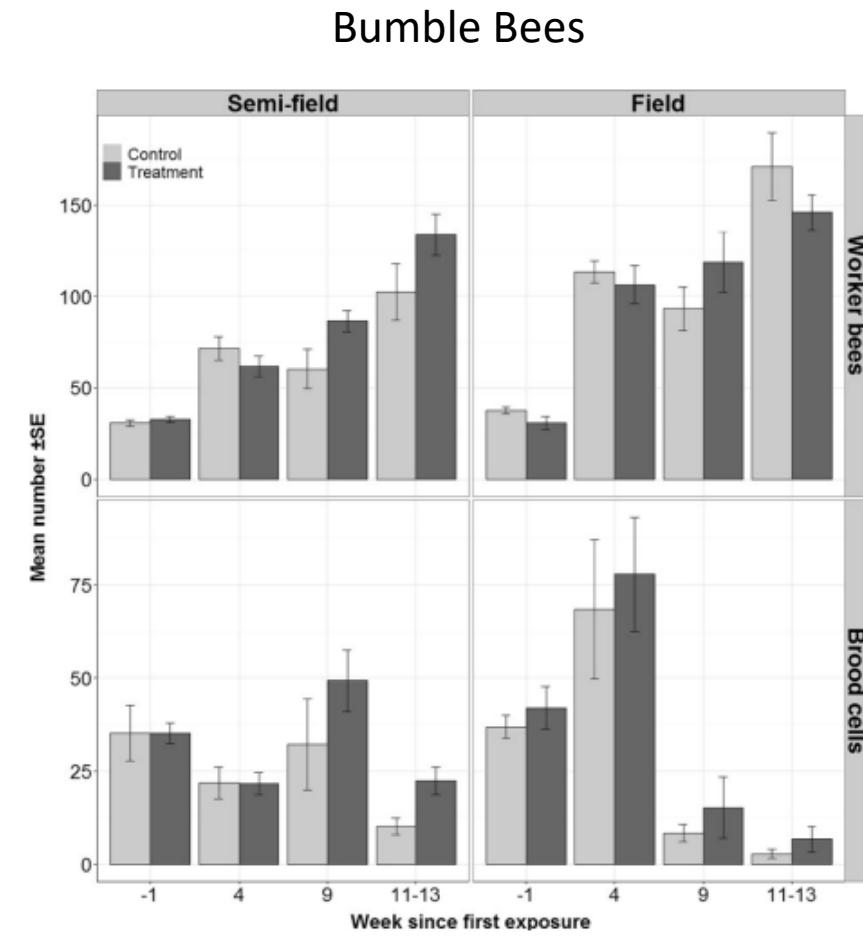
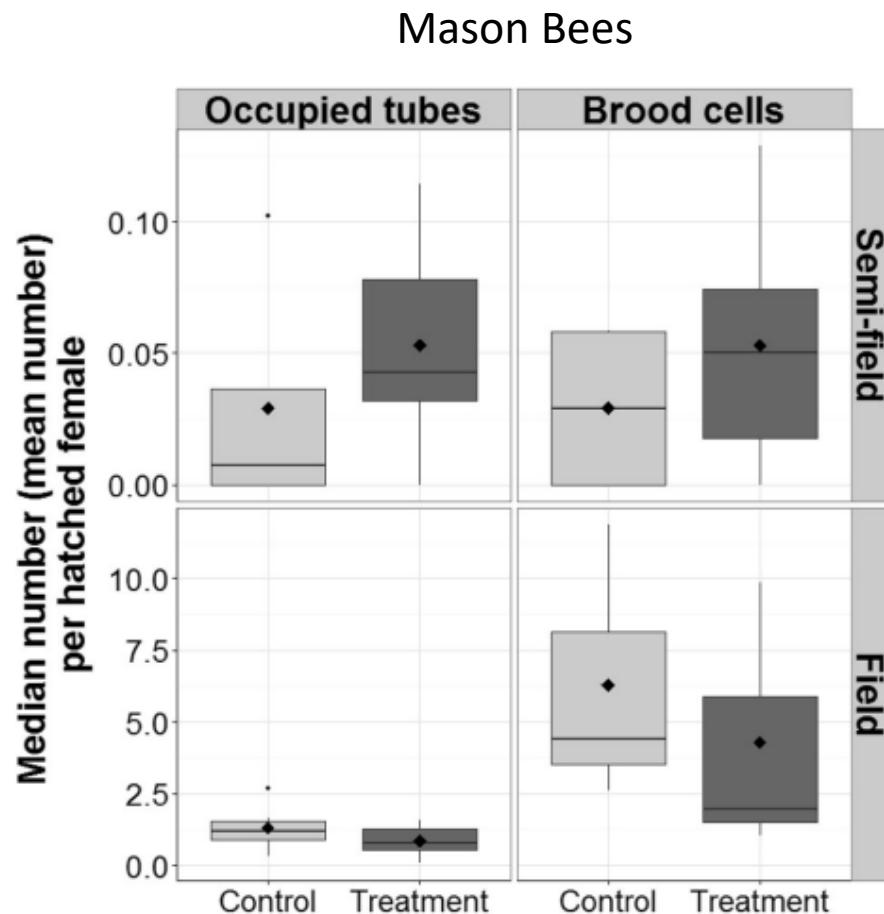


(Sandrock et al, 2014)

# Imidacloprid exposure reduces bumble bee learning and brain volume.



Winter canola grown from treated seed doesn't negatively impact bumble bees or mason bees.

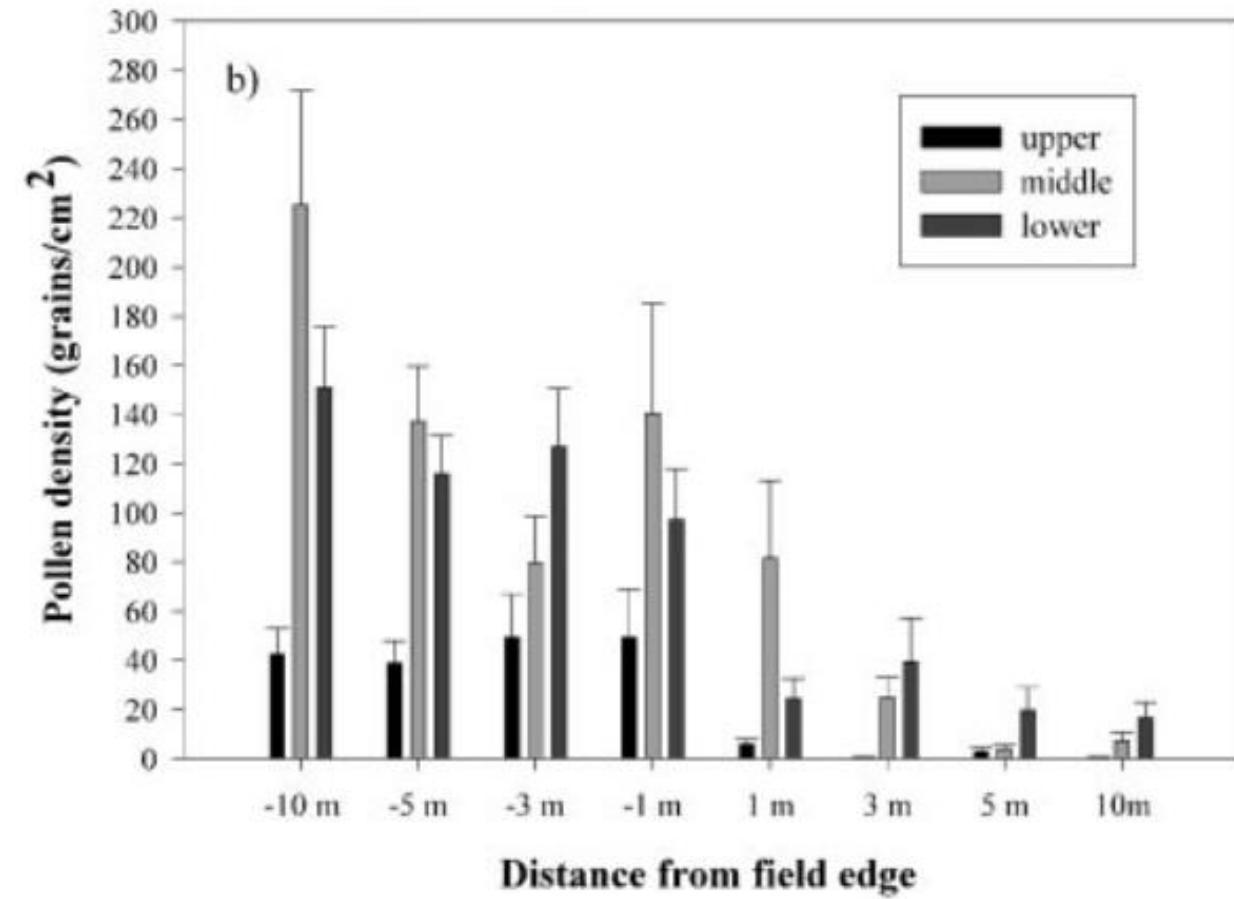


(Dietzsch et al., 2019)

# Does Bt corn kill Monarch caterpillars?



No.

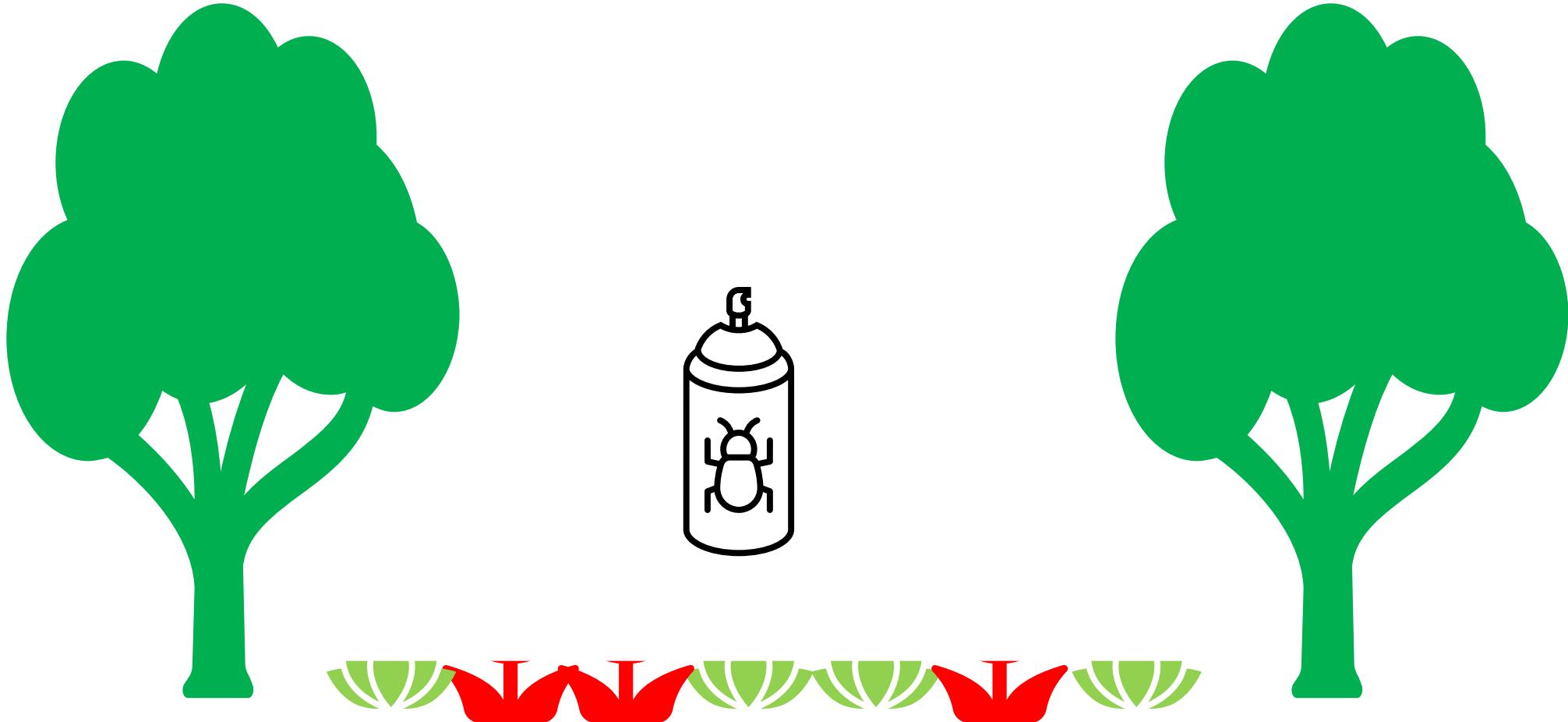


(Pleasants et al, 2001; Sears et al, 2001)

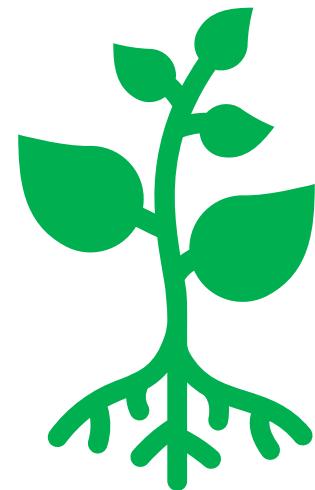
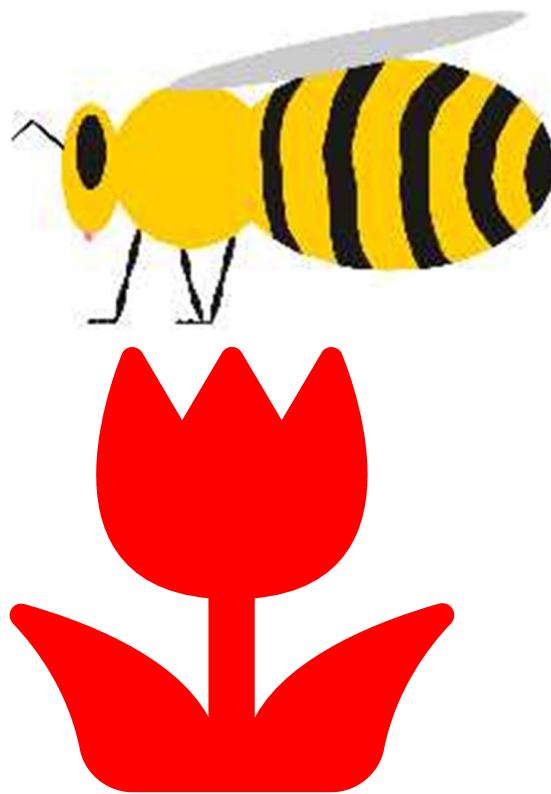
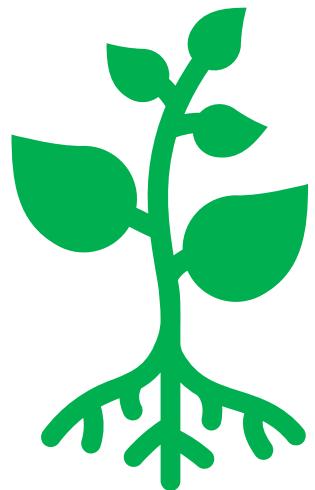
# How to protect the bees

Disclaimer: These are all just general suggestions and not applicable to all pesticides or situations, always consult the label to make sure you are following the law and staying safe!

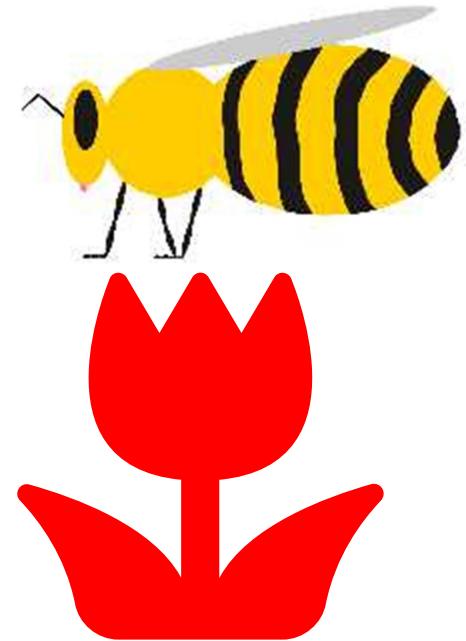
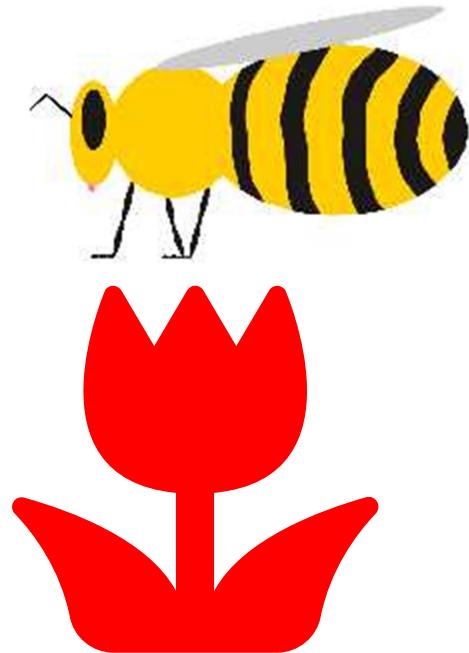
Remove flowers before applying a pesticide.



Try to apply pesticides before or after bloom.



Apply pesticides at sunset or at night when pollinators aren't active.

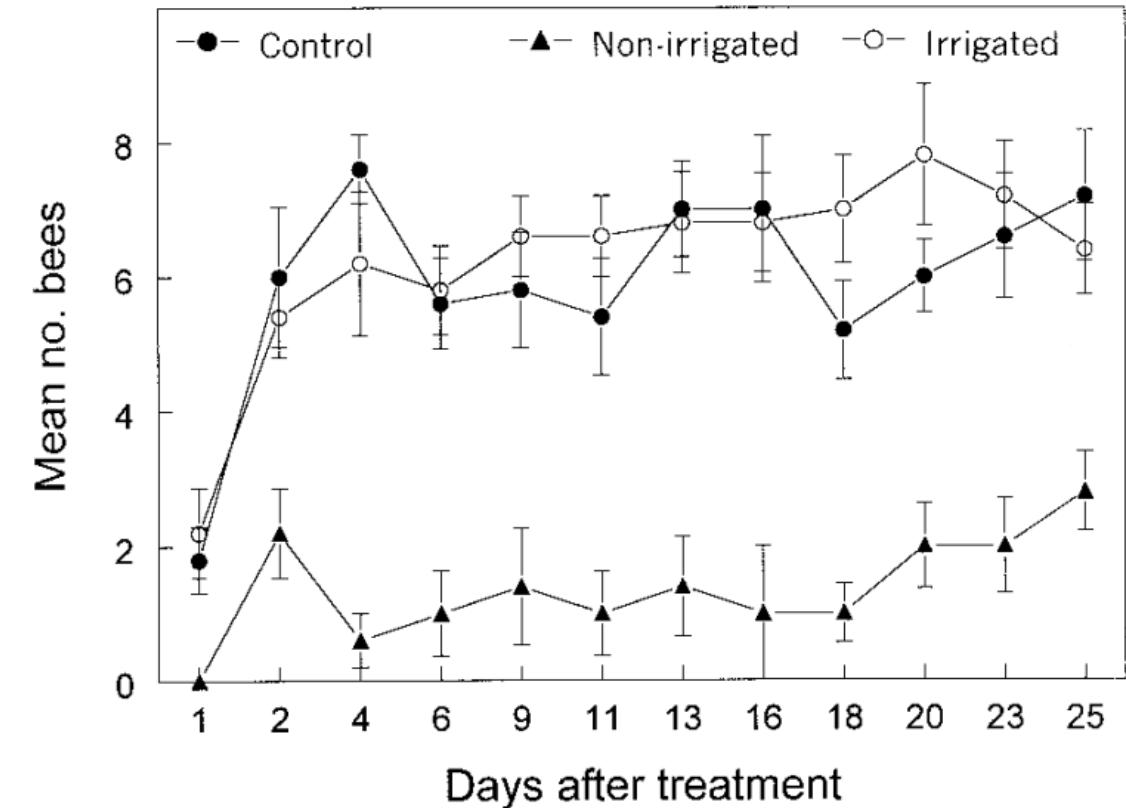
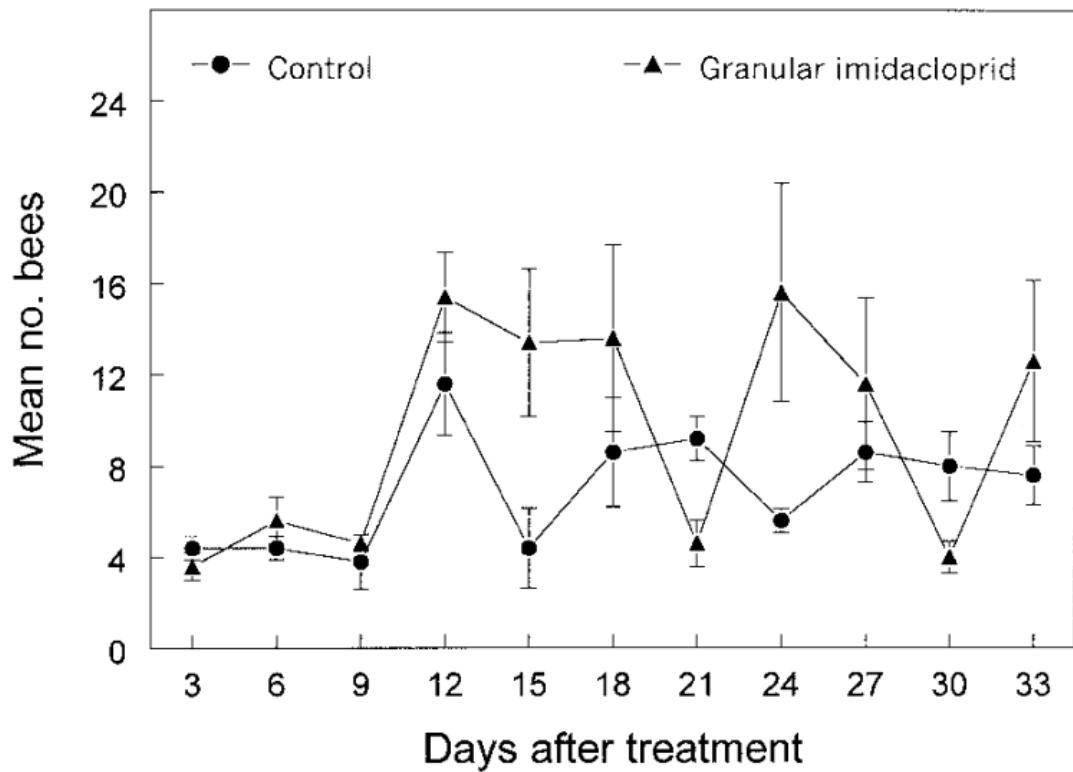


Seed quality and planting techniques can reduce dust emission from treated seed.



(Pochi et al., 2015; Nuyttens et al., 2013)

# Utilize formulations that are safer for pollinators



(Gels et al., 2002)

# Finally, communicate with beekeepers.



Photo credit:  
Beeline Honey

# References

- Bischoff, K., Baert, N., & McArt, S. (2023). Pesticide contamination of beeswax from managed honey bee colonies in New York State. *Journal of Veterinary Diagnostic Investigation*, 35(6), 617–624. <https://doi.org/10.1177/10406387231199098>
- Burgett, M., & Fisher, G. C. (1980). Recovery of Penncap-M® from Foraging Honey Bees 1 and Pollen Storage Cells 2. *Environmental Entomology*, 9(4), 430–431. <https://doi.org/10.1093/ee/9.4.430>
- Ciarlo, T. J., Mullin, C. A., Frazier, J. L., & Schmehl, D. R. (2012). Learning Impairment in Honey Bees Caused by Agricultural Spray Adjuvants. *PLoS ONE*, 7(7), e40848. <https://doi.org/10.1371/journal.pone.0040848>
- Claudianos, C., Ranson, H., Johnson, R. M., Biswas, S., Schuler, M. A., Berenbaum, M. R., Feyereisen, R., & Oakeshott, J. G. (2006). A deficit of detoxification enzymes: Pesticide sensitivity and environmental response in the honeybee. *Insect Molecular Biology*, 15(5), 615–636. <https://doi.org/10.1111/j.1365-2583.2006.00672.x>
- Dively, G. P., Embrey, M. S., Kamel, A., Hawthorne, D. J., & Pettis, J. S. (2015). Assessment of Chronic Sublethal Effects of Imidacloprid on Honey Bee Colony Health. *PLOS ONE*, 10(3), e0118748. <https://doi.org/10.1371/journal.pone.0118748>
- Fisher II, A. F., & Rangel, J. (2018). Exposure to pesticides during development negatively affects honey bee (*Apis mellifera*) drone sperm viability. *PLOS ONE*, 13(12), e0208630. <https://doi.org/10.1371/journal.pone.0208630>
- Frost, E. H., Shutler, D., & Hillier, N. K. (2013). Effects of fluvalinate on honey bee learning, memory, responsiveness to sucrose, and survival. *Journal of Experimental Biology*, 216(15), 2931–2938. <https://doi.org/10.1242/jeb.086538>
- Gels, J. A., Held, D. W., & Potter, D. A. (2002). Hazards of Insecticides to the Bumble Bees (*Bombus impatiens*) (Hymenoptera: Apidae) Foraging on Flowering White Clover in Turf. *Journal of Economic Entomology*, 95(4), 722–728. <https://doi.org/10.1603/0022-0493-95.4.722>
- Holder, P. J., Jones, A., Tyler, C. R., & Cresswell, J. E. (2018). Fipronil pesticide as a suspect in historical mass mortalities of honey bees. *Proceedings of the National Academy of Sciences*, 115(51), 13033–13038. <https://doi.org/10.1073/pnas.1804934115>
- Hoyle, S., & Black, S. (n.d.). *Ethanol Plant Causes Severe Pesticide Contamination in Nebraska*. Xerces Society. Retrieved November 23, 2023, from <https://www.xerces.org/blog/ethanol-plant-causes-severe-pesticide-contamination-in-nebraska>
- Klein, A.-M., Vaissière, B. E., Cane, J. H., Steffan-Dewenter, I., Cunningham, S. A., Kremen, C., & Tscharntke, T. (2007). Importance of pollinators in changing landscapes for world crops. *Proceedings of the Royal Society B: Biological Sciences*, 274(1608), Article 1608. <https://doi.org/10.1098/rspb.2006.3721>
- Pleasants, J. M., Hellmich, R. L., Dively, G. P., Sears, M. K., Stanley-Horn, D. E., Mattila, H. R., Foster, J. E., Clark, P., & Jones, G. D. (2001). Corn pollen deposition on milkweeds in and near cornfields. *Proceedings of the National Academy of Sciences*, 98(21), 11919–11924. <https://doi.org/10.1073/pnas.211287498>

# References

- Sandrock, C., Tanadini, L. G., Pettis, J. S., Biesmeijer, J. C., Potts, S. G., & Neumann, P. (2014). Sublethal neonicotinoid insecticide exposure reduces solitary bee reproductive success. *Agricultural and Forest Entomology*, 16(2), 119–128. <https://doi.org/10.1111/afe.12041>
- Sears, M. K., Hellmich, R. L., Stanley-Horn, D. E., Oberhauser, K. S., Pleasants, J. M., Mattila, H. R., Siegfried, B. D., & Dively, G. P. (2001). Impact of Bt corn pollen on monarch butterfly populations: A risk assessment. *Proceedings of the National Academy of Sciences*, 98(21), 11937–11942. <https://doi.org/10.1073/pnas.211329998>
- Smith, D. B., Arce, A. N., Ramos Rodrigues, A., Bischoff, P. H., Burris, D., Ahmed, F., & Gill, R. J. (2020). Insecticide exposure during brood or early-adult development reduces brain growth and impairs adult learning in bumblebees. *Proceedings of the Royal Society B: Biological Sciences*, 287(1922), 20192442. <https://doi.org/10.1098/rspb.2019.2442>
- *The Wilsonville Bee Kill | Xerces Society*. (n.d.). Retrieved November 23, 2023, from <https://xerces.org/wilsonville-bee-kill>
- Tison, L., Rößner, A., Gerschewski, S., & Menzel, R. (2019). The neonicotinoid clothianidin impairs memory processing in honey bees. *Ecotoxicology and Environmental Safety*, 180, 139–145. <https://doi.org/10.1016/j.ecoenv.2019.05.007>
- Williams, G. R., Troxler, A., Retschnig, G., Roth, K., Yañez, O., Shutler, D., Neumann, P., & Gauthier, L. (2015). Neonicotinoid pesticides severely affect honey bee queens. *Scientific Reports*, 5(1), Article 1. <https://doi.org/10.1038/srep14621>
- Dietzsch, A. C., Kunz, N., Wirtz, I. P., Stähler, M., Heimbach, U., & Pistorius, J. (2019). Does winter oilseed rape grown from clothianidin-coated seeds affect experimental populations of mason bees and bumblebees? A semi-field and field study. *Journal of Consumer Protection and Food Safety*, 14(3), 223–238. <https://doi.org/10.1007/s00003-019-01225-5>
- Pochi, D., Biocca, M., Fanigliulo, R., Gallo, P., Fedrizzi, M., Pulcini, P., Perrino, C., & Marcovecchio, F. (2015). A device for pneumatic precision drills reducing the drift of the abrasion dust from dressed seed. *Crop Protection*, 74, 56–64. <https://doi.org/10.1016/j.cropro.2015.02.026>
- Nuyttens, D., Devarrewaere, W., Verboven, P., & Foqué, D. (2013). Pesticide-laden dust emission and drift from treated seeds during seed drilling: A review. *Pest Management Science*, 69(5), 564–575. <https://doi.org/10.1002/ps.3485>
- Pistorius, J., Bischoff, G., Heimbach, U., & Stähler, M. (2009). Bee poisoning incidents in Germany in spring 2008 caused by abrasion of active substance from treated seeds during sowing of maize. *Hazards of Pesticides to Bees*.
- Nikolakis, A., Chapple, A., Friessleben, R., Neumann, P., Schad, T., Schmuck, R., Schnier, H.-F., Schnorbach, H.-J., Schöning, R., & Maus, C. (2009). An effective risk management approach to prevent bee damage due to the emission of abraded seed treatment particles during sowing of seeds treated with bee toxic insecticides. *Hazards of Pesticides to Bees*.
- Hooven, L. A., Chakrabarti, P., Harper, B. J., Sagili, R. R., & Harper, S. L. (2019). Potential Risk to Pollinators from Nanotechnology-Based Pesticides. *Molecules*, 24(24). <https://doi.org/10.3390/molecules24244458>

# Questions?

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