

14700 Immokalee Road
Naples, FL 34120



April 19, 2015

Environmental Protection Agency
ATTN: Gina McCarthy, Administrator
1200 Pennsylvania Avenue, N.W., Mail Code 1101A
Washington, DC 20460

Dear Madam Administrator,

We call on you to close the knowledge gaps concerning the impacts of neonicotinoids on bees. Current research momentum, and recent rapid increases in the number of studies being published on this topic, provide opportunities for a more comprehensive understanding of how neonicotinoids are affecting bees.

Your agency has acknowledged that a number of these neonics are "highly toxic" to bees. Yet the Environmental Protection Agency has not announced review results of the mounting scientific evidence that implicates these systemic pesticides as a key culprit behind the alarming collapse of bee colonies. If our understanding is incorrect, please provide relevant information.

Both managed and wild bees are subject to multiple, interacting environmental pressures. Bees in modern agricultural landscapes are typically exposed to several classes of pesticides, creating opportunities for multiple combined effects of pesticide exposure. We respectfully request new research to both disentangle how important neonicotinoid use is relative to other potential drivers of bee declines, as well as determine the identity and magnitude of interactive effects among these drivers in the field.

Respectfully,

A handwritten signature in black ink, appearing to be 'D.P. Vasey'.

Dennis P. Vasey

Attachment:
References

References

1. Klein AM, Vaissière BE, Cane JH, Steffan-Dewenter I, Cunningham SA, Kremen C, et al. Importance of pollinators in changing landscapes for world crops. *Proc R Soc B*. 2007;274: 303–313. pmid:17164193 doi: 10.1098/rspb.2006.3721
2. Ollerton J, Winfree R, Tarrant S. How many flowering plants are pollinated by animals? *Oikos*. 2011;120: 321–326. doi: 10.1111/j.1600-0706.2010.18644.x
3. Potts SG, Biesmeijer JC, Kremen C, Neumann P, Schweiger O, Kunin WE. Global pollinator declines: trends, impacts and drivers. *Trends Ecol Evol*. 2010;25: 345–353. doi: 10.1016/j.tree.2010.01.007. pmid:20188434
4. Vanbergen AJ, the Insect Pollinators Initiative. Threats to an ecosystem service: pressures on pollinators. *Front Ecol Environ*. 2013;11: 251–259. doi: 10.1890/120126
5. van der Sluijs JP, Simon-Delso N, Goulson D, Maxim L, Bonmatin JM, Belzunces LP. Neonicotinoids, bee disorders and the sustainability of pollinator services. *Curr Opin Environ Sustainability*. 2013;5: 293–305. doi: 10.1016/j.cosust.2013.05.007
6. Goulson D. An overview of the environmental risks posed by neonicotinoid insecticides. *J Appl Ecol*. 2013;50: 977–987. doi: 10.1111/1365-2664.12111
7. Jeschke P, Nauen R, Schindler M, Elbert A. Overview of the status and global strategy for neonicotinoids. *J Agr Food Chem*. 2011;59: 2897–2908. doi: 10.1021/jf101303g
8. Elbert A, Haas M, Springer B, Thielert W, Nauen R. Applied aspects of neonicotinoid uses in crop protection. *Pest Manag Sci*. 2008;64: 1099–1105. doi: 10.1002/ps.1616. pmid:18561166
9. Jeschke P, Nauen R. Neonicotinoids—from zero to hero in insecticide chemistry. *Pest Manag Sci*. 2008;64: 1084–1098. doi: 10.1002/ps.1631
10. Iwasa T, Motoyama N, Ambrose JT, Roe RM. Mechanism for the differential toxicity of neonicotinoid insecticides in the honey bee, *Apis mellifera*. *Crop Prot*. 2004;2: 371–378. doi: 10.1016/j.cropro.2003.08.018
11. Nuyttens D, Devarrewaere W, Verboven P, Foqué D. Pesticide-laden dust emission and drift from treated seeds during seed drilling: a review. *Pest Manag Sci*. 2013;69: 564–575. doi: 10.1002/ps.3485. pmid:23456984
12. Cresswell JE. A meta-analysis of experiments testing the effects of a neonicotinoid insecticide (imidacloprid) on honey bees. *Ecotoxicology*. 2011;20: 149–157. doi: 10.1007/s10646-010-0566-0. pmid:21080222
13. Hopwood J, Vaughan M, Shepherd M, Biddinger D, Mader E, Hoffman Black S, et al. Are neonicotinoids killing bees? A review of research into the effects of neonicotinoid insecticides on bees, with recommendations for action. Portland: The Xerces Society for Invertebrate Conservation; 2012.
14. Krupke CH, Hunt GJ, Eitzer BD, Andino G, Given K. Multiple routes of pesticide exposure for honey bees living near agricultural fields. *PLoS One*. 2012;7: e29268. doi: 10.1371/journal.pone.0029268. pmid:22235278
15. EU. Regulation (EU) No 485/2013. Official Journal of the European Union. 2013;139: 12–26.
16. Ministry of the Environment and Climate Change. Neonicotinoid regulations. 2015. Available: <http://www.ontario.ca/environment-and-energy/neonicotinoid-regulations>.

17. Dicks L. Bees, lies and evidence-based policy. *Nature*. 2013;494: 283. doi: 10.1038/494283a. pmid:23426287
18. Goulson D. Neonicotinoids and bees: what's all the buzz? *Significance*. 2013;10: 6–11. doi: 10.1111/j.1740-9713.2013.00658.x
19. Gross M. EU ban puts spotlight on complex effects of neonicotinoids. *Curr Biol*. 2013;23: R462–R464. pmid:23894744 doi: 10.1016/j.cub.2013.05.030
20. Cresswell JE, Desneux N, van Engelsdorp D. Dietary traces of neonicotinoid pesticides as a cause of population declines in honey bees: an evaluation by Hill's epidemiological criteria. *Pest Manag Sci*. 2012;68: 819–827. doi: 10.1002/ps.3290. pmid:22488890
21. Maini S, Medrzycki P, Porrini C. The puzzle of honey bee losses: a brief review. *B Insectol*. 2010;63: 153–160.
22. Farooqui T. A potential link among biogenic amines-based pesticides, learning and memory, and colony collapse disorder: a unique hypothesis. *Neurochem Int*. 2013;62: 122–136. doi: 10.1016/j.neuint.2012.09.020. pmid:23059446
23. Fairbrother A, Purdy J, Anderson T, Fell R. Risks of neonicotinoid insecticides to honeybees. *Environ Toxicol Chem*. 2014;33: 719–731. doi: 10.1002/etc.2527. pmid:24692231
24. Smith KM, Loh EH, Rostal MK, Zambrana-Torrel CM, Mendiola L, Daszak P. Pathogens, pests, and economics: drivers of honey bee colony declines and losses. *EcoHealth*. 2013;10: 434–445. doi: 10.1007/s10393-013-0870-2. pmid:24496582
25. Blacquièrè T, Smagghe G, Van Gestel CA, Mommaerts V. Neonicotinoids in bees: a review on concentrations, side-effects and risk assessment. *Ecotoxicology*. 2012;21: 973–992. doi: 10.1007/s10646-012-0863-x. pmid:22350105
26. Pisa L, Amaral-Rogers V, Belzunces LP, Bonmatin J-M, Downs C, Goulson D, et al. Effects of neonicotinoids and fipronil on non-target invertebrates. *Environ Sci Pollut Res*. 2014;22: 68–102. doi: 10.1007/s11356-014-3471-x
27. Godfray HCJ, Blacquièrè T, Field LM, Hails RS, Petrokofsky G, Potts SG, et al. A restatement of the natural science evidence base concerning neonicotinoid insecticides and insect pollinators. *Proc R Soc B*. 2014;281: 20140558. doi: 10.1098/rspb.2014.0558. pmid:24850927
28. Girolami V, Marzaro M, Vivan L, Mazzon L, Giorio C, Marton D, et al. Aerial powdering of bees inside mobile cages and the extent of neonicotinoid cloud surrounding corn drillers. *J Appl Entomol*. 2013;137: 35–44. doi: 10.1111/j.1439-0418.2012.01718.x
29. Rundlöf M, Andersson GK, Bommarco R, Fries I, Hederström V, Herbertsson L, et al. Seed coating with a neonicotinoid insecticide negatively affects wild bees. *Nature*. 2015;521: 77–80. doi: 10.1038/nature14420. pmid:25901681
30. Schmuck R, Schöning R, Stork A, Schramel O. Risk posed to honeybees (*Apis mellifera* L, Hymenoptera) by an imidacloprid seed dressing of sunflowers. *Pest Manag Sci*. 2001;57: 225–238. pmid:11455652 doi: 10.1002/ps.270
31. Larson JL, Redmond CT, Potter DA. Mowing mitigates bioactivity of neonicotinoid insecticides in nectar of flowering lawn weeds and turfgrass guttation. *Environ Toxicol Chem*. 2015;34: 127–132. doi: 10.1002/etc.2768. pmid:25319809
32. Hoffmann EJ, Castle SJ. Imidacloprid in melon guttation fluid: a potential mode of exposure for pest and beneficial organisms. *J Econ Entomol*. 2012;105: 67–71. pmid:22420257 doi: 10.1603/ec11251

33. Stewart SD, Lorenz GM, Catchot AL, Gore J, Cook D, Skinner J, et al. Potential exposure of pollinators to neonicotinoid insecticides from the use of insecticide seed treatments in the mid-southern United States. *Environ Sci Tech*. 2014;48: 9762–9769. doi: 10.1021/es501657w
34. Sechser B, Freuler J. The impact of thiamethoxam on bumble bee broods (*Bombus terrestris* L.) following drip application in covered tomato crops. *J Pest Sci*. 2003;76: 74–77. doi: 10.1046/j.1439-0280.2003.03017.x
35. Byrne FJ, Visscher PK, Leimkuehler B, Fischer D, Grafton-Cardwell EE, Morse JG. Determination of exposure levels of honey bees foraging on flowers of mature citrus trees previously treated with imidacloprid. *Pest Manag Sci*. 2014;70: 470–482. doi: 10.1002/ps.3596. pmid:23788449
36. Stoner KA, Eitzer BD. Movement of soil-applied imidacloprid and thiamethoxam into nectar and pollen of squash (*Cucurbita pepo*). *PLoS One*. 2012;7: e39114. doi: 10.1371/journal.pone.0039114. pmid:22761727
37. Skerl MIS, Bolta SV, Cesnik HB, Gregorc A. Residues of pesticides in honeybee (*Apis mellifera carnica*) bee bread and in pollen loads from treated apple orchards. *B Environ Contam Tox*. 2009;83: 374–377. doi: 10.1007/s00128-009-9762-0
38. Choudhary A, Sharma DC. Dynamics of pesticide residues in nectar and pollen of mustard (*Brassica juncea* (L.) Czern.) grown in Himachal Pradesh (India). *Environ Monit Assess*. 2008;144: 143–150. pmid:17952621 doi: 10.1007/s10661-007-9952-3
39. Chen M, Tao L, McLean J, Lu C. Quantitative analysis of neonicotinoid insecticide residues in foods: implication for dietary exposures. *J Agric Food Chem*. 2014;62: 6082–6090. doi: 10.1021/jf501397m. pmid:24933495
40. Vaikkinen A, Schmidt HS, Kiiski I, Rämö S, Hakala K, Haapala M, et al. Analysis of neonicotinoids from plant material by desorption atmospheric pressure photoionization-mass spectrometry. *Rapid Commun Mass Spectrom*. 2015;29: 424–430. doi: 10.1002/rcm.7123
41. Reetz JE, Zühlke S, Spittler M, Wallner K. Neonicotinoid insecticides translocated in guttated droplets of seed-treated maize and wheat: a threat to honeybees? *Apidologie*. 2011;42: 596–606. doi: 10.1007/s13592-011-0049-1
42. Schreinemachers P, Tipraqsa P. Agricultural pesticides and land use intensification in high, middle and low income countries. *Food Policy*. 2012;37: 616–626. doi: 10.1016/j.foodpol.2012.06.003
43. Gallai N, Salles JM, Settele J, Vaissière BE. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. *Ecol Econ*. 2009;68: 810–821. doi: 10.1016/j.ecolecon.2008.06.014
44. European Food Safety Authority. Statement on the findings in recent studies investigating sub-lethal effects in bees of some neonicotinoids in consideration of the uses currently authorised in Europe. *EFSA Journal*. 2012;10: 2752.
45. Bayer CropScience. Product information for Biscaya OD 240 (in Swedish). 2015. Available: <http://www.cropscience.bayer.se/~media/Bayer%20CropScience/Scandinavia/Sweden/Produkter/Produktsidor%202015/Biscaya%202015.ashx>.
46. Schmuck R, Stadler T, Schmidt HW. Field relevance of a synergistic effect observed in the laboratory between an EBI fungicide and a chloronicotinyl insecticide in the honeybee (*Apis mellifera* L, Hymenoptera). *Pest Manag Sci*. 2003;59: 279–286. pmid:12639044 doi: 10.1002/ps.626
47. Girolami V, Mazzon L, Squartini A, Mori N, Marzaro M, Di Bernardo A, et al. Translocation of neonicotinoid insecticides from coated seeds to seedling guttation drops: a novel way of intoxication for bees. *J Econ Entomol*. 2009;102: 1808–1815. pmid:19886445 doi: 10.1603/029.102.0511

48. Nguyen BK, Saegerman C, Pirard C, Mignon J, Widart J, Thirionet B, et al. Does imidacloprid seed-treated maize have an impact on honey bee mortality? *J Econ Entomol.* 2009;102: 616–623. pmid:19449641 doi: 10.1603/029.102.0220
49. Dively GP, Kamel A. Insecticide residues in pollen and nectar of a cucurbit crop and their potential exposure to pollinators. *J Agr Food Chem.* 2012;60: 4449–4456. doi: 10.1021/jf205393x
50. Gill RJ, Ramos-Rodriguez O, Raine NE. Combined pesticide exposure severely affects individual- and colony-level traits in bees. *Nature.* 2012;491: 105–108. doi: 10.1038/nature11585. pmid:23086150
51. Whitehorn PR, O'Connor S, Wackers FL, Goulson D. Neonicotinoid pesticide reduces bumble bee colony growth and queen production. *Science.* 2012;336: 351–352. doi: 10.1126/science.1215025. pmid:22461500
52. Elston C, Thompson HM, Walters KF. Sub-lethal effects of thiamethoxam, a neonicotinoid pesticide, and propiconazole, a DMI fungicide, on colony initiation in bumblebee (*Bombus terrestris*) micro-colonies. *Apidologie.* 2013;44: 563–574. doi: 10.1007/s13592-013-0206-9
53. Laycock I, Cresswell JE. Repression and recuperation of brood production in *Bombus terrestris* bumble bees exposed to a pulse of the neonicotinoid pesticide imidacloprid. *PLoS One.* 2013;8: e79872. doi: 10.1371/journal.pone.0079872. pmid:24224015
54. Rortais A, Arnold G, Halm MP, Touffet-Briens F. Modes of honeybees exposure to systemic insecticides: estimated amounts of contaminated pollen and nectar consumed by different categories of bees. *Apidologie.* 2005;36: 71–83. doi: 10.1051/apido:2004071
55. Halm MP, Rortais A, Arnold G, Tasei JN, Rault S. New risk assessment approach for systemic insecticides: the case of honey bees and imidacloprid (Gaucho). *Environ Sci Technol.* 2006;40: 2448–2454. pmid:16646488 doi: 10.1021/es051392i
56. Sanchez-Bayo F, Goka K. Pesticide residues and bees—a risk assessment. *PLoS One.* 2014;9: e94482. doi: 10.1371/journal.pone.0094482. pmid:24718419
57. Gels JA, Held DW, Potter DA. Hazards of insecticides to the bumble bees *Bombus impatiens* (Hymenoptera: Apidae) foraging on flowering white clover in turf. *J Econ Entomol.* 2002;95: 722–728. pmid:12216812 doi: 10.1603/0022-0493-95.4.722
58. Larson JL, Redmond CT, Potter DA. Assessing insecticide hazard to bumble bees foraging on flowering weeds in treated lawns. *PLoS One.* 2013;8: e66375. doi: 10.1371/journal.pone.0066375. pmid:23776667
59. Larson JL, Redmond CT, Potter DA. Impacts of a neonicotinoid, neonicotinoid-pyrethroid premix, and anthranilic diamide insecticide on four species of turf-inhabiting beneficial insects. *Ecotoxicology.* 2014;23: 252–259. doi: 10.1007/s10646-013-1168-4. pmid:24493235
60. Barbosa WF, Smagghe G, Guedes RNC. Pesticides and reduced-risk insecticides, native bees and pantropical stingless bees: pitfalls and perspectives. *Pest Manag Sci.* 2015;71: 1049–1053. doi: 10.1002/ps.4025. pmid:25892651
61. Stark JD, Jepson PC, Mayer DF. Limitation to the use of topical toxicity data for prediction of pesticide side-effect in the field. *J Econ Entomol.* 1995;88: 1081–1088. doi: 10.1093/jee/88.5.1081
62. Cresswell JE, Page CJ, Uygun MB, Holmbergh M, Li Y, Wheeler JG, et al. Differential sensitivity of honey bees and bumble bees to a dietary insecticide (imidacloprid). *Zoology.* 2012;115: 365–371. doi: 10.1016/j.zool.2012.05.003. pmid:23044068

63. Biddinger DJ, Robertson JL, Mullin C, Frazier J, Ashcraft SA, Rajotte EG, et al. Comparative toxicities and synergism of apple orchard pesticides to *Apis mellifera* (L.) and *Osmia cornifrons* (Radoszkowski). *PLoS One*. 2013;8: e72587. doi: 10.1371/journal.pone.0072587. pmid:24039783
64. Cresswell JE, Robert FXL, Florance H, Smirnov N. Clearance of ingested neonicotinoid pesticide (imidacloprid) in honey bees (*Apis mellifera*) and bumblebees (*Bombus terrestris*). *Pest Manag Sci*. 2014;70: 332–337. doi: 10.1002/ps.3569. pmid:23633150
65. Arena M, Sgolastra F. A meta-analysis comparing the sensitivity of bees to pesticides. *Ecotoxicology*. 2014;23: 324–334. doi: 10.1007/s10646-014-1190-1. pmid:24435220
66. Devillers J, Decourtye A, Budzinski H, Pham-Delègue MH, Cluzeau S, Maurin G. Comparative toxicity and hazards of pesticides to *Apis* and non-*Apis* bees. A chemometrical study. *SAR QSAR Environ Res*. 2003;14: 389–403. pmid:14758982 doi: 10.1080/10629360310001623980
67. Thompson HM, Hunt LV. Extrapolating from honeybees to bumblebees in pesticide risk assessment. *Ecotoxicology*. 1999;8: 147–166.
68. Williams NM, Crone EE, Minckley RL, Packer L, Potts SG. Ecological and life-history traits predict bee species responses to environmental disturbances. *Biol Conserv*. 2010;143: 2280–2291. doi: 10.1016/j.biocon.2010.03.024
69. Brittain C, Potts SG. The potential impacts of insecticides on the life-history traits of bees and the consequences for pollination. *Basic Appl Ecol*. 2011;12: 321–331. doi: 10.1016/j.baae.2010.12.004
70. Breeze TD, Bailey AP, Balcombe KG, Potts SG. Pollination services in the UK: how important are honeybees? *Agr Ecosyst Environ*. 2011;142: 137–143. doi: 10.1016/j.agee.2011.03.020
71. Garibaldi LA, Steffan-Dewenter I, Winfree R, Aizen MA, Bommarco R, Cunningham SA, et al. Wild pollinators enhance fruit set of crops regardless of honey bee abundance. *Science*. 2013;339: 1608–1611. doi: 10.1126/science.1230200. pmid:23449997
72. Aizen MA, Harder LD. The global stock of domesticated honey bees is growing slower than agricultural demand for pollination. *Curr Biol*. 2009;19: 915–918. doi: 10.1016/j.cub.2009.03.071. pmid:19427214
73. Breeze TD, Vaissière BE, Bommarco R, Petanidou T, Seraphides N, Kozák L, et al. Agricultural policies exacerbate honeybee pollination service supply-demand mismatches across Europe. *PLoS One*. 2014;9: e82996. doi: 10.1371/journal.pone.0082996. pmid:24421873
74. Kremen C, Williams NM, Thorp RW. Crop pollination from native bees at risk from agricultural intensification. *Proc Natl Acad Sci USA*. 2002;99: 16812–16816. pmid:12486221 doi: 10.1073/pnas.262413599
75. Winfree R, Williams NM, Dushoff J, Kremen C. Native bees provide insurance against ongoing honey bee losses. *Ecol Lett*. 2007;10: 1105–1113. pmid:17877737 doi: 10.1111/j.1461-0248.2007.01110.x
76. Mommaerts V, Reynders S, Boulet J, Besard L, Sterk G, Smagghe G. Risk assessment for side-effects of neonicotinoids against bumblebees with and without impairing foraging behavior. *Ecotoxicology*. 2010;19: 207–215. doi: 10.1007/s10646-009-0406-2. pmid:19757031
77. Feltham H, Park K, Goulson D. Field realistic doses of pesticide imidacloprid reduce bumblebee pollen foraging efficiency. *Ecotoxicology*. 2014;23: 317–323. doi: 10.1007/s10646-014-1189-7. pmid:24448674
78. Gill RJ, Raine NE. Chronic impairment of bumblebee natural foraging behaviour induced by sublethal pesticide exposure. *Funct Ecol*. 2014;28: 1459–1471. doi: 10.1111/1365-2435.12292

79. Desneux N, Decourtye A, Delpuech JM. The sublethal effects of pesticides on beneficial arthropods. *Annu Rev Entomol.* 2007;52: 81–106. pmid:16842032 doi: 10.1146/annurev.ento.52.110405.091440
80. Suchail S, Debrauwer L, Belzunces LP. Metabolism of imidacloprid in *Apis mellifera*. *Pest Manag Sci.* 2004;60: 291–296. pmid:15025241 doi: 10.1002/ps.772
81. Suchail S, De Sousa G, Rahmani R, Belzunces LP. In vivo distribution and metabolism of 14C-imidacloprid in different compartments of *Apis mellifera* L. *Pest Manag Sci.* 2004;60: 1056–1062. pmid:15532678 doi: 10.1002/ps.895
82. Brunet JL, Badiou A, Belzunces LP. In vivo metabolic fate of (14C)-acetamiprid in six biological compartments of the honeybee, *Apis mellifera* L. *Pest Manag Sci.* 2005;61: 742–748. pmid:15880574 doi: 10.1002/ps.1046
83. Bonmatin JM, Moineau I, Charvet R, Fleche C, Colin ME, Bengsch ER. A LC/APCI-MS/MS Method for analysis of imidacloprid in soils, in plants, and in pollens. *Anal Chem.* 2003;75: 2027–2033. pmid:12720336 doi: 10.1021/ac020600b
84. Mullin CA, Frazier M, Frazier JL, Ashcraft S, Simonds R, vanEngelsdorp D, et al. High levels of miticides and agrochemicals in North American apiaries: implications for honey bee health. *PLoS One.* 2010;5: e9754. doi: 10.1371/journal.pone.0009754. pmid:20333298
85. Chauzat MP, Martel AC, Blanchard P, Clément MC, Schurr F, Lair C, et al. A case report of a honey bee colony poisoning incident in France. *J Apicult Res.* 2010;49: 113–115. doi: 10.3896/ibra.1.49.1.22
86. Chauzat MP, Carpentier P, Martel AC, Bougeard S, Cougoule N, Porta P, et al. Influence of pesticide residues on honey bee (Hymenoptera: Apidae) colony health in France. *Environ Entomol.* 2009;38: 514–523. pmid:19508759 doi: 10.1603/022.038.0302
87. Pareja L, Colazzo M, Pérez-Parada A, Niell S, Carrasco-Letelier L, Besil N, et al. Detection of pesticides in active and depopulated beehives in Uruguay. *Int J Environ Res Publ Health.* 2011;8: 3844–3858. doi: 10.3390/ijerph8103844
88. Tasei JN, Ripault G, Rivault E. Hazards of imidacloprid seed coating to *Bombus terrestris* (Hymenoptera: Apidae) when applied to sunflower. *J Econ Entomol.* 2001;94: 623–627. pmid:11425015 doi: 10.1603/0022-0493-94.3.623
89. Cutler GC, Scott-Dupree CD. Exposure to clothianidin seed-treated canola has no long-term impact on honey bees. *J Econ Entomol.* 2007;100: 765–772. pmid:17598537 doi: 10.1603/0022-0493(2007)100[765:etsch]2.0.co;2
90. Ondo Zue Abaga N, Alibert P, Dousset S, Savadogo PW, Savadogo M, Sedogo M. Insecticide residues in cotton soils of Burkina Faso and effects of insecticides on fluctuating asymmetry in honey bees (*Apis mellifera* Linnaeus). *Chemosphere.* 2011;83: 585–592. doi: 10.1016/j.chemosphere.2010.12.021. pmid:21190716
91. Boily M, Sarrasin B, DeBlois C, Aras P, Chagnon M. Acetylcholinesterase in honey bees (*Apis mellifera*) exposed to neonicotinoids, atrazine and glyphosate: laboratory and field experiments. *Environ Sci Pollut Res.* 2013;20: 5603–5614. doi: 10.1007/s11356-013-1568-2
92. Pilling E, Campbell P, Coulson M, Ruddle N, Tornier I. A four-year field program investigating long-term effects of repeated exposure of honey bee colonies to flowering crops treated with thiamethoxam. *PLoS One.* 2013;8: e77193. doi: 10.1371/journal.pone.0077193. pmid:24194871
93. Cutler GC, Scott-Dupree CD. A field study examining the effects of exposure to neonicotinoid seed-treated corn on commercial bumble bee colonies. *Ecotoxicology.* 2014;23: 1755–1763. doi: 10.1007/s10646-014-1340-5. pmid:25194943

94. Cutler GC, Scott-Dupree CD, Sultan M, McFarlane AD, Brewer L. A large-scale field study examining effects of exposure to clothianidin seed-treated canola on honey bee colony health, development, and overwintering success. *PeerJ*. 2014;2: e652. doi: 10.7717/peerj.652. pmid:25374790
95. Pohorecka K, Skubida P, Miszczak A, Semkiw P, Sikorski P, Zagibajlo K, et al. Residues of neonicotinoid insecticides in bee collected plant materials from oilseed rape crops and their effect on bee colonies. *J Apic Sci*. 2012;56: 115–134. doi: 10.2478/v10289-012-0029-3
96. Goulson D. Neonicotinoids impact bumblebee colony fitness in the field; a reanalysis of the UK's Food & Environment Research Agency 2012 experiment. *PeerJ*. 2015;3: e854. doi: 10.7717/peerj.854. pmid:25825679
97. Alburaki M, Boutin S, Mercier PL, Loubliey Y, Chagnon M, Derome N. Neonicotinoid-coated Zea mays seeds indirectly affect honeybee performance and pathogen susceptibility in field trials. *PLoS One*. 2015;10: e0125790. doi: 10.1371/journal.pone.0125790. pmid:25993642
98. Pirk CW, de Miranda JR, Kramer M, Murray TE, Nazzi F, Shutler D, et al. Statistical guidelines for *A. mellifera* research. *J Apicult Res*. 2013;52: 52.4.13. doi: 10.3896/ibra.1.52.4.13
99. Steffan-Dewenter I, Kuhn A. Honeybee foraging in differentially structured landscapes. *Proc R Soc B*. 2003;270: 569–575. pmid:12769455 doi: 10.1098/rspb.2002.2292
100. Walther-Hellwig K, Frankl R. Foraging habitats and foraging distances of bumblebees, *Bombus* spp. (Hym., Apidae), in an agricultural landscape. *J Appl Entomol*. 2000;124: 299–306. doi: 10.1046/j.1439-0418.2000.00484.x
101. Beekman M, Ratnieks FLW. Long-range foraging by the honey-bee, *Apis mellifera* L. *Funct Ecol*. 2000;14: 490–496. doi: 10.1046/j.1365-2435.2000.00443.x
102. The Food and Environment Research Agency. Effects of neonicotinoid seed treatments on bumble bee colonies under field conditions. 2013. Available: <http://fera.co.uk/ccss/documents/defraBumbleBeeReportPS2371V4a.pdf>.
103. Faucon JP, Aurières C, Drajnudel P, Mathieu L, Ribiere M, Martel AC, et al. Experimental study on the toxicity of imidacloprid given in syrup to honey bee (*A. mellifera*) colonies. *Pest Manag Sci*. 2005;61: 111–125. pmid:15619715 doi: 10.1002/ps.957
104. Lu C, Warchol KM, Callahan RA. Sub-lethal exposure to neonicotinoids impaired honey bees winterization before proceeding to colony collapse disorder. *B Insectol*. 2014;67: 125–130.
105. Sandrock C, Tanadini M, Tanadini LG, Fauser-Misslin A, Potts SG, Neumann P. Impact of chronic neonicotinoid exposure on honeybee colony performance and queen supersedure. *PLoS One*. 2014;9: e103592. doi: 10.1371/journal.pone.0103592. pmid:25084279
106. Macfadyen S, Banks JE, Stark JD, Davies AP. Using semifield studies to examine the effects of pesticides on mobile terrestrial invertebrates. *Annu Rev Entomol*. 2014;59: 383–404. doi: 10.1146/annurev-ento-011613-162109. pmid:24160417
107. Köhler HR, Triebkorn R. Wildlife ecotoxicology of pesticides: can we track effects to the population level and beyond? *Science*. 2013;341: 759–765. doi: 10.1126/science.1237591. pmid:23950533
108. European Food Safety Authority. Bee health. 2015. Available: <http://www.efsa.europa.eu/en/topics/topic/beehealth>.
109. Henry M, Beguin M, Requier F, Rollin O, Odoux JF, Aupinel P, et al. A common pesticide decreases foraging success and survival in honey bees. *Science*. 2012;336: 348–350. doi: 10.1126/science.1215039. pmid:22461498

110. Bryden J, Gill RJ, Mitton RA, Raine NE, Jansen VA. Chronic sublethal stress causes bee colony failure. *Ecol Lett*. 2013;16: 1463–1469. doi: 10.1111/ele.12188. pmid:24112478
111. Henry M, Bertrand C, Le Féon V, Requier F, Odoux JF, Aupinel P, et al. Pesticide risk assessment in free-ranging bees is weather and landscape dependent. *Nature Comm*. 2014;5: 4359. doi: 10.1038/ncomms5359
112. Cresswell JE, Thompson HM. Comment on "A common pesticide decreases foraging success and survival in honey bees". *Science*. 2012;337: 1453. pmid:22997307 doi: 10.1126/science.1224618
113. Becher MA, Grimm V, Thorbek P, Horn J, Kennedy PJ, Osborne JL. BEEHAVE: a systems model of honeybee colony dynamics and foraging to explore multifactorial causes of colony failure. *J Appl Ecol*. 2014;51: 470–482. pmid:25598549 doi: 10.1111/1365-2664.12222
114. Banks JE, Stark JD, Vargas RI, Ackleh AS. Deconstructing the surrogate species concept: a life history approach to the protection of ecosystem services. *Ecol Appl*. 2014;24: 770–778. pmid:24988775 doi: 10.1890/13-0937.1
115. Tomizawa M, Yamamoto I. Binding of nicotinoids and the related compounds to the insect nicotinic acetylcholine receptor. *J Pestic Sci*. 1992;17: 231–236. doi: 10.1584/jpestics.17.4_231
116. Kessler SC, Tiedeken EJ, Simcock KL, Derveau S, Mitchell J, Softley S, et al. Bees prefer foods containing neonicotinoid pesticides. *Nature*. 2015;521: 74–76. doi: 10.1038/nature14414. pmid:25901684
117. Palmer MJ, Moffat C, Saranzewa N, Harvey J, Wright GA, Connolly CN. Cholinergic pesticides cause mushroom body neuronal inactivation in honeybees. *Nat Commun*. 2013;4: 1634. doi: 10.1038/ncomms2648. pmid:23535655
118. Alaux C, Brunet JL, Dussaubat C, Mondet F, Tchamitchan S, Cousin M, et al. Interactions between *Nosema* microspores and a neonicotinoid weaken honeybees (*A. mellifera*). *Environ Microbiol*. 2010;12: 774–782. doi: 10.1111/j.1462-2920.2009.02123.x. pmid:20050872
119. Di Prisco G, Cavaliere V, Annoscia D, Varricchio P, Caprio E, Nazzi F, et al. Neonicotinoid clothianidin adversely affects insect immunity and promotes replication of a viral pathogen in honey bees. *Proc Natl Acad Sci USA*. 2013;110: 18466–18471. doi: 10.1073/pnas.1314923110. pmid:24145453
120. Moffat C, Pacheco JG, Sharp S, Samson AJ, Bollen KA, Huang J, et al. Chronic exposure to neonicotinoids increases neuronal vulnerability to mitochondrial dysfunction in the bumblebee (*Bombus terrestris*). *FASEB J*. 2015;29: 2112–2119. doi: 10.1096/fj.14-267179. pmid:25634958
121. Decourtye A, Armengaud C, Renou M, Devillers J, Cluzeau S, Gauthier M, et al. Imidacloprid impairs memory and brain metabolism in the honeybee (*A. mellifera* L.). *Pestic Biochem Phys*. 2004;78: 83–92. doi: 10.1016/j.pestbp.2003.10.001
122. Decourtye A, Devillers J, Cluzeau S, Charreton M, Pham-Delègue MH. Effects of imidacloprid and deltamethrin on associative learning in honeybees under semi-field and laboratory conditions. *Ecotox Environ Safe*. 2004;57: 410–419. doi: 10.1016/j.ecoenv.2003.08.001
123. Schneider CW, Tautz J, Grünwald B, Fuchs S. RFID tracking of sublethal effects of two neonicotinoid insecticides on the foraging behavior of *A. mellifera*. *PLoS One*. 2012;7: e30023. doi: 10.1371/journal.pone.0030023. pmid:22253863
124. Yang EC, Chang HC, Wu WY, Chen YW. Impaired olfactory associative behavior of honeybee workers due to contamination of imidacloprid in the larval stage. *PLoS One*. 2012;7: e49472. doi: 10.1371/journal.pone.0049472. pmid:23166680

125. Tan K, Chen W, Dong S, Liu X, Wang Y, Nieh JC. A neonicotinoid impairs olfactory learning in Asian honey bees (*Apis cerana*) exposed as larvae or as adults. *Sci Rep.* 2015;5: 10989. doi: 10.1038/srep10989. pmid:26086769
126. Rondeau G, Sánchez-Bayo F, Tennekes HA, Decourtye A, Ramírez-Romero R, Desneux N. Delayed and time-cumulative toxicity of imidacloprid in bees, ants and termites. *Sci Rep.* 2014;4: 5566. doi: 10.1038/srep05566. pmid:24993452
127. Schmid-Hempel P, Heeb D. Worker mortality and colony development in bumblebees, *Bombus lucorum* (L.) (Hymenoptera, Apidae). *Mitt Schweiz Entomol Ges.* 1991;64: 93–108.
128. Roulston TAH, Goodell K. The role of resources and risks in regulating wild bee populations. *Annu Rev Entomol.* 2011;56: 293–312. doi: 10.1146/annurev-ento-120709-144802. pmid:20822447
129. González-Varo JP, Biesmeijer JC, Bommarco R, Potts SG, Schweiger O, Smith HG, et al. Combined effects of global change pressures on animal-mediated pollination. *Trends Ecol Evol.* 2013;28: 524–530. doi: 10.1016/j.tree.2013.05.008. pmid:23746938
130. Thompson HM, Fryday SL, Harkin S, Milner S. Potential impacts of synergism in honeybees (*A. mellifera*) of exposure to neonicotinoids and sprayed fungicides in crops. *Apidologie.* 2014;45: 545–553. doi: 10.1007/s13592-014-0273-6
131. Vidau C, Diogon M, Aufauvre J, Fontbonne R, Viguès B, Brunet JL, et al. Exposure to sublethal doses of fipronil and thiacloprid highly increases mortality of honeybees previously infected by *Nosema ceranae*. *PLoS One.* 2011;6: e21550. doi: 10.1371/journal.pone.0021550. pmid:21738706
132. Pettis JS, Johnson J, Dively G. Pesticide exposure in honey bees results in increased levels of the gut pathogen *Nosema*. *Naturwissenschaften.* 2012;99: 153–158. doi: 10.1007/s00114-011-0881-1. pmid:22246149
133. Doublet V, Labarussias M, Miranda JR, Moritz RF, Paxton RJ. Bees under stress: sublethal doses of a neonicotinoid pesticide and pathogens interact to elevate honey bee mortality across the life cycle. *Environ Microbiol.* 2015;17: 969–983. doi: 10.1111/1462-2920.12426. pmid:25611325
134. Retschnig G, Neumann P, Williams GR. Thiacloprid-*Nosema ceranae* interactions in honey bees: host survivorship but not parasite reproduction is dependent on pesticide dose. *J Invertebr Pathol.* 2014;118: 18–19. doi: 10.1016/j.jip.2014.02.008. pmid:24594300
135. Fauser-Misslin A, Sadd BM, Neumann P, Sandrock C. Influence of combined pesticide and parasite exposure on bumblebee colony traits in the laboratory. *J Appl Ecol.* 2014;51: 450–459. doi: 10.1111/1365-2664.12188
136. Retschnig G, Williams GR, Odemer R, Boltin J, Di Poto C, Mehmman MM, et al. Effects, but no interactions, of ubiquitous pesticide and parasite stressors on honey bee (*Apis mellifera*) lifespan and behaviour in a colony environment. *Environ Microbiol.* 2015; In press.