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

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Who cares about pollinators?

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

(Klein et al, 2007)

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More Than Just Honey Bees

More Than Just Honey Bees

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More Than Just Honey Bees

The 4 P's

Sandhill Crane Festival

PESTS
Varroa Mites

PATHOGENS
Virus, Fungus, etc.

POOR NUTRITION
Where are the flowers?

PESTICIDES
Neccesary Exposure

Graphic courtesy of Project Apis m.

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

https://www.xerces.org/blog/ethanol-plant-causes-severe-pesticide-contamination-in-nebraska

Nebraska ethanol plant

Photo: Judy Wu-Smart

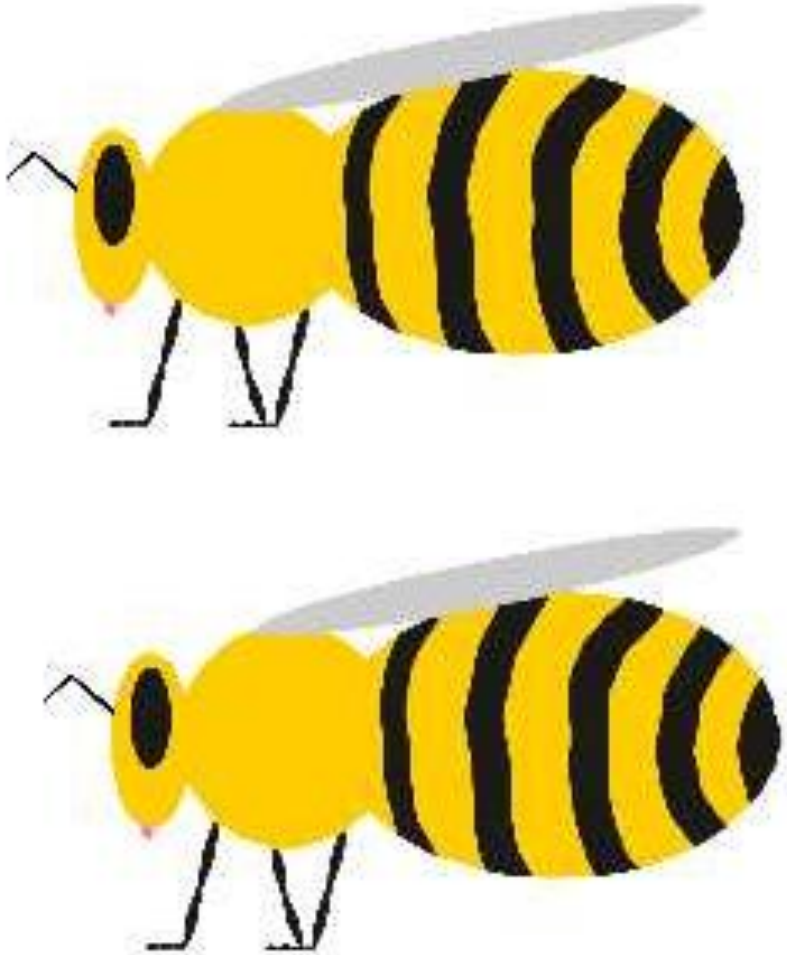
https://www.xerces.org/blog/ethanol-plant-causes-severe-pesticide-contamination-in-nebraska

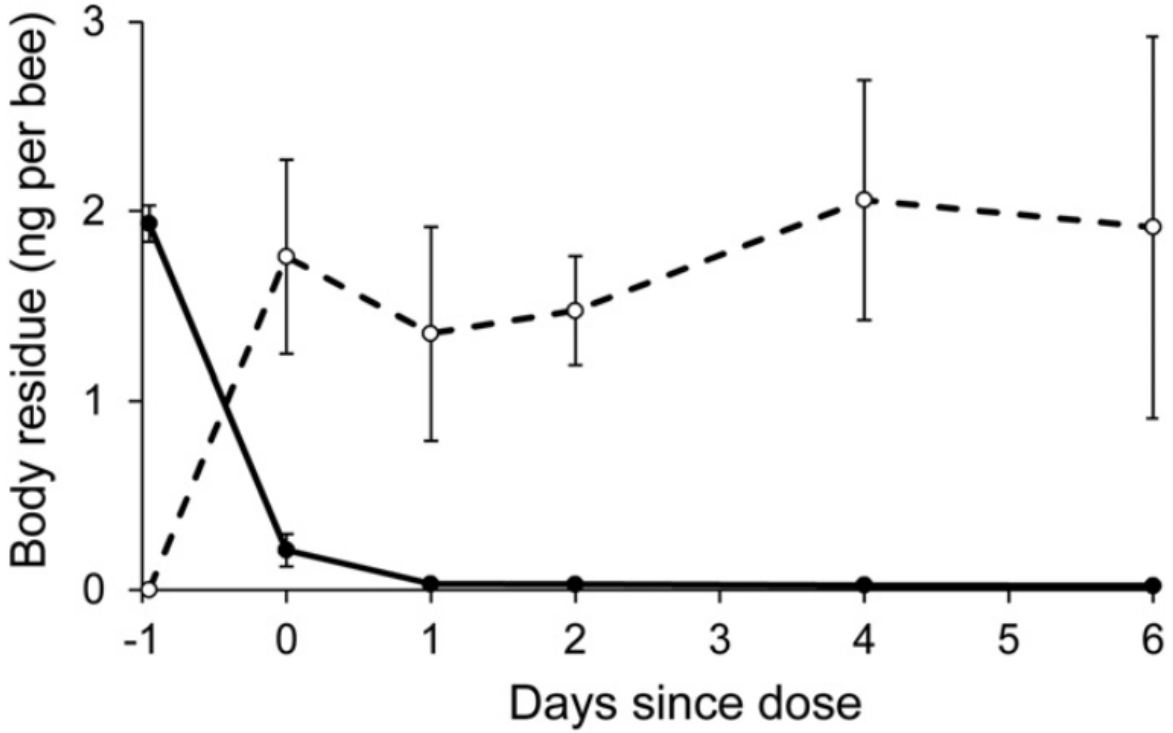
Excessive dust from corn planting poisoned over 11,500 German hives

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

Lethal and sublethal effects

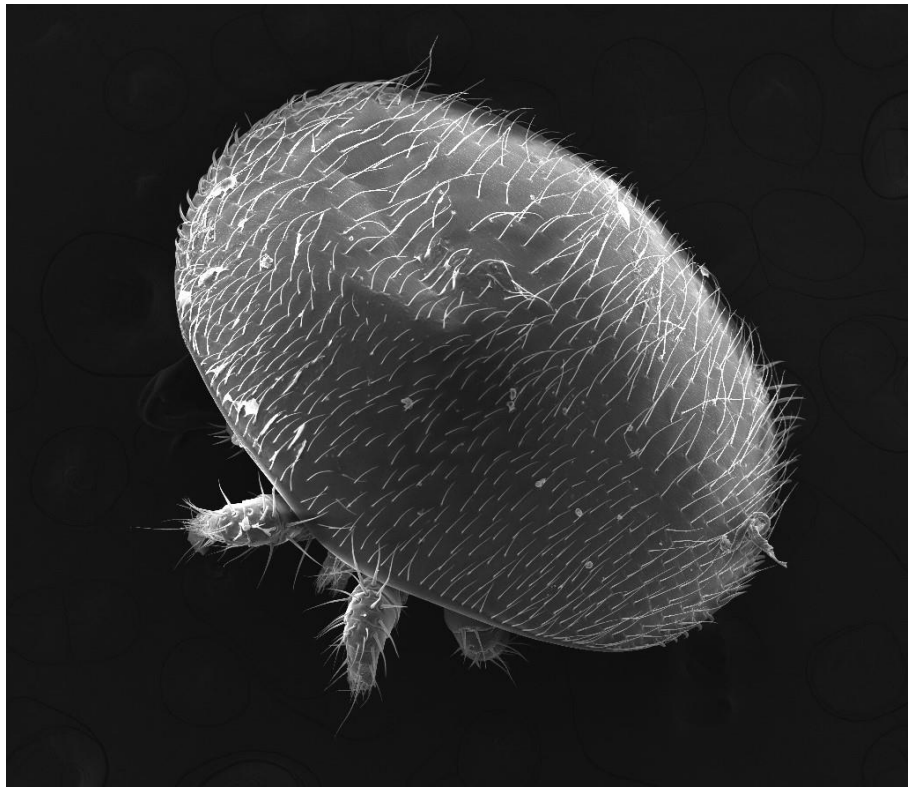
Fipronil metabolites effectively bioaccumulates in honey bees.

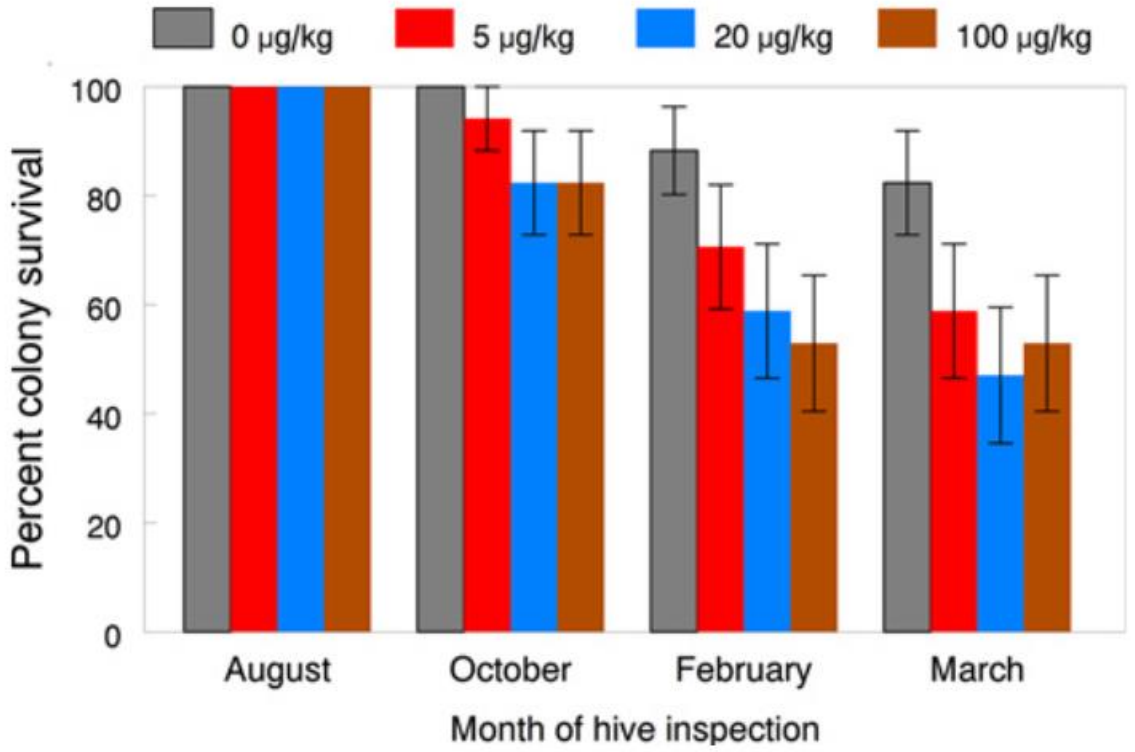




(Holder et al. 2018)

Chronic exposure to imidacloprid can decrease winter survival



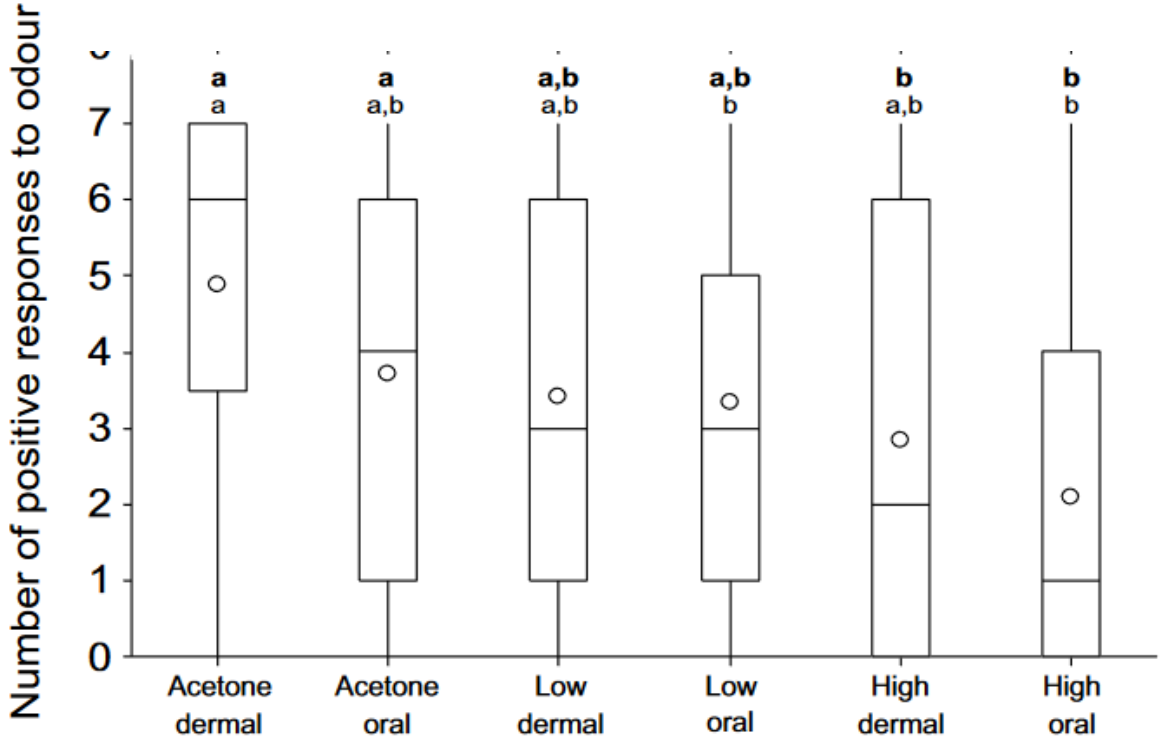


(Dively et al. 2015)

Learning and memory is vital to honey bee survival.

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

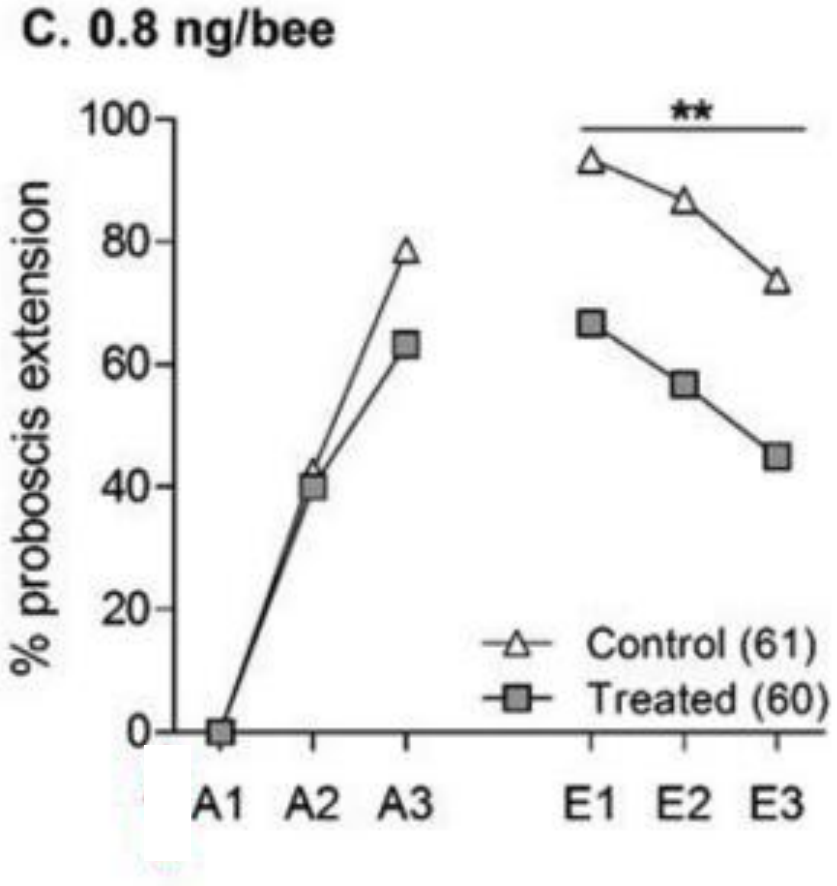
(Matsumoto et al. 2012)



(Frost et al. 2013)

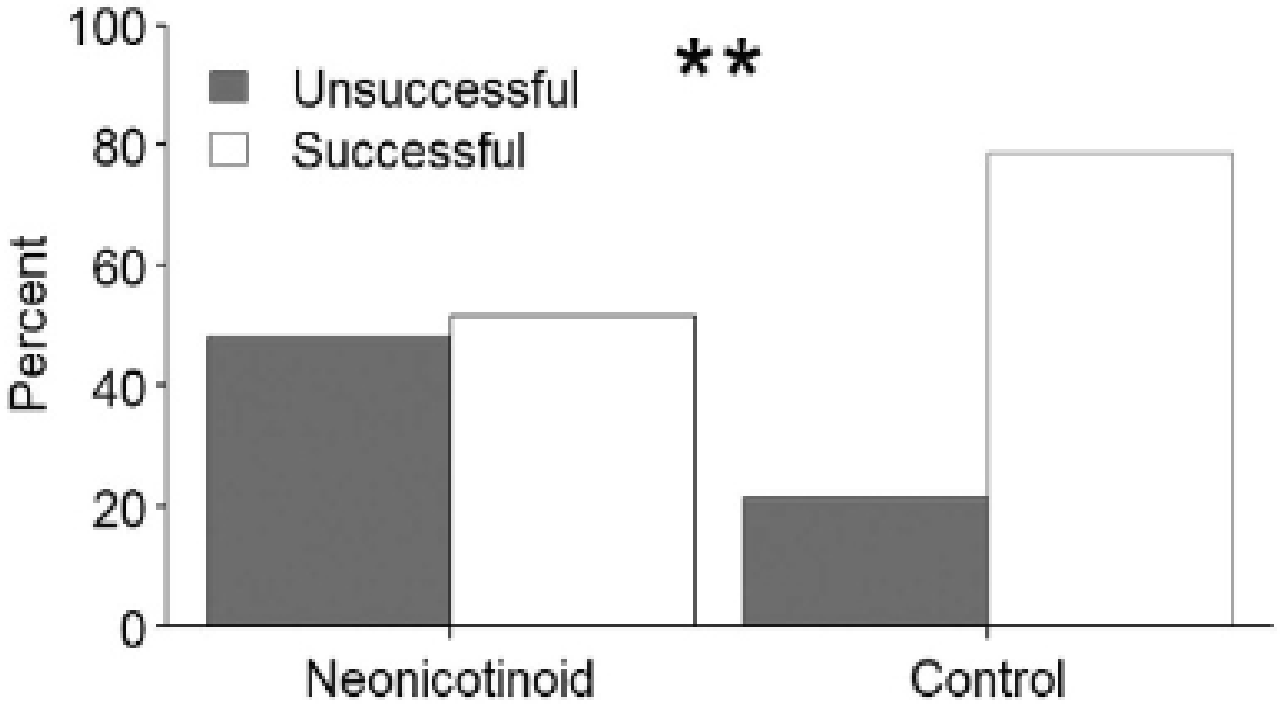
Clothianidin also negatively impacts honey bee learning and memory.

(Matsumoto et al. 2012)



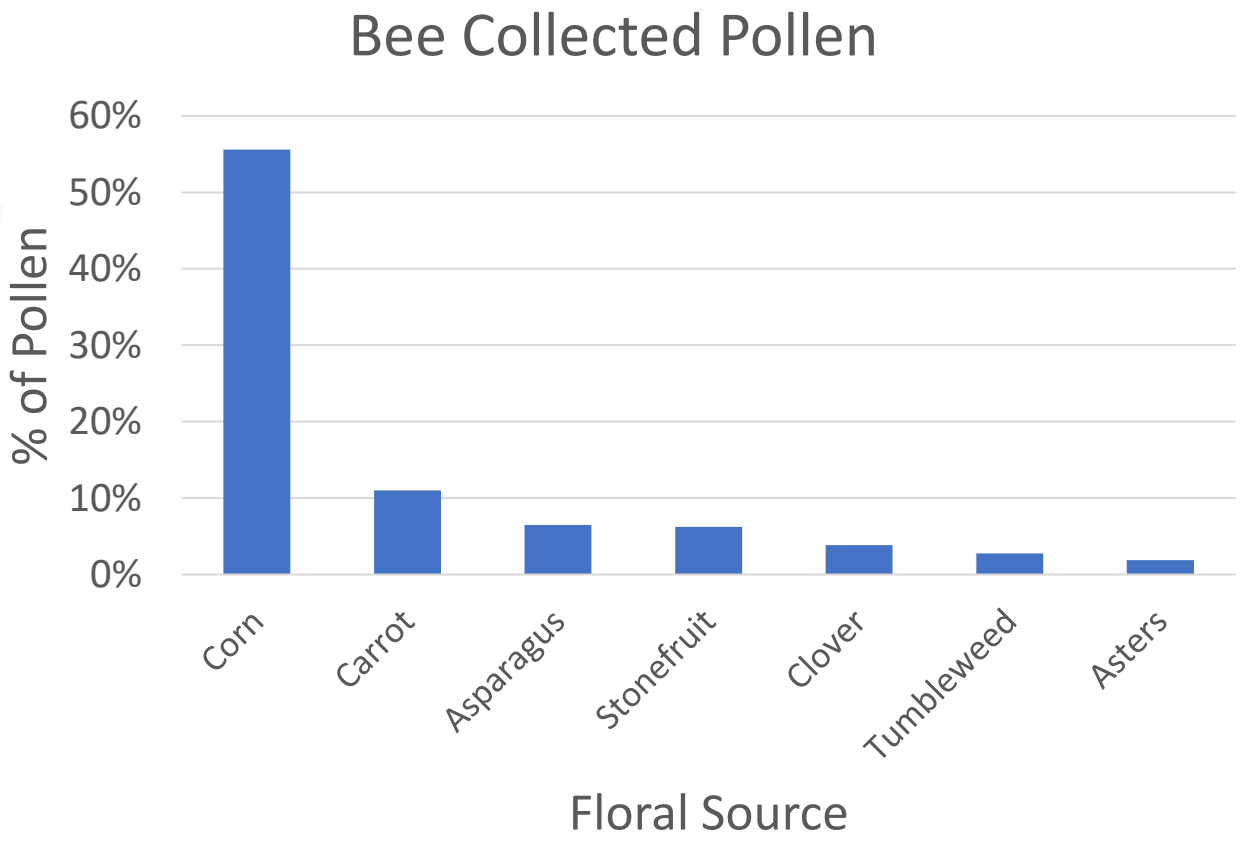
(Tison et al, 2019)

Exposure to thiamethoxam and clothianidin can negatively impact queen success

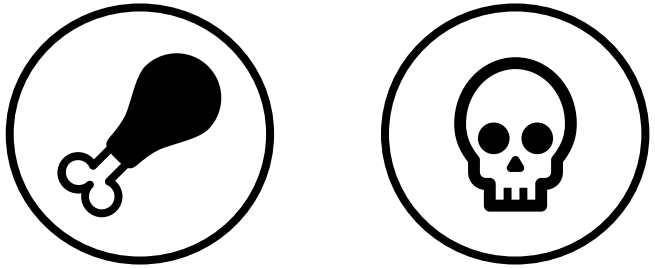


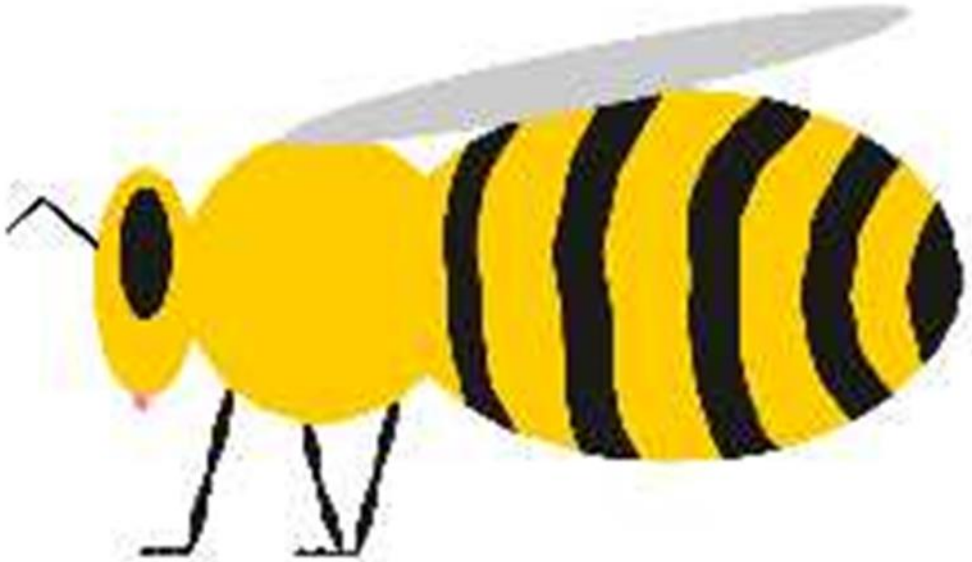
(Williams et al, 2015)

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



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

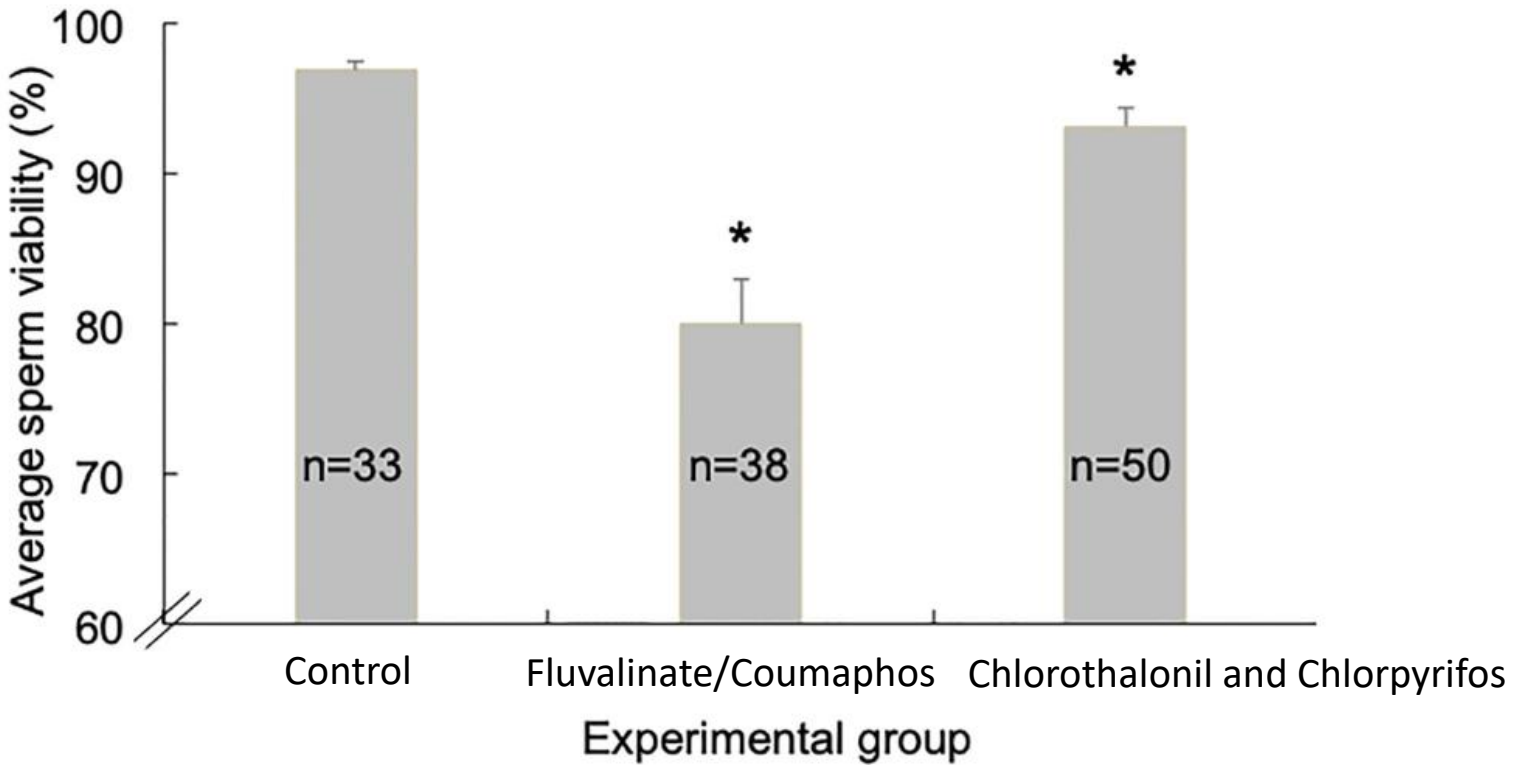




(Burgett & Fisher 1980)

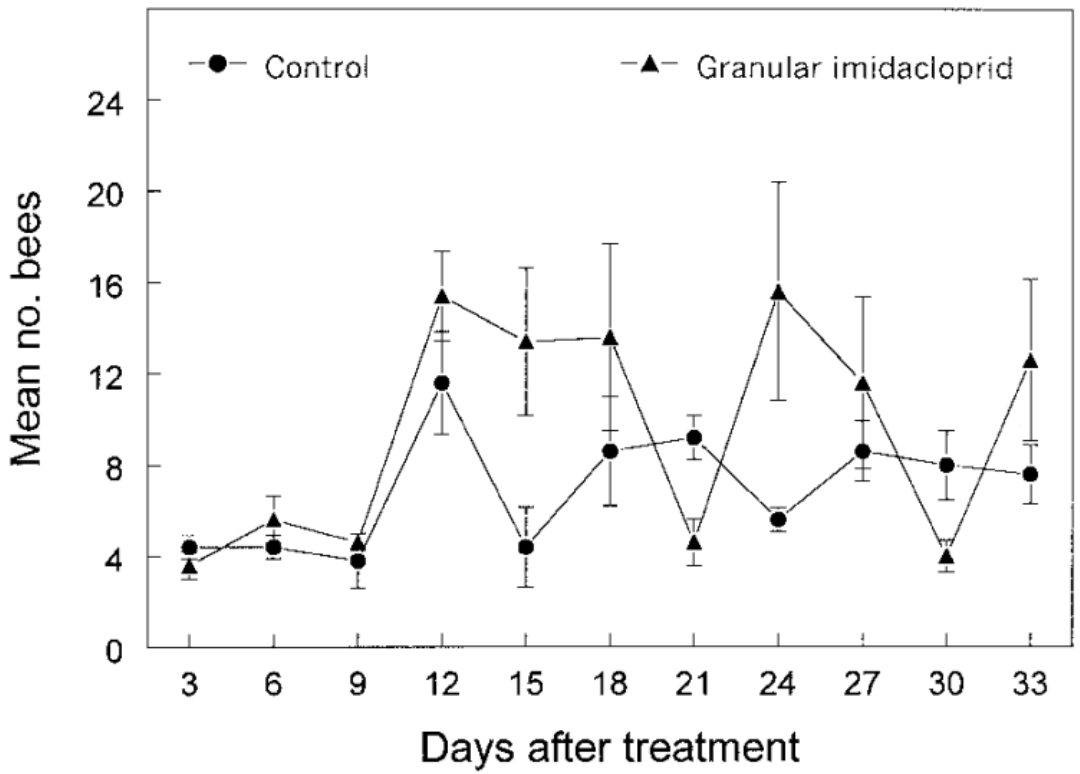
Beeswax 101

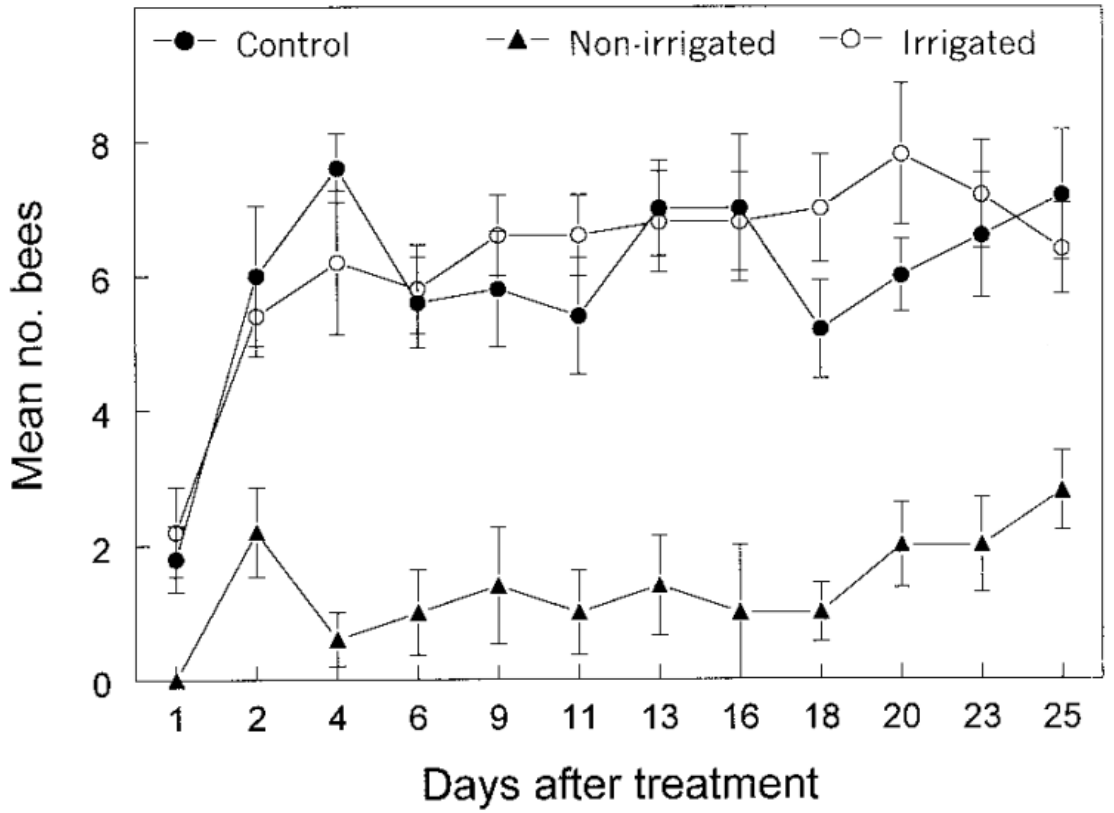
Chronic exposure through wax decreases sperm viablity.



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

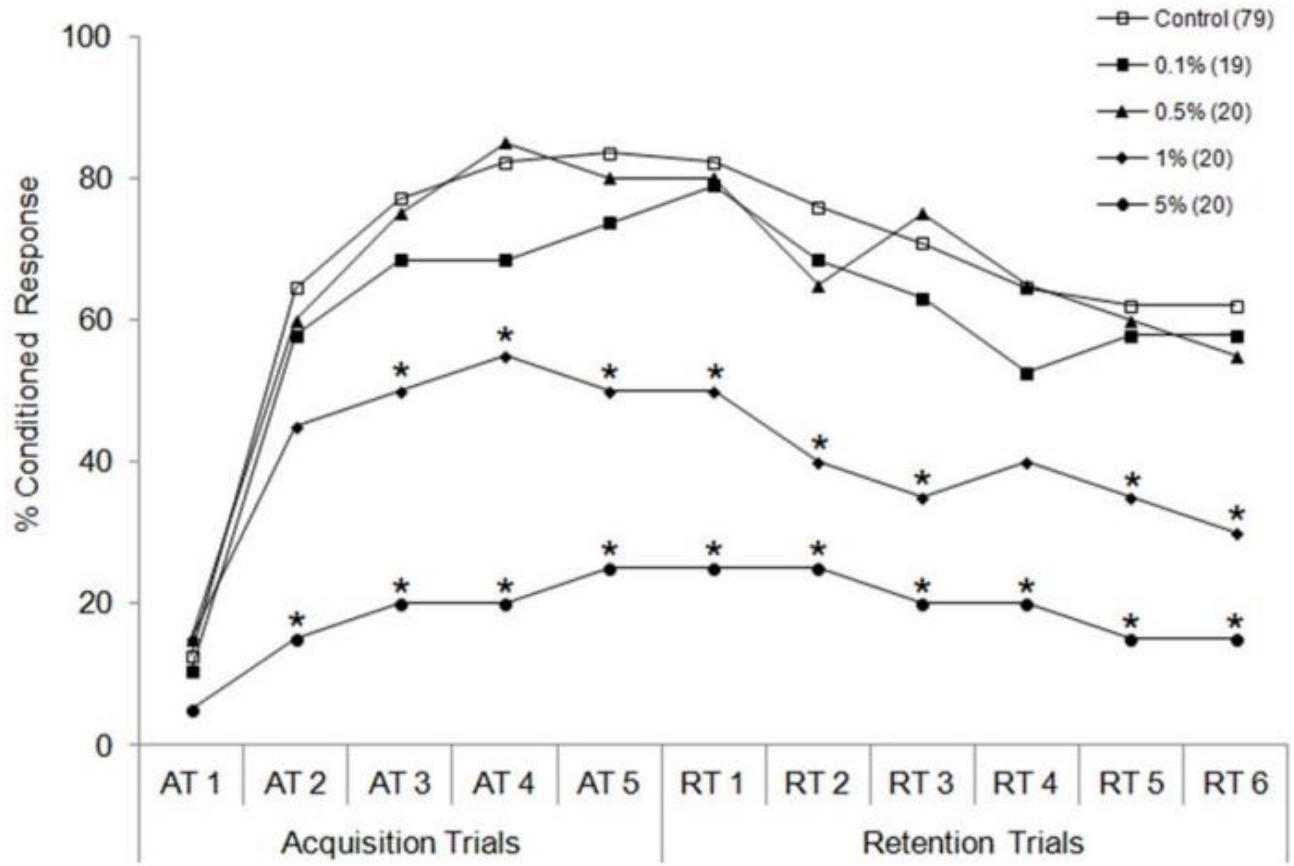
Granular application and post treatment irrigation decrease hazard to bumble bees





(Gels et al., 2002)

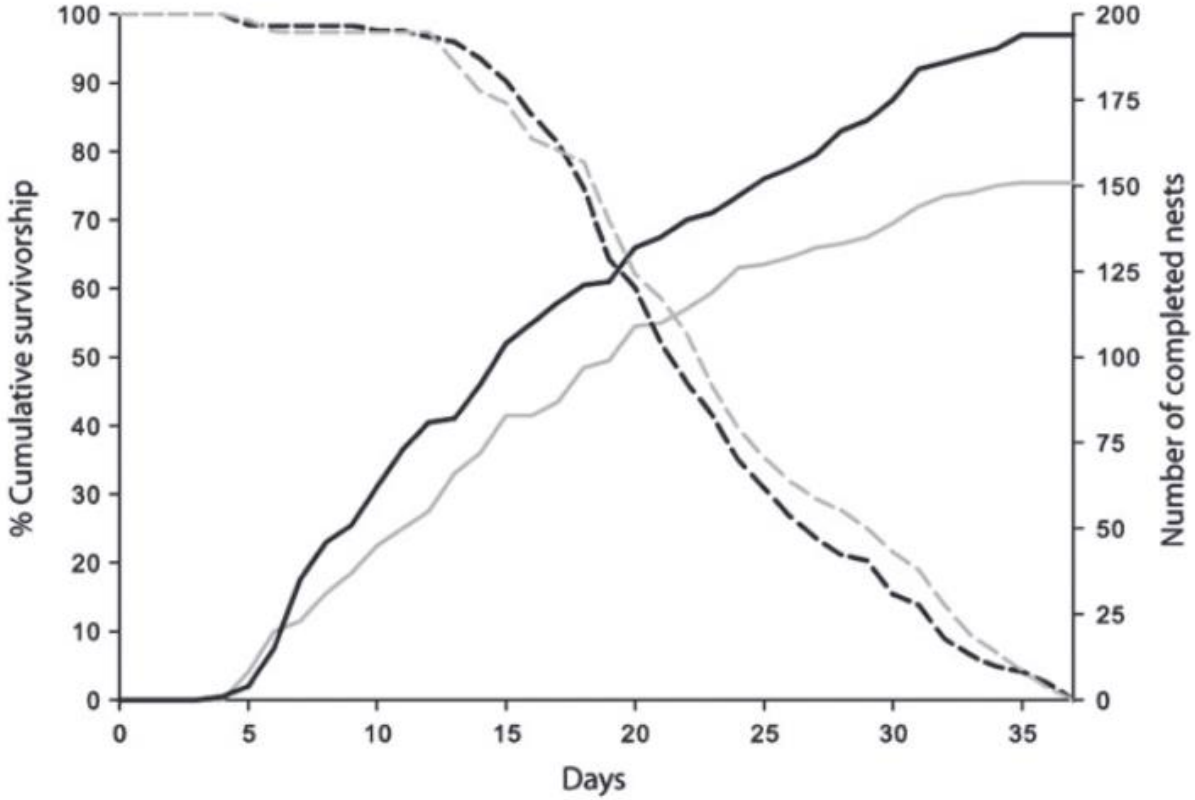
Organosillicone surfactants negatively impact honey bee learning.



(Ciarlo et al., 2012)

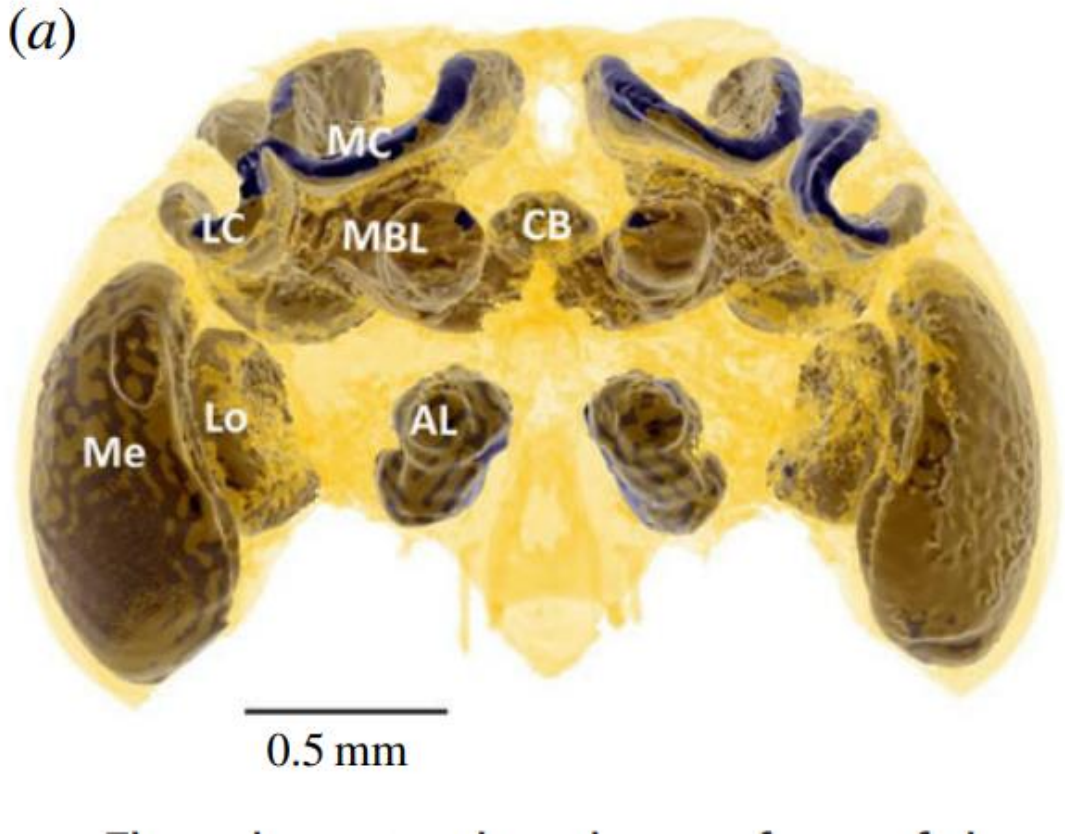
Red mason bees exposed to neonicotinoids have less reproductive success

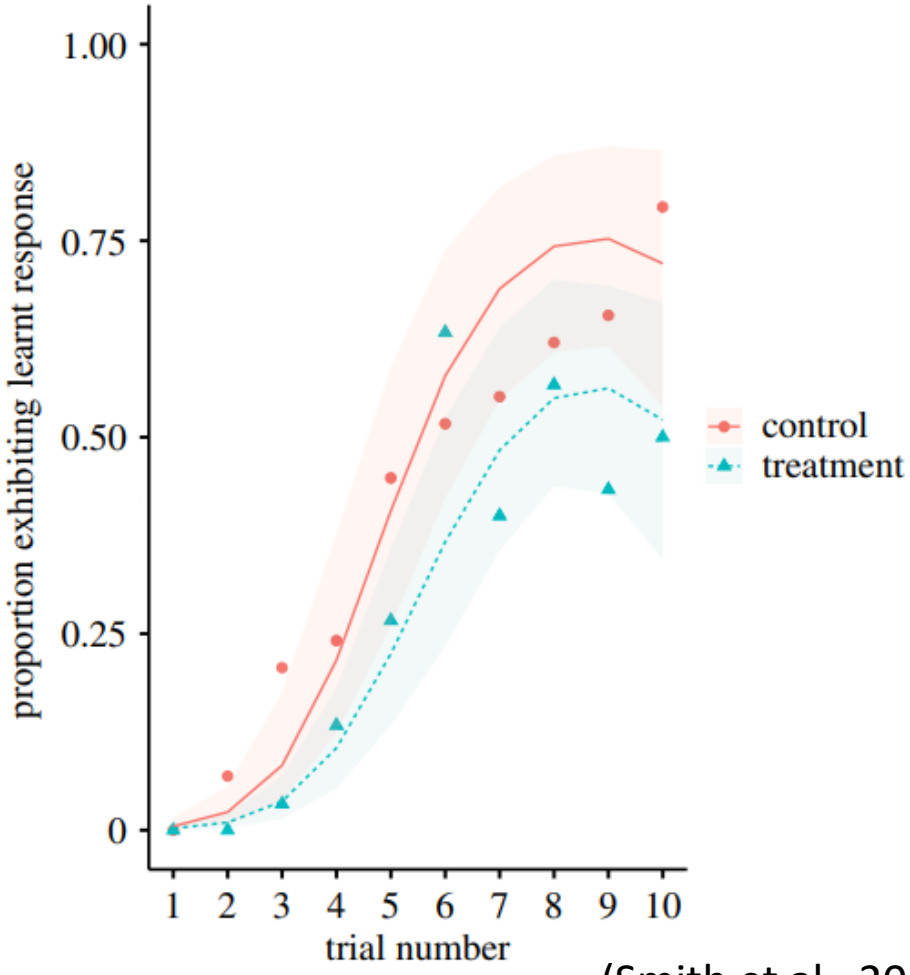
Photo courtesy of https://www.gardenia.net/guide/mason-bees



(Sandrock et al, 2014)

Imidacloprid exposure reduces bumble bee learning and brain volume.

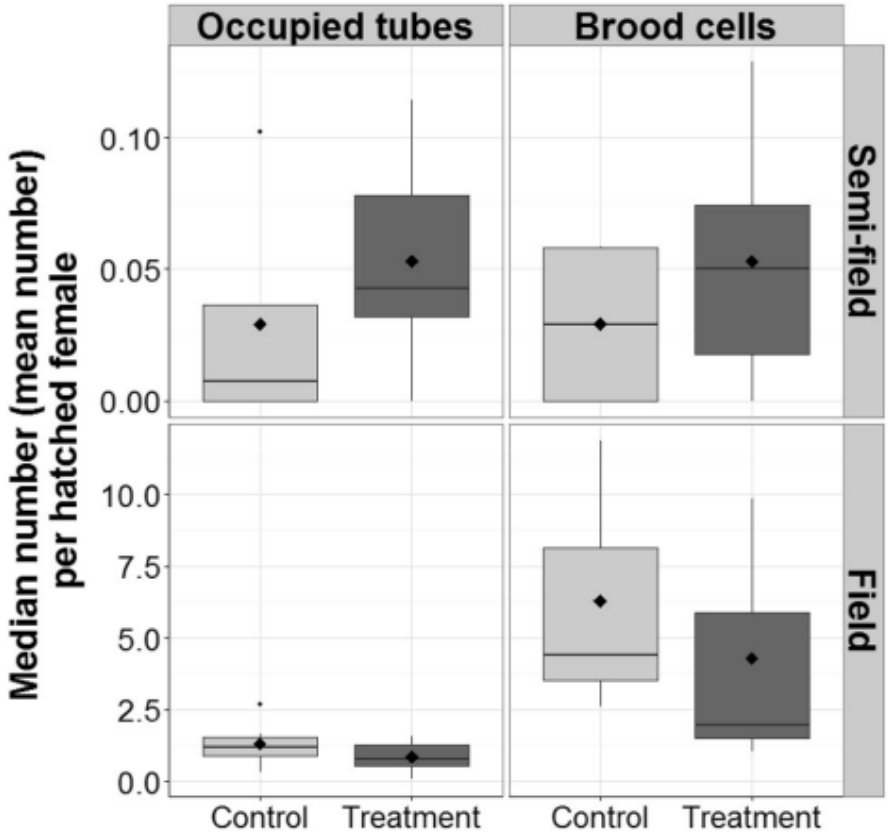




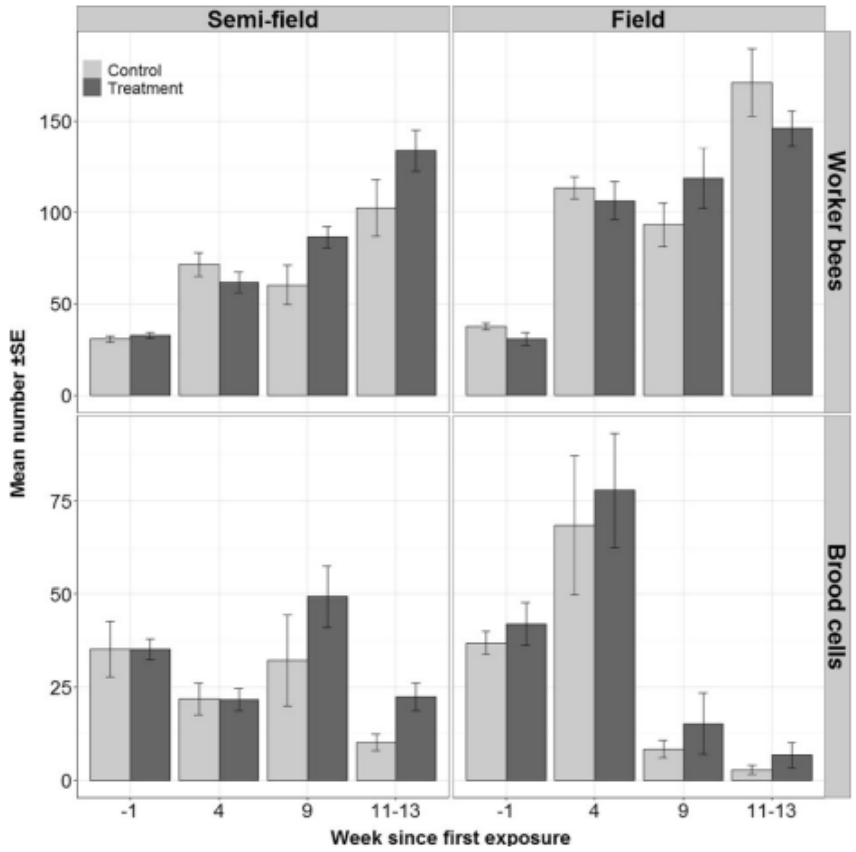
(Smith et al., 2020)

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

Mason Bees



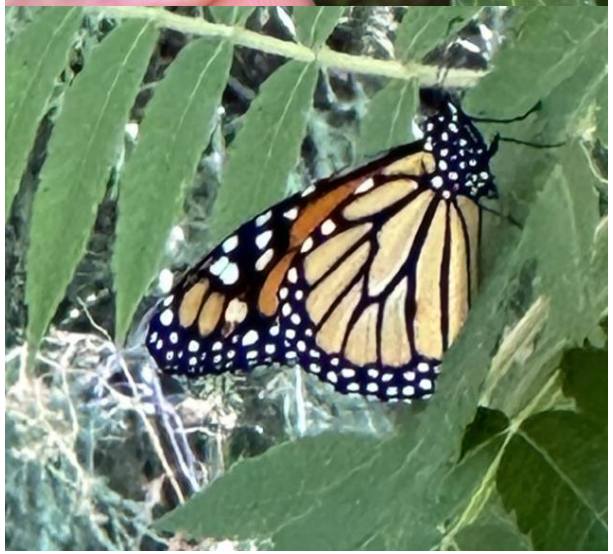
Bumble Bees

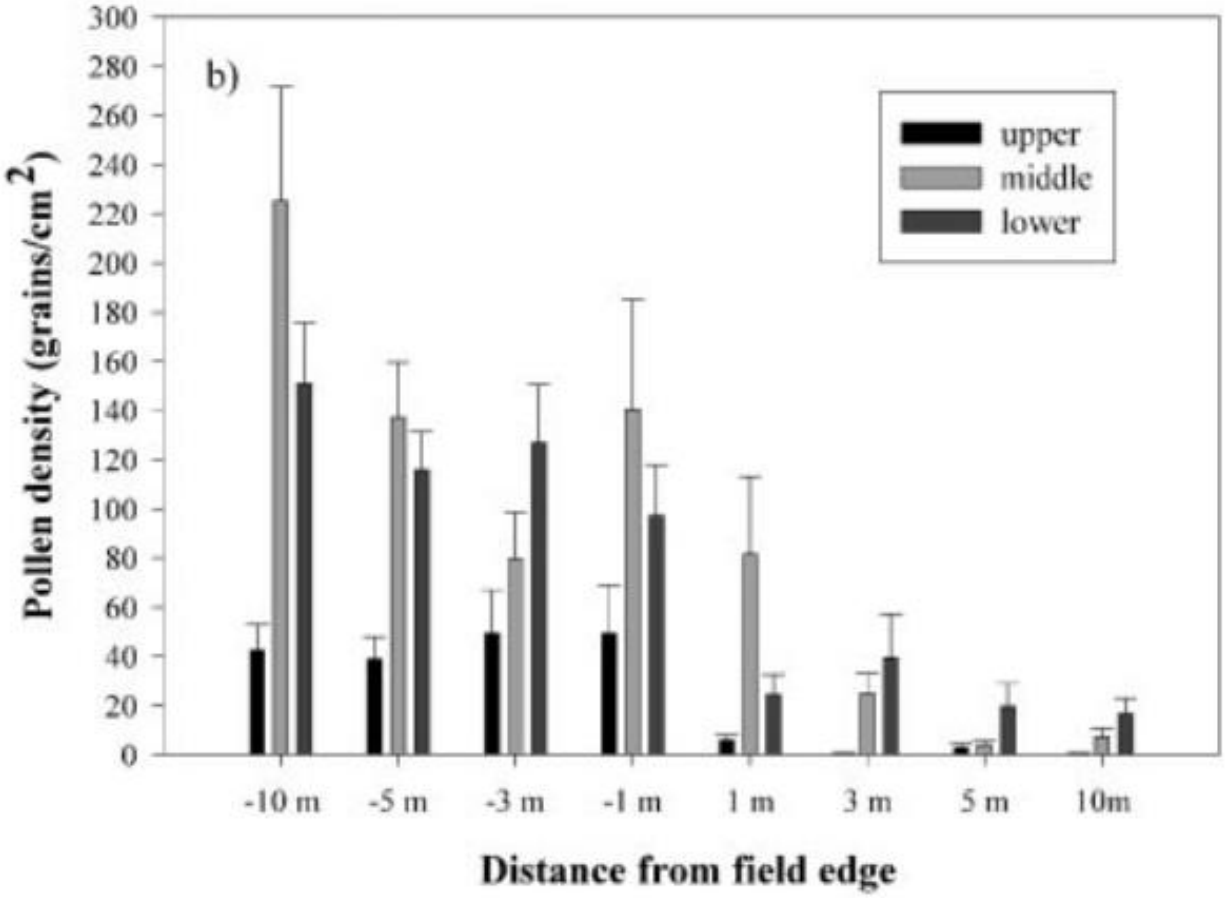


(Dietzsch et al., 2019)

Does Bt corn kill Monarch caterpillars?

No.



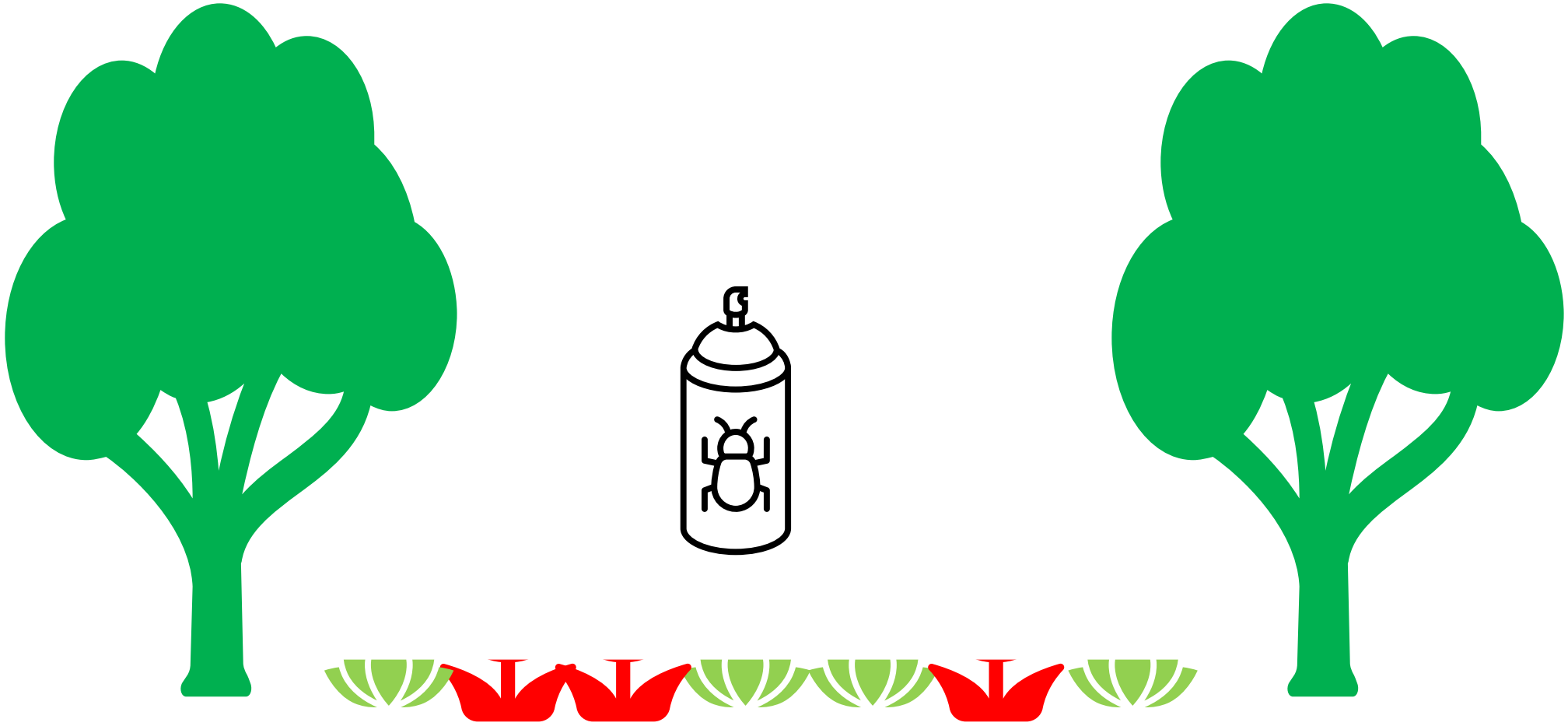


(Pleasants et al, 2001; Sears et al, 2001)

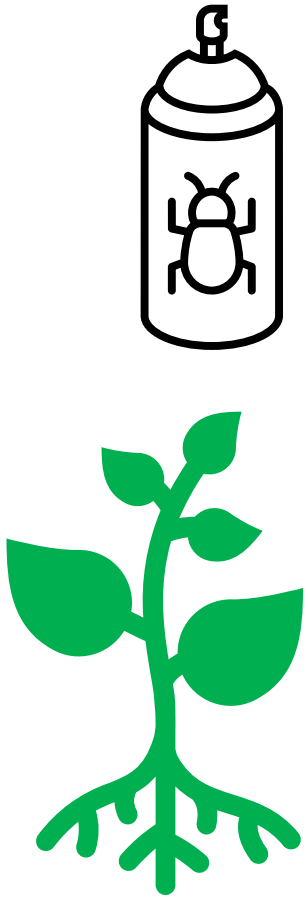
How to protect the bees

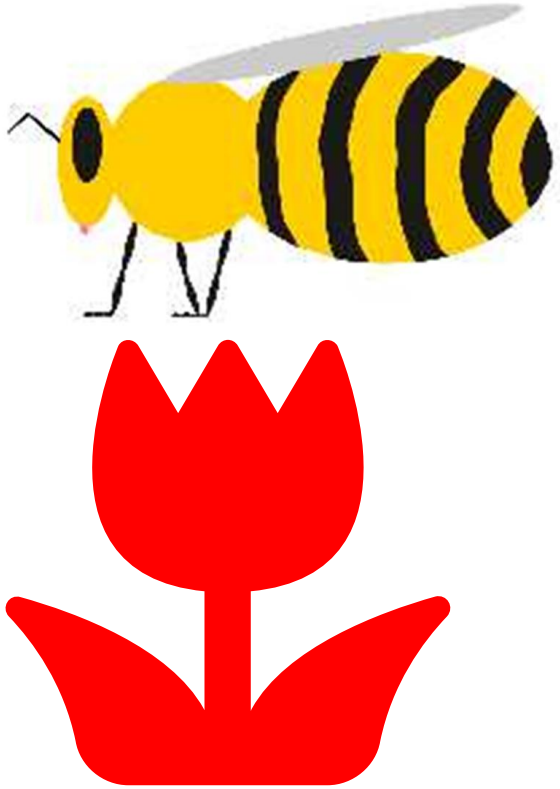
Disclaimer: These are all just general suggestions and not applicable to all pesticides or situations, always consult the label to make sure you are following the law and staying safe!

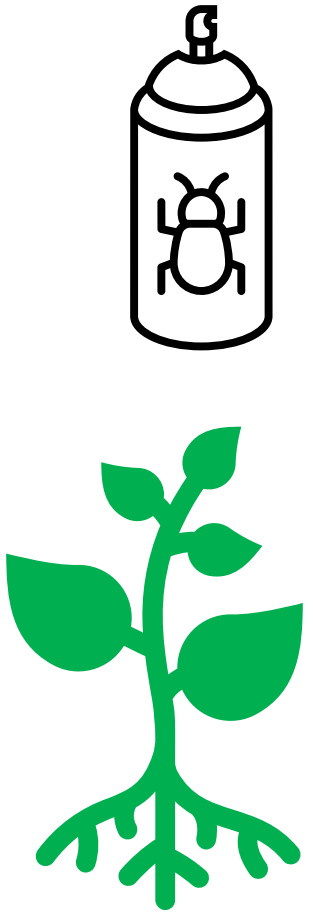
Remove flowers before applying a pesticide.



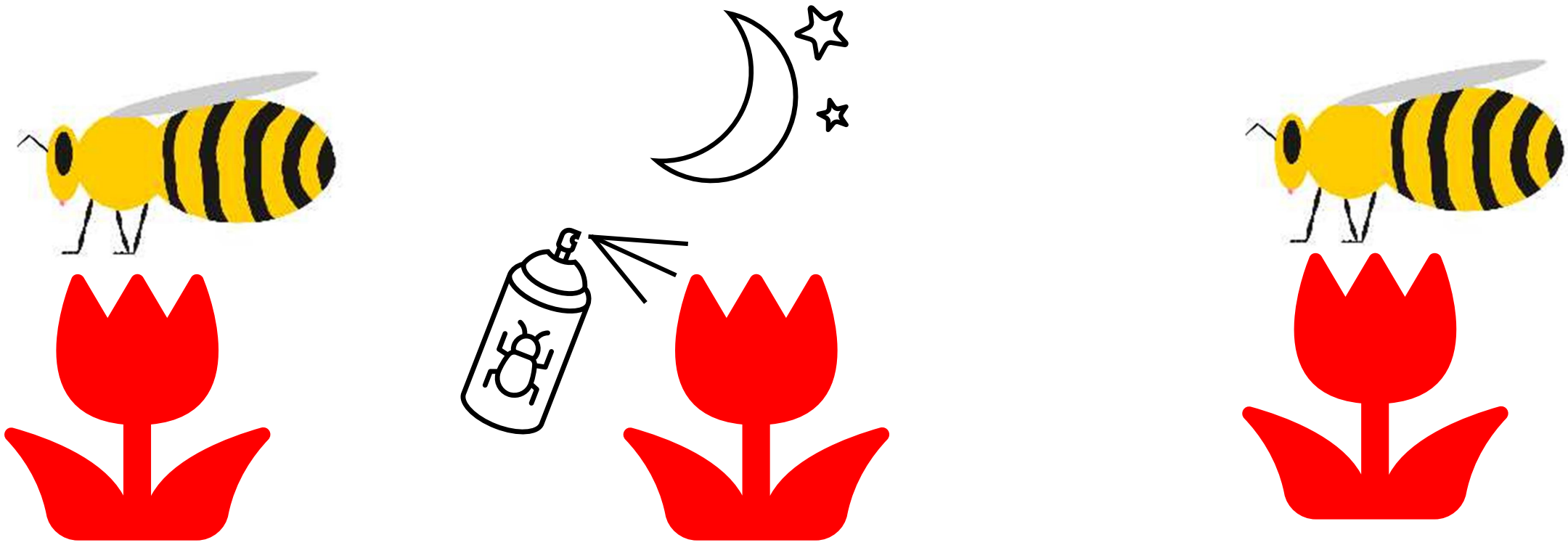
Try to apply pesticides before or after bloom.







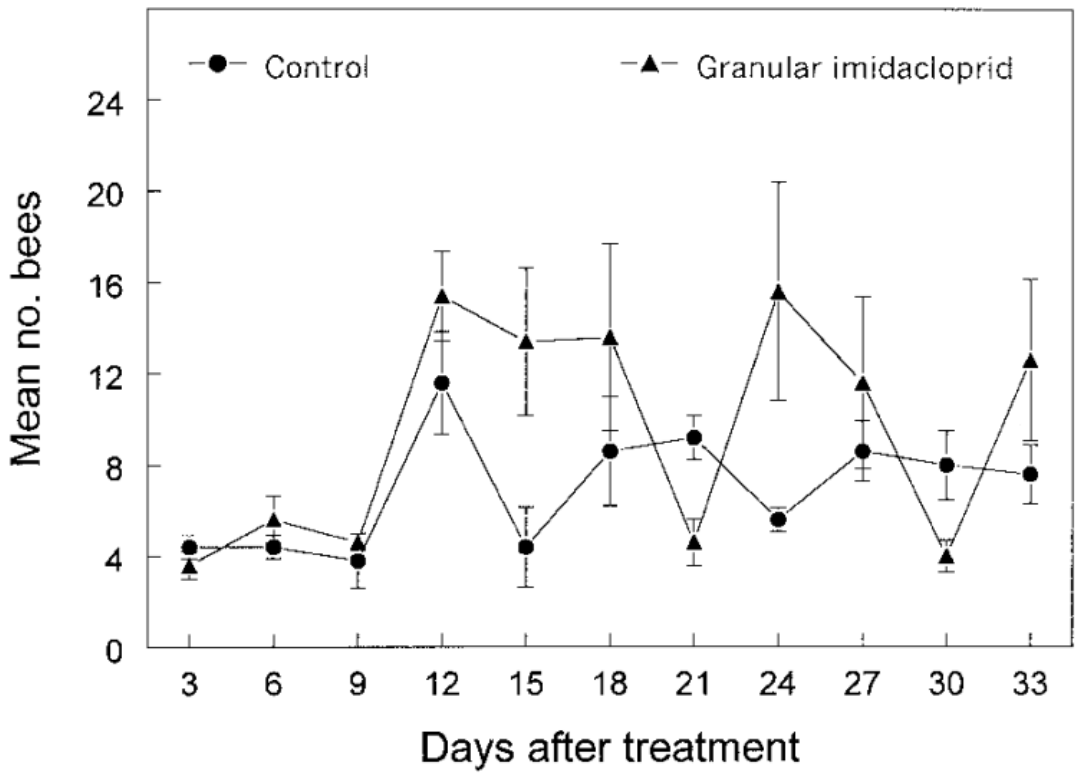
Apply pesticides at sunset or at night when pollinators aren’t active.

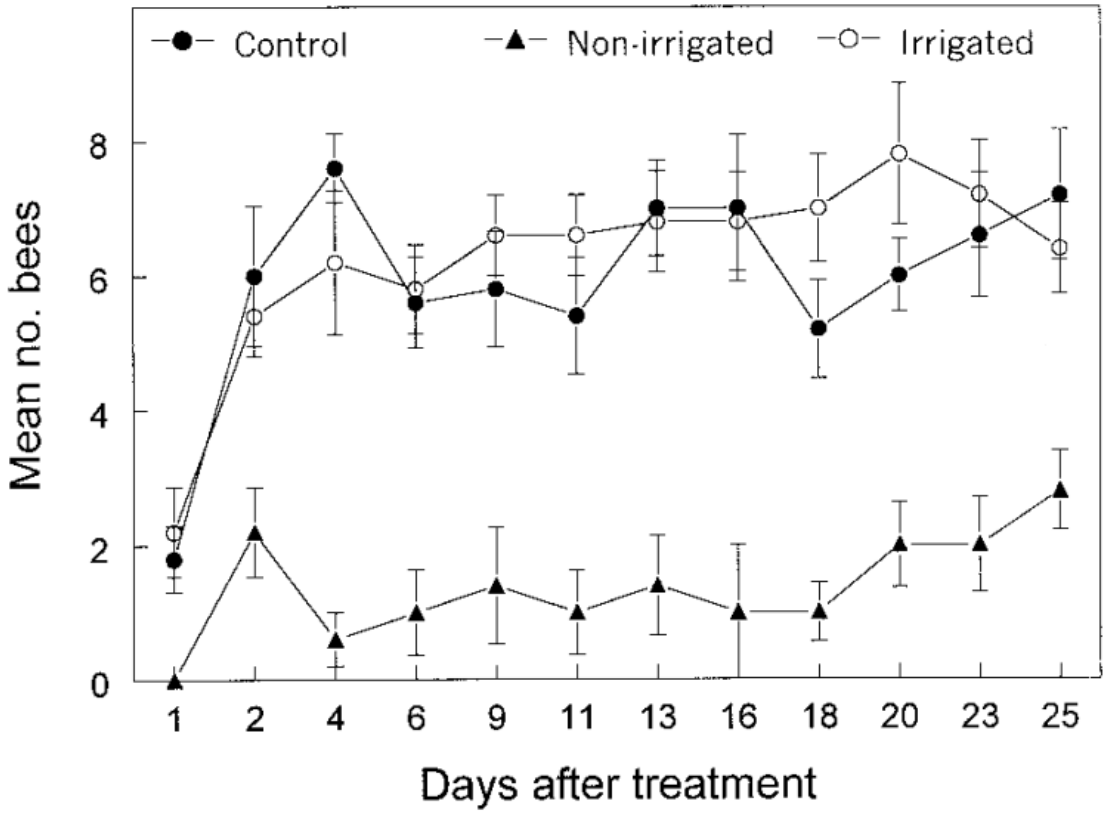


Seed quality and planting techniques can reduce dust emission from treated seed.

(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., & Stahler, 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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