

BEEVOCAL

Issue 3_2018

TODAY'S SOCIETAL CHALLENGES REQUIRE THE BEST OF SCIENCE

Are biases and unfounded preconceptions getting in the way?



Bayer Bee Care experts explain why we can't allow biases and allegations to get in the way of public-private collaborations.

The companion article *The best of science to protect bees* provides an overview of the Bee Care Center's own collaborative research projects.

OPINION

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In a globalized and fast-paced world, the challenges we face are highly complex and must be tackled with increasingly fragmented resources. Cross-sector collaborations have become a means to efficiently generate the best long-term and high-impact solutions to problems. Research is no exception.

Analyses of Nature Index, a database of author affiliation information from 82 high-quality, international science journals, show the number of partnerships between the corporate sector and academic or government institutions has doubled since 2012. Reported cross-sector collaborations reached well over 25,000 in 2016 for all natural science areas covered by the selected journals.¹

While most people would agree that cross-sector collaborations enable efficient resource use and stimulate innovation through cross-disciplinary exchange, perceptions may change when dealing with controversial topics. In those cases, industry contributions often become overshadowed by some, who believe that business interests are at odds with truthful, transparent and independent science.

But is that really the case? Can we not have the best of both worlds – meaningful, top-quality research supported by businesses, who look to create marketable technologies that solve global problems? At the Bayer Bee Care Center, we believe this synergy is a must.

Interests are not the problem. Biases are.

All institutions have interests, be it businesses, government, universities, non-governmental organizations (NGOs) or publishers. The reward for the efforts may differ in the end – a marketable product, secure funding, high publication rankings – but they define goals all the same. In our opinion, however, having business, career, funding or other interests does not *per se* undermine the value of a joint research project.



In a globalized and fast-paced world, the challenges we face are highly complex.



Quite the opposite, it sets the stage for collaborations that benefit all parties. Business may drive the research questions in a joint project no differently than a set of priorities drive research grant awards. Yet, if all parties in a collaboration respect and act according to principles of information transparency and scientific rigor, results are the outcome of a mutual, carefully-planned and agreed-upon experiment.

What must not happen is that the different interests bias discussion and reporting of controversial topics. A genuine debate about the use of crop protection products, for example, cannot ignore the fact that current pressures on ecosystems stem from the mounting demands of a rapidly-growing human population. Thus, assessing the use of these products must consider both environmental and social impacts, like that pesticides have helped boost crop productivity worldwide and make diverse foods affordable for the average family;² or that, for instance, weaving pyrethroid insecticides into mosquito nets has made the largest contribution to reducing the prevalence of malaria in Africa between 2000 and 2015.³

Articles reporting effects of pesticides are published and cited substantially more often than those reporting no effects, regardless of study quality.

Hanson *et al.* (2018)⁴



The report of a large-scale field study raises questions about sensationalism in science. Read more in our BEENOW article *Sensationalism Versus Science*.

SENSATIONALISM IN SCIENCE

An evaluation of the scientific literature on ecotoxicology shows that articles reporting effects of pesticides are published and cited substantially more often than those reporting no effects, regardless of study quality.⁴ As an example, two publications on the same topic – the effects of neonicotinoid insecticides on bees – using the same bee species, and with the same main author drew vastly different attention. The publication of the study results claiming effects of pesticides garnered an Altmetric⁵ score nearly 25 times higher than the study that showed no effects.^{6, 7}

This partiality gives researchers little or no incentive to submit and publish research that shows no adverse effects – an equally valid finding – and results in an inadequate picture of the evidence. This is exacerbated by the fact that extensive studies conducted to assess the risks of crop protection products often go unpublished by scientific journals. Furthermore, the push for a publishable headline encourages misleading interpretation of research outcomes and the use of experimental designs that boost the likelihood of detecting effects but fail to reproduce real-world conditions.

Global sustainable development and environmental stewardship must build on the comprehensive examination of equally-weighted facts, with the common goal to develop and use technologies that improve quality of life. This is the intersection where businesses, governments, research institutions and non-governmental organizations could work together to drive real progress. Yet, the selective discounting of studies and arguments on “the other” side of a controversial topic sabotages that possibility because it stifles open exchange and biases the production of new knowledge. This brings us to our next topic – truthfulness in science.

Scrutinize methods to reveal truth

Truthful research is at the core of the scientific process, and various review mechanisms, each with strengths and weaknesses, aim to ascertain the quality and integrity of reported research. Scientific publications, for example, go through the peer review process, where invited experts assess the soundness of the concepts and approach in a manuscript. However, these experts rarely validate the methods used or question the data presented and, thus, peer review cannot always ensure reproducibility or prevent fraud. Symptoms of this shortcoming are mirrored by a 2016 *Nature* survey, where more than 70 percent of respondents said they had tried but were unable to reproduce published experiments.⁸

Industry studies that are conducted to obtain regulatory approval of products attempt to address the issue of results reproducibility and reliability by using validated testing methods and by working according to the principles of Good Laboratory Practices (GLP). Test method validation is a lengthy process of scrutinizing testing designs to eliminate confounding variables that can influence results and creating detailed experimental guidelines that can be employed at any testing site. Consequently, the tests used to assess the impact of pesticides on bees for regulatory approval took several years to validate.⁹ The upshot, however, was a standardized methodology to ensure that differences in observations are not the result of differences in methods. GLP entails rigorous control mechanisms that dictate the processes and conditions under which studies are planned, performed, monitored, recorded, archived and reported. The use of GLP enables the systematic oversight by authorities of safety testing, testing facilities and study documentation, which helps ensure data integrity and study transparency.

The acknowledged challenge of reproducing results found in scientific literature raises the question as to what the discussion around pesticides might be if all the studies presented as evidence had used the same validated testing methods and a standardized documentation system like GLP. Furthermore, what might the discussion look like if all studies around a topic were readily available? That is, transparency of research efforts, our next topic, leads to better-informed decisions.

Advocate for transparency to tear down walls

It is a fact that ecotoxicological studies, conducted by industry to achieve approval of products from regulatory agencies, are normally not accessible to all. They are often reviewed only by expert authorities, entrusted to evaluate study outcomes and make decisions in the interest of public health and environmental safety. This is changing, however, with a global call for transparency that has rippled through all sectors, private and public.

> 70 %

of respondents in a *Nature* survey said they have tried but were unable to reproduce published experiments.



Validated testing methods, standardized documentation and transparency would allow for better-informed decisions.

TRANSPARENCY AT BAYER

Bayer recently launched a transparency initiative that provides regulatory study reports to the public and has initiated a dialogue to reinforce trust in the company commitment to drive technological advances while caring for the planet and its inhabitants. Read more at www.cropscience-transparency.bayer.com.

Transparency is also integral to collaborations under the Bee Care Science Program. Collaboration contracts typically state that partners will publish findings, even when parties involved differ in opinion on a topic. The important thing is that study results are disseminated and debated in a broader forum.



The website of the Bayer Transparency Initiative gives access to crop protection safety data.

Independence of thought leads to open debate and action

The same openness that cultivates truthful, high-quality research can serve as a mechanism to promote the independence of thought that supports comprehensive examination of equally-weighted facts. Realistically, all research is subject to influence, be it from an employer, funder, peers, competitors or others. Trying to divide or differentiate research into “independent versus dependent” is simply artificial. Moreover, far from diminishing the value of research, the differing perspectives that arise from such dependencies promote end solutions that are more adequate for our most pressing challenges. Where independence and openness are essential in our evaluation of evidence, our assessment of methods and our discussion of influences and their impact. Pressuring counterparts in a debate with the argument that “independent” research is more credible than “dependent” is counterproductive. It silences input that could advance the discussion or forces a neutral standpoint that prevents action. Independence and impartiality are the mindset for open debate; they neither preclude having an opinion nor should they ever lead to ineffectiveness.

Trying to differentiate between ‘independent’ and ‘dependent’ research is artificial and counterproductive.

Protecting pollinators and advancing pollination requires an open and transparent debate based on the comprehensive scrutiny of equally-weighted facts.





Open and transparent exchange drives true progress

The Bayer Bee Care Center was founded to facilitate expert scientific support for bee health. Our mandate is to protect pollinators and enhance crop pollination. In our experience, the only way to drive workable, real-world protection measures is to step back from the dynamics that shape the perception of a controversial topic and, instead, focus on facts. Years of collaborating with private and public institutions have taught us that open and transparent exchange on stakeholder interests and dependencies leads to strengthened scrutiny of results, out-of-the-box thinking and the highest standards of scientific rigor. We believe that these collaborations are genuine examples of the synergy that merges meaningful, top-quality research with the business goal to create marketable, problem-solving technologies.

And yes, our track record of successful, long-term research collaborations is, at times, marred by skepticism born from our connection to Bayer's business in crop protection products. Yet, a closer look at the projects we engage in (see our article *The best of science to protect bees*) shows that efforts across affiliations, experiences and beliefs bring true progress and answers, instead of stagnation and inaction. Our collaborations are far more than shared research resources. They broaden perspectives, enable the tackling of problems from multiple angles and provide a clear path to bring solutions to farmers, beekeepers, company executives and policy makers. Our collaborations aim for the best of science and embody the notion that a problem shared is a problem solved.



In Chile, a Bee Care project aims to better understand crop-pollinator dynamics in avocado.

The Bayer Bee Care Center was founded to facilitate expert scientific support for bee health.

1 Nature Index. 2017. A firm shift. *Nature* 552: 6–7. DOI: 10.1038/d41586-017-07420-4

2 Hossard, L. et al. 2014. Effects of halving pesticide use on wheat production. *Nature Scientific Reports* 4: 4405. DOI: 10.1038/srep04405

3 Bhatt, S. et al. 2016. The effect of malaria control on *Plasmodium falciparum* in Africa between 2000 and 2015. *Nature* 526: 207–211. DOI: 10.1038/nature15535

4 Hanson, M.L. et al. 2018. Evidence of citation bias in the pesticide ecotoxicology literature. *Ecotoxicology* 27(7): 1039–1045. DOI: 10.1007/s10646-018-1918-4

5 Altmetric is a system that tracks the attention that research output (e.g. scholarly articles, datasets) receives online. For more information, see www.altmetric.com

6 Baron, G.L. et al. 2017. Pesticide reduces bumblebee colony initiation and increases probability of population extinction. *Nature Ecology & Evolution* 1: 1308–1316

7 Stanley, D.A. and N.E. Raine. 2017. Bumblebee colony development following chronic exposure to field-realistic levels of the neonicotinoid pesticide thiamethoxam under laboratory conditions. *Nature Scientific Reports* 7: 8005. DOI: 10.1038/s41598-017-08752-x

8 Baker, M. 2016. Is there a reproducibility crisis? *Nature* 533: 452–454

9 Bayer Bee Care Center. 2017. Testing on the wild side: bee safety testing beyond the honey bee. <https://beecare.bayer.com/media-center/beenow/detail/bee-safety-testing-beyond-the-honey-bee>

BEEVOCAL

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THE BEST OF SCIENCE TO PROTECT BEES

Collaborations that let us understand better, do more and go further



Bayer Bee Care experts introduce several collaborative research projects of the Bee Care Science Program.

Our BEEVOCAL 3_2018 explains why the Bee Care Center considers collaboration so important for science.

Pollinator protection and the pollination services that insects, such as bees, provide to agriculture are global issues that require large-scale thinking and international engagement. At the Bayer Bee Care Center, we believe that carrying out our mandate to protect pollinators and advance pollination requires an open and transparent debate, based on the comprehensive scrutiny of equally-weighted facts.

To capture the full scope of the issues, we collaborate with scientists who can provide relevant input, local knowledge and scientific expertise, independent of their affiliation in the corporate, academic or governmental sectors. We work with the best scientists because we want the best of science. This goes above and beyond experience and information. For us, the best of science is a collection of added benefits — broadened perspectives, multifaceted approaches, a path to the end user and future-proofed results — that constitute the unique value of collaborative work.

Despite our efforts to build long-term, carefully-planned research set-ups that produce high-quality outcomes, at times our work encounters skepticism and dismissal because of the preconceived notion that business involvement leads to flawed science. We hope that clarity about the greater value of our collaborative projects and their importance to carrying out our mandate will lift some of this incredulity and highlight the valuable contributions of our research partners to protect bees and other pollinators.

Capture broader perspectives

Spanning geography, stakeholders and interests, collaborations build an environment in which idea exchange and constructive disagreement lead to a broader and more granular understanding of a problem. Perspectives of each collaboration member are the product of specific experiences and can be decisive in successfully finding a solution. Debating these perspectives fertilizes new ideas and reveals common

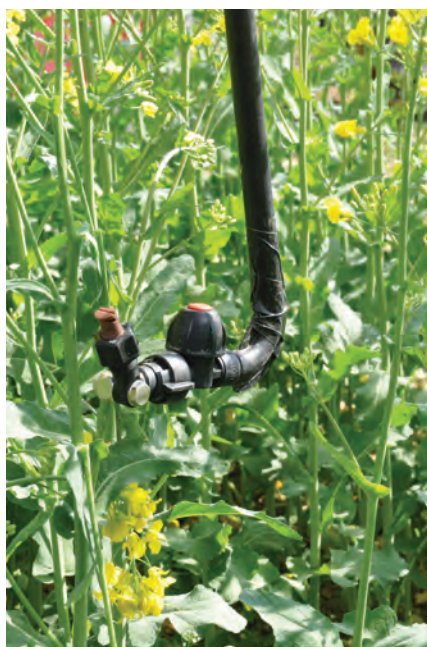
OPINION

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The Dropleg application technology (above and right) reduces the pesticide exposure of pollinators, and the pesticide residues in pollen, nectar and honey.



ground from which to establish shared objectives. Furthermore, the quality of outcomes is improved by peer scrutiny of research data and by the transparency in data interpretation that results from open exchange.

“The Dropleg project is a win-win situation for all parties involved.”

Dr. Klaus Wallner, Apicultural State Institute, University of Hohenheim, Germany

DROPLEG PROJECT

The joint development of the Dropleg application technology is a good example of how disparate perspectives can lead to new, implementable ideas. As part of the Germany-wide FITBEE collaboration between 14 research institutions and companies, one of the aims of the Dropleg Project was to reduce bee exposure to crop protection products used on oilseed rape fields. Researchers, agricultural equipment manufacturers and Bayer Bee Care worked together to conceptualize, develop and test hook extensions for spray booms that apply crop protection products below the crop flowering canopy. The success of the Dropleg technology on oilseed rape has prompted proposals to examine its use in other crops.



Honey bees (*Apis mellifera*) are important cashew pollinators in Northeast Brazil.

Facilitate multifaceted approaches

Undoubtedly, when experts from different disciplines team up, they bring an enriched arsenal of knowledge and tools to tackle a research question. Collaborations, however, go beyond multidisciplinary problem-solving; they also enable a multifaceted approach.

Ecological, behavioral and physiological questions about bees are diverse and insights have repercussions for resource management, landscape use, agricultural and economic systems. Conversely, these also have a bearing on the success of pollinator protection measures. The complexity of these topics calls for gathering information and generating knowledge at multiple touchpoints while disseminating insights to a vast network of stakeholders. Taking on such a large endeavor in isolation is overwhelming, costly and rarely effective. Collaborations, however, support decentralized focus on different topics, regions or applications while funneling gained insights into an overarching framework that integrates and distributes knowledge.

BEE ECOLOGY IN BRAZIL

Our partnerships in Brazil exemplify this multifaceted approach. Scientists from local universities, industry partners and contract research organizations are answering targeted questions about bee ecology in an array of projects, while our collaborative structure disseminates knowledge gained across projects and to the public. Teams are surveying pollinators in various crops, looking at health and activity of managed honey bee colonies, as well as pollination services by wild bees. Researchers are exploring the suitability of managed native wild bees for the pollination of different crop types. Specialists are compiling an online, image-rich pollen catalog to help beekeepers and crop growers identify nectar and pollen sources for bees. Educators are translating findings into an easy-to-understand manual to help growers apply pollinator-friendly farming practices that improve crop yields. Clearly, the power of this multifaceted approach is the cross-sector investment, the decentralized application of expertise and the propagation of knowledge at all levels – from researcher to farmer and resource manager – so decisions are based on facts.



Carpenter bee (*Xylocopa frontalis*) visiting a passion fruit (*Passiflora edulis*) flower. These flowers are pollinated only by large bulky bees like this species.

“It is really important that research institutions and industry work together because joining expertise and resources leads to better results, in less time, at a lower cost. In fact, some projects would not happen otherwise.”

Professor Breno Magalhães Freitas, Federal University of Ceará, Brazil



Professor Breno Magalhães Freitas, agronomist and pollinator scientist at the Federal University of Ceará in Brazil, analyzes why the productivity of melon plants in Brazilian agriculture can vary significantly.

Pave a path to the end user

An often-cited advantage of academia-industry collaborations is a defined path from basic research to end-user application, whether marketable product or recommended practice. This path emerges from the distinct but complementary research approaches of the two parties that feed insights from the laboratory or field into a development pipeline, informed by market intelligence, production expertise and regulatory know-how.





VARROA GATE

The Varroa Gate is the successful outcome of complementary work between *Varroa* mite experts Professor Nikolaus Koeniger and Dr. Gudrun Koeniger, currently at the University of Würzburg, Bayer's Animal Health Business Unit, Bee Care Center and many other collaboration partners. In treating the *Varroa* mite, it is not just about finding the right bee medicine (varroacide), it is also about finding the right delivery system for the varroacide. One of the biggest problems beekeepers face is the mite's ability to spread between colonies, carried by foraging worker bees which have picked up the mite before returning to the hive.

As an alternative application method, the collaborators came up with the idea of a modified hive entrance consisting of several small holes where an active substance "rubs off" on bees as they pass through, effectively using entering bees to distribute the varroacide throughout the hive. In this way, a control against *Varroa* is created at the beehive entrance, minimizing mite infestation, which is especially important for vulnerable colonies preparing for the winter season.

Designing and testing prototypes of the Varroa Gate demanded high expertise from all parties, forcing the team back to the drawing board many times before succeeding. Chemists at Bayer's Engineering and Technology division devised materials to slowly release the varroacide, so the bees could take it into the hive over several months, providing a much longer treatment period compared to the product strips already on the market.

After extensive development, clinical efficacy trials and field residue studies, involving numerous collaborations including experts from Wageningen University, the Varroa Gate, which contains flumethrin, received regulatory approval in the EU in early 2017. It is, or will be, available to beekeepers in 24 European countries, a feat accomplished by the regulatory experts and product management teams at Bayer Animal Health.



The Varroa Gate protects the bees in the hive against the *Varroa* mite and also prevents renewed infestation from outside sources. Read our BEENOW article *Developing New Treatments: Bringing New Bee Health Varroacide Products to Market* to learn more.

"The applied nature of the partnership with the Bayer Bee Care Center is very important to me because I can directly discuss the practicality of our scientific findings with our target audience, in my case, beekeepers."

Dr. Tjeerd Blacquière, Wageningen Plant Research, Netherlands

Actionable and future-proof research investments

In the end, the success of the Bayer Bee Care Center is measured in improvements to pollinator health resulting from the research we foster. This means that the knowledge and tools we help create must be practical and implementable; they must accommodate the ecological profile and technological capabilities of regions where bees provide services. Only so, can we fulfill our objective.

HEALTHY HIVES

As part of the Healthy Hives 2020 LATAM program, our collaborators in Latin America are, or will be, surveying honey bee health in Chile, Colombia, Argentina and Costa Rica, to then introduce concrete, quantifiable and region-specific improvement measures.

In the USA, the Healthy Hives 2020 USA program has funded ten projects with academic and research institutions, to support honey bee health goals which were prioritized as most critical for North America. These include assessing honey bee genetics for natural disease resistance; using smart hive technologies for colony monitoring and establishing best management practices for beekeeping, based on recorded hive performance data.

“Through our participation in Healthy Hives we can transfer global knowledge to local growers and adapt it to the Latin American agricultural context.”

Marnix Doorn, Fraunhofer Chile Research Foundation, Chile

“Research by Healthy Hives 2020 grant recipients has the potential to make an immediate impact on honey bee colony health.”

Danielle Downey, Executive Director Project *Apis m.*, and Healthy Hives 2020 USA program manager



POLLINATION OF VEGETABLES IN KENYA

In Africa, the National Museums of Kenya and Jomo Kenyatta University in Nairobi, Kenya, are working with the Bayer Bee Care Center on a project that merges improved yields of small farms with nature conservation by determining optimal pollination patterns for small vegetable farms and empowering female farmers with knowledge, to use resources sustainably.

“The partnership is empowering the rural communities, especially women farmers through mobilization and sharing of knowledge, expertise and technologies, to support the achievement of the sustainable development goals in Kenya.”

Dr. Esther Kioko, National Museums of Kenya, Kenya



Collaborating with researchers, beekeepers, growers, resource managers and land developers in private and public sectors futureproofs our investment in bee health because only through this exchange can we obtain an accurate picture of the questions to be addressed and ensure that our global efforts are relevant to all stakeholders involved.

Equally important to future-proofing our investment is the longevity of our research projects. Only insights from long-term data are robust against the inevitable temporal and typical variation of natural systems. Moreover, our long-term partnerships attest to the value that our partners see in an open dialogue across sector lines and the quality of the outcomes produced.

ECOLOGICAL ENHANCEMENT IN GERMANY

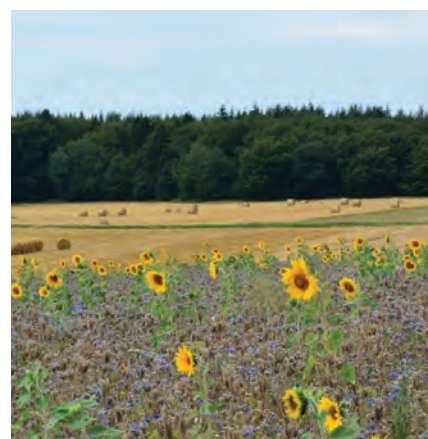
Our cooperation with the Institute for Landscape Ecology and Nature Conservation (ILN) in Bühl and the Institute for Agroecology and Biodiversity (IFAB) in Mannheim assesses the impact of ecological enhancement measures – for instance flowering strips and bee banks (soil structures for wild bee nesting) – on the biodiversity of pollinators in intensively-managed agricultural land. The project is into its ninth year of asking questions, not only about whether the presence of ecological enhancement measures improves pollinator biodiversity but also about how the size and distribution of these measures impact bee and butterfly diversity.

An ecosystem of innovation for pollinators

Our collaboration partners have become a powerful and insightful network for high-quality bee health research — an ecosystem of innovation, so to speak. As a global company, Bayer has business interests that define investments and goals. In the case of pollinators, the aim is to strike a balance between helping farmers expand food production and contributing to the health, safety and diversity of pollinators. Those interests are best served when research is rigorous enough to guarantee truthfulness; detailed in planning to enable transparency and consensus-driven in execution to ensure that all perspectives and influences are considered.

We call for open debate. We invite all researchers, experts or others with an interest in the well-being of bees and other pollinators to look at the work fostered by the Bayer Bee Care Center, to scrutinize the research we carry out with our collaborators and to talk to us about new ideas and suggestions. Strong scientific insights, not unfounded preconceptions, will inform decisions to resolve controversy. Everyone stands to benefit from this exchange, and above all, the bees.

We invite all researchers, experts or others with an interest in the well-being of bees and other pollinators to look at the work fostered by the Bayer Bee Care Center and to scrutinize the research we carry out with our collaborators.



Through surveys of pollinator populations scientists can assess the effectiveness of ecological enhancement measures, like wildflower strips, in boosting the diversity and abundance of wild bees and butterflies.

FURTHER READING

Sensationalism in Science

Our BEENOW article *Science Versus Sensationalism* sheds a light on why good science, not sensational headlines, should drive research conclusions.

Varroa Gate

Read more about the Varroa Gate in our BEENOW article *Developing New Treatments: Bringing New Bee Health Varroacide Products to Market*.

Find both articles at:
www.beenow.bayer.com

Good Laboratory Practices

Learn more about the importance of GLP in our BEEINFORMed article *The Science of Bee Testing and Pesticide Risk Assessment*, available from:
www.beecare.bayer.com/media-center/publications

EXPERTS



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