Pesticides have negative effects on non-target organisms

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Data collection and selection

Where contested values (e.g. different interpretation of sample sizes resulting from unclear methods descriptions) or other potential issues (e.g. different management between treatments) were identified on the second assessment, these were assessed by group discussion with other co-authors. At least three group members participated in each discussion. If understanding of the data was the same, we retained the data. If not, we contacted the author directly to ask for the data or clarification on certain metrics, e.g. sample size. If the authors did not respond or we failed to contact the authors, their data was excluded. When studies were rejected, efforts were made to find other papers by the same authors or affiliations using the same data set, resulting in the inclusion of 312 additional substitute studies. The final data set used in this analysis comprised 1,705 studies and 20,212 effect size observations.

In the cases where no standard errors, standard deviations, or confidence intervals had been reported, we calculated standard deviations following Nakagawa et al.[1] (Eq.6), referred to as the "All Cases" method. Among the 1,705 studies, there were 414 studies with missing standard errors, standard deviations, or confidence intervals (studies with transformed data were also considered as missing standard errors, standard deviations, or confidence intervals).

For laboratory experiments with bacteria or fungi, sample sizes usually were the number of independent biological experiments. For field experiments, the sample sizes were taken to be the replicate plots. For field experiments, we were generally also able to extract the locations that the authors provided in the paper. This was only occasionally possible for lab experiments. In cases where the authors had not provided accurate study locations, we contacted the first or corresponding authors. In all other cases, the main affiliation institution of the first author was considered to be the study location of that paper. However, for some papers, where the authors had multiple affiliated institutions, we considered the first affiliation to be the study's location.

Mixtures of pesticides were not included in this paper, due to the following reasons: 1) long time span between the first and last sampling date (see the Methods in the main text); 2) most of the control groups of the compound pesticide-treated groups were not defined appropriately enough. For example, in Belden et al., Env Tox Chem 29:2477-2480, the authors tested the effects of the compound fungicide (Stratego) composed of the active ingredients Propiconazole and Trifloxystrobin, on the mortality of *Bufo cognatus* tadpoles; thus, the study should have had three control groups (including also single-pesticide treatments; however, in that case, a Trifloxystrobin-treated group was not tested; and 3) mixing pesticides may lead to the formation of unknown

chemical intermediates, aggregation, precipitation or other reactions, making it difficult to effectively compare single-pesticides with pesticide mixtures.

To reduce within-study sources of bias, typical for studies considering the effects of pesticides on biodiversity, we assessed each study for: 1) incomplete outcome data relating to the loss of samples which may cause bias in the effect sizes used in our meta-analysis; 2) consistent identification of randomization of treatment allocations to avoid systematic bias; 3) consistent identification of baseline conditions to which random allocation of treatments occurred to avoid bias resulting from chance allocation to different historic non-pesticide agricultural practices like fertilizer, irrigation, soil tillage etc; 4) consistency of target organisms for lab or field experiments to minimize bias associated with taxonomic variation between treatments in the test species. This is crucial, as even closely related species may differ in their toxicokinetic responses to pesticide absorption and elimination; 5) consistent spatiotemporal scale of assessment across treatment groups to avoid bias associated with comparisons with study taxa at different points along a spectrum from acute to chronic exposure; 6) excluding treatments that incorporate multiple pesticide stressors to avoid bias associated with hard to predict synergistic effects of pesticide interactions (i.e. where multiple pesticide exposure experiments were discarded so that each treatment group included only one insecticide, fungicide, or herbicides); 7) evidence for selective outcome reporting whereby only a subset of the recorded variables are reported suggesting selection bias in result reporting. Studies not meeting these requirements were excluded.

Predictor variables

The analysis considered six categorical explanatory variables, one binary variable and two continuous variables. These were:

Non-target organism group: The non-target organism group was a categorical variable that denoted whether the organisms were: i) animals, including invertebrates (i.e., Protozoa, Coelenterata, Rotifera, Platyhelminthes, Nemathelminthes, annelids, molluscs, arthropods, echinoderms) and vertebrates (i.e., fish, amphibians, reptiles, birds and mammals); ii) plants, including seed plants (i.e., dicotyledonous or monocotyledonous plants) and spore-producing plants (i.e., algae plants and fern plants), and; iii) microorganisms, representing bacteria (i.e., cocci, *Bacillus* and *Spirillum*) and fungi (i.e., Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina and Glomeromycota). Animals, plants and microorganisms represented broad categorical groups that are intended to support interpretation of differences in the types of responses seen to pesticides. We accounted for phylogenetic relationships between the plants in the meta-

analysis, however, for animals and microorganisms, sufficiently resolved phylogenies were not available to support this approach. Note that some species listed here could also have been classified as pests (i.e., not non-target organisms) but have been included if a study reported a non-target effect. For instance, the influence of a herbicide on an insect pest can clearly be considered non-target in this context. Data discussing the target effects of pesticides were (of course) omitted, such as the impact of an insecticide on an insect pest. Viruses were excluded from the microorganism variable, as there were no papers considering direct pesticide impacts on viruses. The complexity of studies considering how pesticides moderate immune responses to viral diseases in hosts were too complex to include in this meta-anlaysis. The classification of animals, plants and microorganisms followed Liu & Zheng[2], Zhao[3] and Yang[4], respectively.

Response variable: The assessed endpoint covered growth, reproduction, measures of behaviour (animals only) and other physiological biomarkers.

Experiment type: This variable included laboratory and field experiments (greenhouse experiments were considered as laboratory experiments)[5].

Pesticide variables: Pesticide types were assigned according to whether they were mineral-based, biogenic or chemical-synthetic pesticides. Likewise, insecticides were split into mineral-based insecticides (only inorganic aluminum, inorganic boron and inorganic sulfur were considered here as there was not sufficient literature on other mineral-based insecticide effects on non-target organisms), biogenic insecticides (i.e., botanical, microbial and antibiotic insecticides) and chemical synthetic insecticides (i.e., Amide, Benzoylphenylurea, Carbamate, Diacylhydrazine, Dichloropropene, Formamidine, Isoxazoline, Neonicotinoid, Nereistoxin, Olefin, Organochlorine, Organonitrogen, Organophosphorus, Phenylether, Phenylpyrazole, Pyrethroid, Pyridine, Pyrrole, Semicarbazide, Sulfoximine, Tetronic acid, Thiadiazinone, Thiourea and Triazine insecticides). As no literature on mineral-based herbicide impact on non-target organism was available, we divided herbicides into biogenic herbicides (e.g., microbial and Botanical herbicides) and chemical synthetic herbicides (i.e., Amide, Aryloxyphenoxy-propionate, Benzoic acid, Carbamate, Cyclohexene oxime, Dinitroaniline, Diphenylether, Imidazole, Imidazolinone, Isooxazole, Nitrile, Organophosphorus, Oxazolidinedione, Phenoxy carboxylic acid, Phenylurea, Pyrazolone, Pyridazinone, Pyridine, Pyridine carboxylic acid, Pyrimidine, Pyrrolidone, Quinolinic acid, Substituted phenylurea, Sulfonylurea, Thiodiazine, Triazine, Triazinone, Triazole, Triazolinone, Triketone and Uracil herbicides). Fungicides were split into mineral-based fungicides (i.e., Dithiocarbamate, inorganic copper and inorganic sulfur and Bicarbonate fungicides), biogenic fungicides (i.e., Botanical, microbial and antibiotic fungicides) and chemical synthetic fungicides

(i.e., Allylamine, Amide, Benzimidazole, Carbamate, Dinitrophenyl crotonate, Guanidine, Imidazole, Imide, Methoxyacrylate, Morpholine, Organomercurial, Organophosphorus, Organosulfureous, Organotin, Phenylurea, Phosphite, Piperazine, Pyridine, Pyrilamine, Pyrimidine, Pyrrole, Quinoline, Quinone, Substitutive benzene, Thiazole, Triazole and Triketone). The classification of pesticides including insecticides, fungicides and herbicides followed the approach described by Zheng & Sun[6], Qi et al.[7], and Zhou and Sun[8]. The responses of animals, plants and microorganisms to pesticide types are given in Supplementary Tables 9−11, and the effects of pesticide application rate-dependent increase are listed in Supplementary Data 8.

Further detail on the response category for species exposed to pesticides: The following text expands on the main text by providing details on the variety of response metrics and how these were aggregated into response groups for meta-analysis. We split the response variables into multiple categories nested within each taxonomic group.

Each effect size was based on a measured metric which was categorized as being either a measure of growth, reproduction, behavior or a biomarker. The definition of these response trait groupings varied between the animals, plants and microorganisms. The response traits linked to the ′animals′ group were: i) growth: This relates to metrics describing an increase in the physical size of the organism, including metrics like length, mass or direct indicators of animal growth, such as molting rate, or mitotic index; ii) reproduction, including such response metrics as animal population survival rate, population abundance (i.e., number of eggs, juveniles, cocoons and adults), emergence rate, fecundity, sperm motility, sperm quantity, sperm viability, survival rate of spermatozoa, number of sperm cells, ovary volume, ovary cell viability, ovarian stem sheath cell viability, viability of cervical cells, ovary mass, number of estrous cycles, estrous cycle length of animals, testicular tissue weight, testicular tissue size, primary spermatocyte cell size. Note that the mean net gain in hive weight for honeybees has been included here as an indicator of reproduction, as it will be directly associated with an increase in bee reproduction across all castes within a colony. We acknowledge that this could be considered a measure of growth if you consider the colony to be the biological reproductive unit; iii) behaviour, representing a response category unique to animals, and including traits such as, mating behaviours, walking speed, walking distance, as well as feeding behaviours including prey capture success, attack rate of predators, bee dance, phototaxis of insects, and feeding or flower visitation rates; iii) biomarkers, which included metabolic activity (e.g., animal amino acid metabolism, glycolipid metabolism and the tricarboxylic acid (TCA) cycle), activity of detoxification systems, genotoxicity and measures of cellular damage and its mitigation,

and hormones (e.g., testosterone, estradiol, estrone, and progesterone). As biomarkers may be both up and down regulated these were treated as absolute values (details below).

Plant performance was characterized as: i) *Plant growth*, considered to include growth rate and plant size characteristics, including plant width, height, biomass, periphyton biomass, leaf area, leaf thickness and number of leaves and the plant mitotic index; ii) *Plant reproduction*, which included the yield of fruits, grains, pods, vegetative reproductive plant parts and seeds per area; iii) *Plant biomarkers* included nitrogen metabolism, ammonium metabolism, plant photosynthesis (i.e., net photosynthetic rate), plant transpiration (i.e., transpiration rate, stomatal conductance) and lipid metabolism. We also included intra-cellular biochemical energy acquisition processes, specifically those linked to pigments used by plants to absorb light for energy production (e.g., chlorophyll or carotenoid content in cells) as a biomarker.

Microorganism performance was also defined by growth, reproduction, and metabolism: i) Microorganism growth included measures of colonial growth rate, cell biomass, dry biomass, and hyphal length of arbuscular mycorrhizal fungi; ii) Microorganism reproduction was measured by metrics including yeast cell population viability, spore viability, spore germination, percent of arbuscular mycorrhizal colonization and spore number; iii) Microorganism biomarkers refer to bacteriochlorin, a series of chemical reactions in which microorganisms absorb nutrients to sustain life and proliferate and degrade substrates. In catabolism, this includes measures of oxidation, exothermic and enzymatic degradation processes, while in anabolism, this includes reductive endothermic processes and enzyme synthesis.

From the perspective of interpretation, a decrease in growth, reproduction or behavioral responses of animals, plants and microorganisms was considered to denote a *negative* effect of pesticides. Thus, percentages and proportion of mortality or abnormal growth/reproduction data of non-target organisms were transformed into percentages and proportions of survival or normal growth/reproduction data of non-target organisms.

Climatic zone: temperate or tropical (temperate zones ranged from 23.5°N to 66.5°N and from 23.5°S to 66.5°S, and the tropical zones ranged from 0−23.5°N and from 0−23.5°S).

Exposure medium: i) Terrestrial: This refers to species who are exposed to pesticides either by direct contact or from soil or their life history placing them at exposure risk in terrestrial systems, such as arable agriculture for example through overspray or contacts with sprayed surfaces or pesticide contaminated plant products; with this category we included microorganisms associated with terrestrial systems (e.g. soil) even when tested under laboratory conditions. ii) Aquatic: Exposure through pesticides in water and typically including aquatic animals and plants; we include

here microorganisms who are associated with aquatic systems (e.g. soil) even when tested under laboratory conditions.

Conflict of interest status: one binary variable. "1" denotes that a certain article identified in its acknowledgements or another relevant section that there was a conflict of interest associated with its funding sources. For example, this may relate to industry funding. Where no conflict of interest was identified, this was coded for as "0". Identification of conflicts of interest and their subsequent inclusion in the meta-analysis were dependent on authors of papers disclosing these. There is of course a possibility that this was not done in every case. It was considered impractical to independently investigate the funding history for the 1,705 published papers included in the analysis where conflict of interest statements were absent.

Publication year: a continuous metric based on the time when the articles were published. This was included to look for systematic variation in reported effect size trends over time. For example, this may occur where an increased acknowledgement of negative effects of pesticides leads to greater rates of publication of negative effects over time.

Pesticide application rate: a continuous metric based on the lowest application rate (not zero) compared to the lowest baseline reference exposure value (not the control) in each study.

Assessing whether field recommended or environmentally relevant application rates for pesticides had similar effect sizes

An important aspect of the analysis was to determine whether the observed effects of pesticides would be seen under exposure concentrations that may plausibly be encountered under field conditions, be they those resulting from application rates of pesticides at authorised rates or maximum reported environmentally concentrations from monitoring, e.g. of water bodies. This stratification of the data was conducted to exclude unusually high exposure rates imposed as part of an experimental protocol designed for the purpose of hazard assessment, e.g. to create an application rate response curve. To identify these realistic exposure studies, we deleted the data on pesticide exposure field experiments in which pesticide application rates were higher than those of the maximum recommended pesticide application rate (e.g. the maximum product label rate). For aquatic systems, we based our assessments on maximum reported environmental concentrations. As an initial source of such values, we used the UK Environment Agency 'Water quality monitoring data GC-MS and LC-MS semi-quantitative screen' assessments (https://www.data.gov.uk/dataset/0c63b33e-0e34-45bb-a779-16a8c3a4b3f7/water-quality-monitoring-data-gc-ms-and-lc-ms-semi-quantitative-screen, accessed on 1/3/2023). These data

provide semi-quantitative gas chromatography-mass spectrometry (GC-MS and LC-MS) screening of water samples which includes a wide range of pesticides. As this data set was focused on the UK, we supplemented this available monitoring information with a review of papers from around the world selected from a Web of Science search for 'Pesticides' And 'Monitoring' and 'Water', along with targeted searches for individual compounds where we had missing values. We continued to review papers from this search until we reached a point where we failed to identify higher maximum reported concentrations for pesticide where residue active ingredients data was available. Our maximum reported values are based on data from an additional 68 publications, although a far greater number than this were assessed but failed to include relevant information on pesticide concentrations (See Supplementary Tables 10–14 and 17–22). Using these thresholds for real-world maximum exposure rates we constructed two new data sets for terrestrial and aquatic systems to which previously described meta-analysis approaches were applied.

Effect size (ES) measure

The effect size, lnRR, was calculated to examine the pesticide use effects. Log response ratios and their associated sampling variances are generally calculated according to

$$\mathrm{lnRR}_1 = \ln\left(\frac{m_1}{m_2}\right) \quad \text{(Eq.1)}$$

$$\mathrm{v}(\mathrm{lnRR}_1) = \frac{sd_1^2}{n_1 m_1^2} + \frac{sd_2^2}{n_2 m_2^2} = \frac{\mathrm{CV}_1^2}{n_1} + \frac{\mathrm{CV}_2^2}{n_2} \quad \text{(Eq.2)}$$

where m_1 and m_2 are the observed values of the treatment and control group, v represents the sampling variance, $sd_1$and sd_2 the standard deviations per group, and n_1 and n_1 the sample sizes per group. The CV′s are the corresponding coefficients of variation for treatment and control groups, respectively. In order to deal with missing SDs in a dataset, Nakagawa et al.[1] proposed new methods to weigh the average coefficient of variation estimated from studies in a study that does report SDs:

$$\mathrm{lnRR}_2 = \ln\left(\frac{m_1}{m_2}\right) + \frac{1}{2}\left(\frac{\mathrm{CV}_1^2}{n_2} - \frac{\mathrm{CV}_2^2}{n_1}\right) \quad \text{(Eq.3)}$$

$$\mathrm{v}(\mathrm{lnRR}_2) = \frac{\mathrm{CV}_1^2}{n_1} + \frac{\mathrm{CV}_2^2}{n_2} + \frac{\mathrm{CV}_1^4}{2n_1^2} + \frac{\mathrm{CV}_2^4}{2n_2^2} \quad \text{(Eq.4)}$$

$$\ln RR_3 = \ln\left(\frac{m_1}{m_2}\right) + \frac{1}{2}\left(\frac{\left[\sum_{i=1}^{K} n_{1i} CV_{1i} / \sum_{i=1}^{K} n_{1i}\right]^2}{n_1} - \frac{\left[\sum_{i=1}^{K} n_{2i} CV_{2i} / \sum_{i=1}^{K} n_{2i}\right]^2}{n_2}\right) \quad \text{(Eq.5)}$$

$$v(\ln RR_3) = \frac{\left[\sum_{i=1}^{K} n_{1i} CV_{1i} / \sum_{i=1}^{K} n_{1i}\right]^2}{n_1} + \frac{\left[\sum_{i=1}^{K} n_{2i} CV_{2i} / \sum_{i=1}^{K} n_{2i}\right]^2}{n_2} + \frac{\left[\sum_{i=1}^{K} n_{1i} CV_{1i} / \sum_{i=1}^{K} n_{1i}\right]^4}{2n_1^2} + \frac{\left[\sum_{i=1}^{K} n_{2i} CV_{2i} / \sum_{i=1}^{K} n_{2i}\right]^4}{2n_2^2} \quad \text{(Eq.6)}$$

where $CV = sd/m$ is the coefficient of variation; sd and n are the corresponding standard deviations and sample sizes, respectively; CV_{1i} and CV_{2i} are the CVs from the ith study (study: i=1,2,…,K).

Eqns. 3 and 5 can improve the accuracy and precision of the overall mean estimate. Eq. 5 and 6 can be used to calculate the effect sizes and sample variances when SDs are missing, and Eq. 3 and 4 can be used to calculate the effect sizes and sample variances when SDs are not missing.

In the present paper, we use Eq.5 to calculate effect regardless of whether SDs were missing or not, which is referred to as the "All Cases" method[1]. When combining lnRR of observations by using meta-analysis in each group, we used the combined lnRR, which was the average effect size for each group.

Meta-regression models for pesticide use

We performed meta-regression analysis using the R package metafor (version 3.4-0), in which we took log response ratio (lnRR) as the effect size measure (in the function "lnrr_laj()" in R.file "func.R" developed by Nakagawa et al.[1]) (Eqs. 3 and 5). We used the usual large-sample approximation to compute the sampling variances (in the function "v_lnrr_laj()" in R.file "func.R", which is equal to Eqs. 4 and 6). The lnRRs were employed as the response variable to fit the models. Taxonomic groups (i.e., animals, plants and microorganisms) were treated as fixed effects along with the moderator variables (i.e., pesticide class, study types, climatic zone, exposure medium, pesticide type, and number of added pesticide application rates). As measures from the same control individual were used repeatedly in comparisons of effects of different doses of the same pesticides these could be considered non-independent representing a form of "double-counting". In order to

solve this problem we assigned the argument "V" in "rma.mv()" function with the sampling variance-covariance matrix estimated by function "vcalc()" in R package metafor[9],where the parameter rho assumed values of 0.3, 0.5 or 0.6 to account for within-study correlation structures. To account for between-pesticide differences, we used the active ingredient pesticide identity as a random effect in the models. Although not considered in the main results, the included studies were also analysed in subsets (e.g., as higher resolution taxonomic groups) to better understand the effects within these various strata (see below).

To construct each mixed-effects meta-analysis model, we first fitted a base model integrating the taxonomic group as the only fixed effect. Secondly, we fitted a model integrating the interactions between the taxonomic group and other moderator variables to allow for a sequential test of whether they improved model fit based on likelihood-ratio tests (LRT). Thirdly, for model comparisons, we employed LRT of the model including the taxonomic group response category (growth, reproduction, behaviour (animals only) and biomarker of animals, plants and microorganisms) and the interactions between the response category and any evaluated moderator (Supplementary Table 1). Specifically, a model with a single predictor (e.g., taxonomic group) was compared with a model with two moderators (e.g., taxonomic group plus climatic zone types) and their interaction (e.g., taxonomic group × climatic zone types) (see Supplementary Tables 1 and 2 for detailed explanation). The null model corresponded to the equation:

$$\beta_{ij} = \text{Taxonomic groups} + r_i + \varepsilon_{ij} \quad \text{(Eq.7)}$$

The full model corresponded to the equation:

$$\beta_{ij} = \text{Taxonomic groups} + \text{moderators} + r_i + \varepsilon_{ij} \quad \text{(Eq.8)}$$

$$\beta_{ij} = \text{Taxonomic groups} + \text{moderators} + \text{Taxonomic groups} \times \text{moderatores} + r_i + \varepsilon_{ij} \quad \text{(Eq.9)}$$

Where β_{ij} is the jth effect size of study i, r_i represents the random effect of the pesticide species in ith study, and ε_{ij} is the random error term with variance equal to the lnRR's sample variance estimate.

For examining the significant terms of the taxonomic groups, we compared the full model with the null model, and the full model was as follows:

$$\beta_{ij} = \text{Taxonomic group} + \text{Taxonomic group response categories} \times \text{moderators} + r_i + \varepsilon_{ij} \quad \text{(Eq.10)}$$

Note that we subdivided the taxonomic groups (e.g., animals, plants and microorganisms) into taxonomic group response categories (e.g., animal growth, animal reproduction, animal behaviour,

animal biomarkers, plant growth, plant reproduction, plant biomarkers, microorganism growth, microorganism reproduction, and microorganism biomarkers). We categorized the responses to pesticides into four response metrics, namely, growth, reproduction, behavior and biomarkers. Taxonomic group responses were animal growth, animal reproduction, animal biomarkers, plant growth, plant reproduction, plant biomarkers, microorganism growth, microorganism reproduction, and microorganism biomarkers. As part of the analysis, we needed to examine whether the full model had a better explanation than the null model, reflecting the presence of overlap in evaluating the effect sizes of taxonomic groups and a series of taxonomic group response categories. To do this we applied the LRT in comparing the null model with the full model for exploring the interactions between the taxonomic group response categories and the different moderators. The null model was as follows:

$$\beta_{ij} = \text{Taxonomic group response categories} + r_i + \varepsilon_{ij} \quad \text{(Eq.11)}$$

The full model followed the equation:

$$\beta_{ij} = \text{Taxonomic group response categories} + \text{Taxonomic group response categories} \times \text{moderators} + r_i + \varepsilon_{ij} \quad \text{(Eq.12)}$$

$$\beta_{ij} = \text{Taxonomic group response categories} + \text{moderators} + \text{Taxonomic group response categories} \times \text{moderators} + r_i + \varepsilon_{ij} \quad \text{(Eq.13)}$$

Thereafter, to estimate effects and their corresponding confidence intervals for each taxonomic group, taxonomic group response category and their associations with the moderators, the following models were employed:

$$\beta_{ij} = \text{Taxonomic groups} + r_i + \varepsilon_{ij} \quad \text{(Eq.12)}$$

$$\beta_{ij} = \text{Taxonomic groups} + \text{moderators} + r_i + \varepsilon_{ij} \quad \text{(Eq.13)}$$

$$\beta_{ij} = \text{Taxonomic groups} + \text{moderators} + \text{Taxonomic groups} \times \text{moderators} + r_i + \varepsilon_{ij} \quad \text{(Eq.14)}$$

$$\beta_{ij} = \text{Taxonomic group response categories} + r_i + \varepsilon_{ij} \quad \text{(Eq.15)}$$

$$\beta_{ij} = \text{Taxonomic group response categories} + \text{moderators} + r_i + \varepsilon_{ij} \quad \text{(Eq.16)}$$

$$\beta_{ij} = \text{Taxonomic group response categories} + \text{moderators} + \text{Taxonomic group response categories} \times \text{moderators} + r_i + \varepsilon_{ij} \quad \text{(Eq.17)}$$

Where compared to the earlier models with interactions terms, the above models contained the

main effect in terms of taxonomic groups and taxonomic group response. The t-values and their 95% confidence intervals were derived from the corresponding fitted meta-regression models to evaluate whether the mean effect sizes were significant in the various categories.

Meta-analyses following the above steps were also undertaken to determine whether the observed effects of pesticides would be seen under real-world exposure conditions (as described above), as opposed to unusually high application rates imposed as part of an experimental protocol (e.g., to create an application rate response curve). The responses of different taxonomic groups and their growth, reproduction, behaviour and biomarkers to application rates under recommended field application rates are presented in Supplementary Tables 10–14, and these responses to application rates under maximum environmentally relevant concentrations are presented in Supplementary Tables 17–22.

Phylogenetic covariance structures for animals, plants and microorganisms

As the underlying phylogeny may affect responses predicted by the mixed-effects model meta-analysis, we performed a phylogenetic correction for plants, animals and microorganisms where phylogenies were available in the current literature (see below for details). In these analyses, "plant species", "animal species" or "microorganism species" was included as a random effect with phylogenetic relatedness as part of the correlation structure. The phylogenetic correction was built into the meta-analysis for the animals, plants and microorganisms, respectively using rotl[10,11]. Rotl is a freely available package for R designed to take advantage of the Open Tree of Life's[11, 12] Application Programming Interfaces (APIs) to access subtrees from the synthetic Open Tree, as well as the published source trees that contribute to the synthesis to generate comprehensive phylogenies for plants, animals and microorganisms. Not all species could be included as at least some had not at the time of analysis been barcoded to a level that allowed inclusion in a phylogeny. For all the 1,705 studies and 20,212 effect sizes, there existed a total of 192 plant species, 553 animal species and 78 microorganisms suitable for the phylogenetic analysis in this study (see Supplementary Tables 1.3 and 2.3 for plants, Supplementary Tables 1.4 and 2.4 for animals, and Supplementary Tables 1.5 and 2.5 for microorganisms)[10-12].

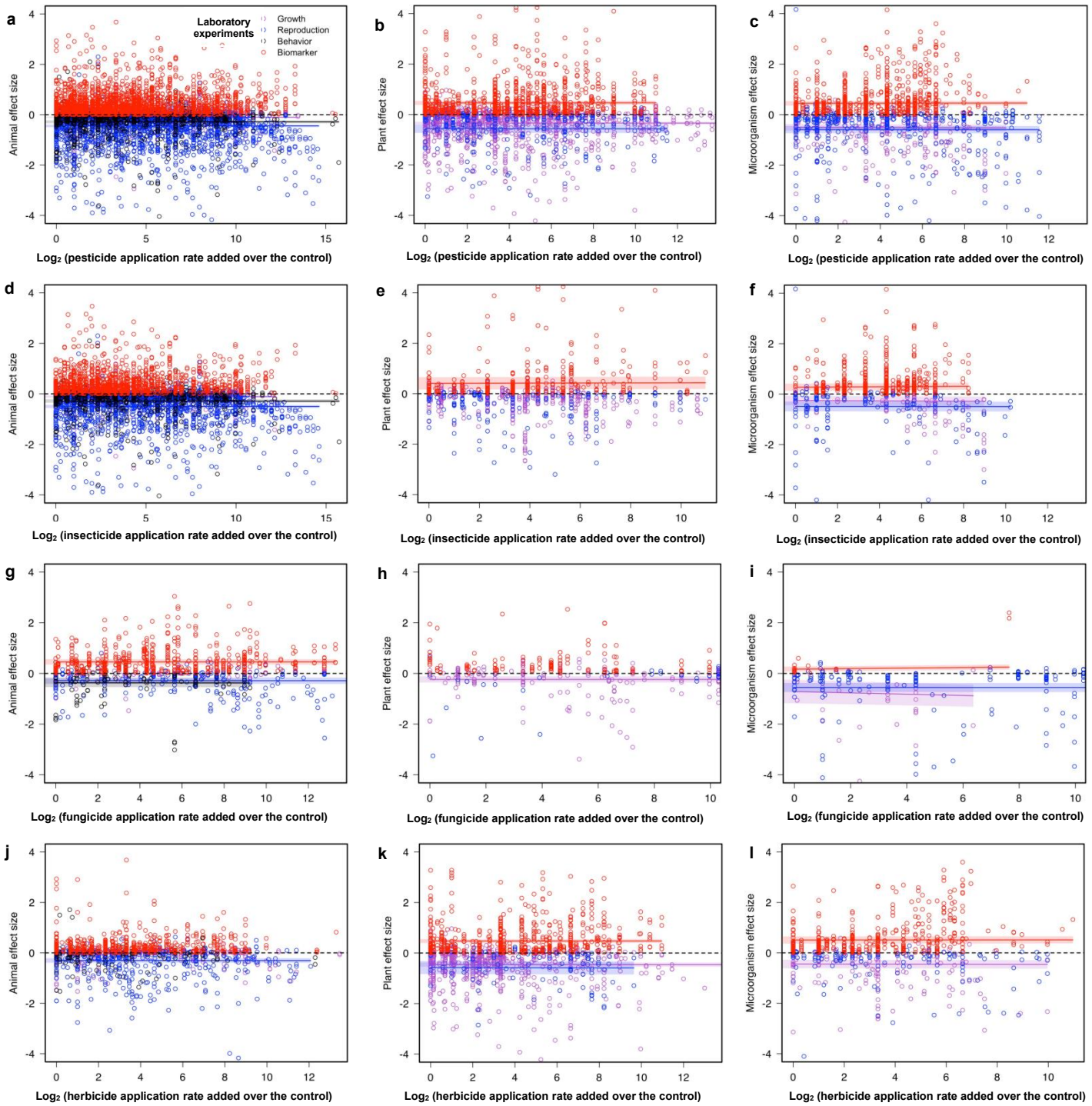
Publication bias test

We employed regression tests to estimate the publication bias in the meta-analyses[13] (see Supplementary Table 2). To undertake this, a regression coefficient between the effect size and the sample variance was evaluated. A publication bias test using the trim-and-fill method[14], as

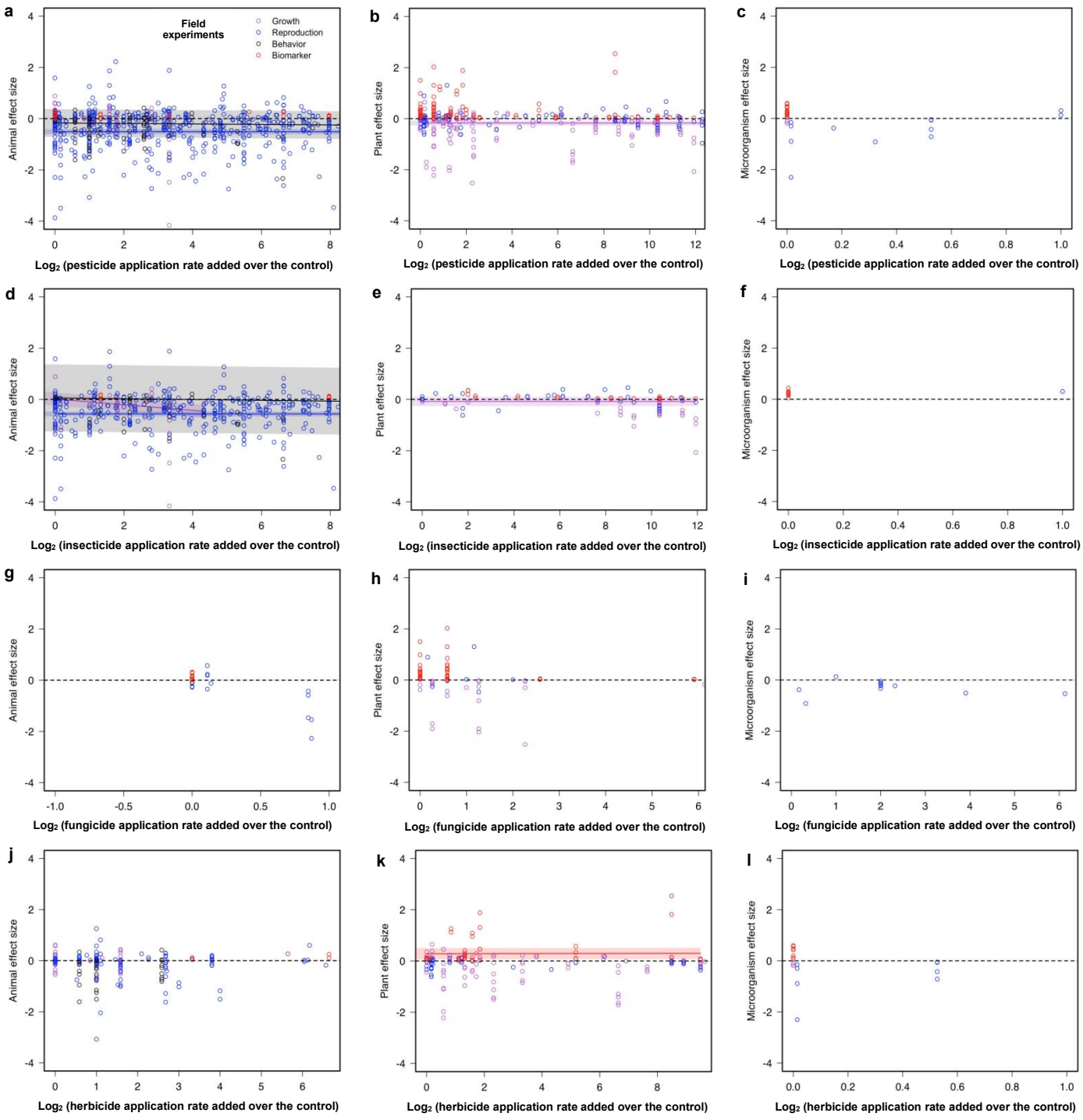
suggested by Egger et al.[13], was performed which supported the robustness of our results. Nakagawa and Santos[15] suggest that residuals from models should be used to assess publication bias in mixed-effects meta-regression analysis. We employed this approach by using sampling variances as an additional moderator within the mixed-effects model to examine publication bias. Finally, we applied the Rosenthal fail-safe method to the full dataset[13]. These analyses suggest that our results were stable even if publication bias was a characteristic of the underlying data (value of regression test=-24.879, P<0.001). As it is important for researchers to account for the heterogeneity in different studies, we follow Pappalardo et al.[16] who argued that applying the residuals from the regression models of various parametric settings may be a more appropriate approach to perform publication bias evaluation. Using this approach publication bias was assessed for all models (Supplementary Table 2). We also undertook the fail-safe test[17] which produced a score of 11,459,423 for the whole dataset of 1,705 articles. This score is much larger than the as-hoc threshold of 101,070 (101,070 = 5n + 10, where n is the number of observations in the analyses set at 2,0212 for our meta-analysis). The interpretation of this is that only by incorporating at least 11,358,353 studies with nonsignificant effect size values would the dataset show an overall insignificant effect size, proving that the results in this paper are strongly stable to publication bias.

Sensitivity tests

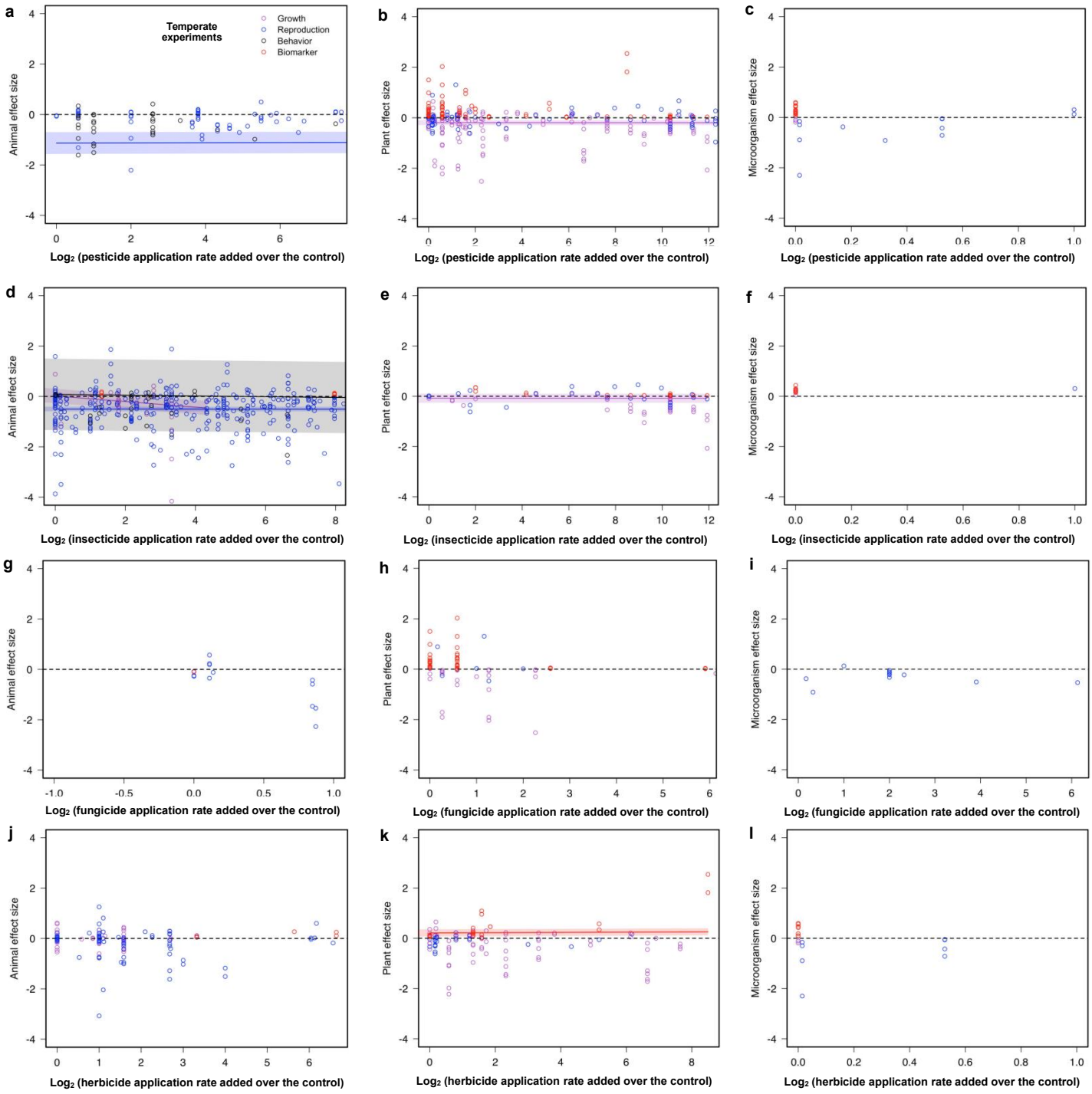
We applied sensitivity tests to ensure robustness of the results. The method is a nonparametric (rank-based) data augmentation technique proposed by Duval and Tweedie[14,18]. The method can be used to evaluate the number of studies missing from a meta-analysis because of the suppression of the most extreme results on one side of the funnel plot. The method could then augment the observed data so that the funnel plot is more symmetric and recomputes the summary estimate based on the complete data. Statistical values for these sensitivity analysis are presented for the different taxonomic groups of invertebrates, vertebrates, seed plants, spore-producing plants, bacteria and fungus for the overall 1705 studies (see Supplementary Table 9).



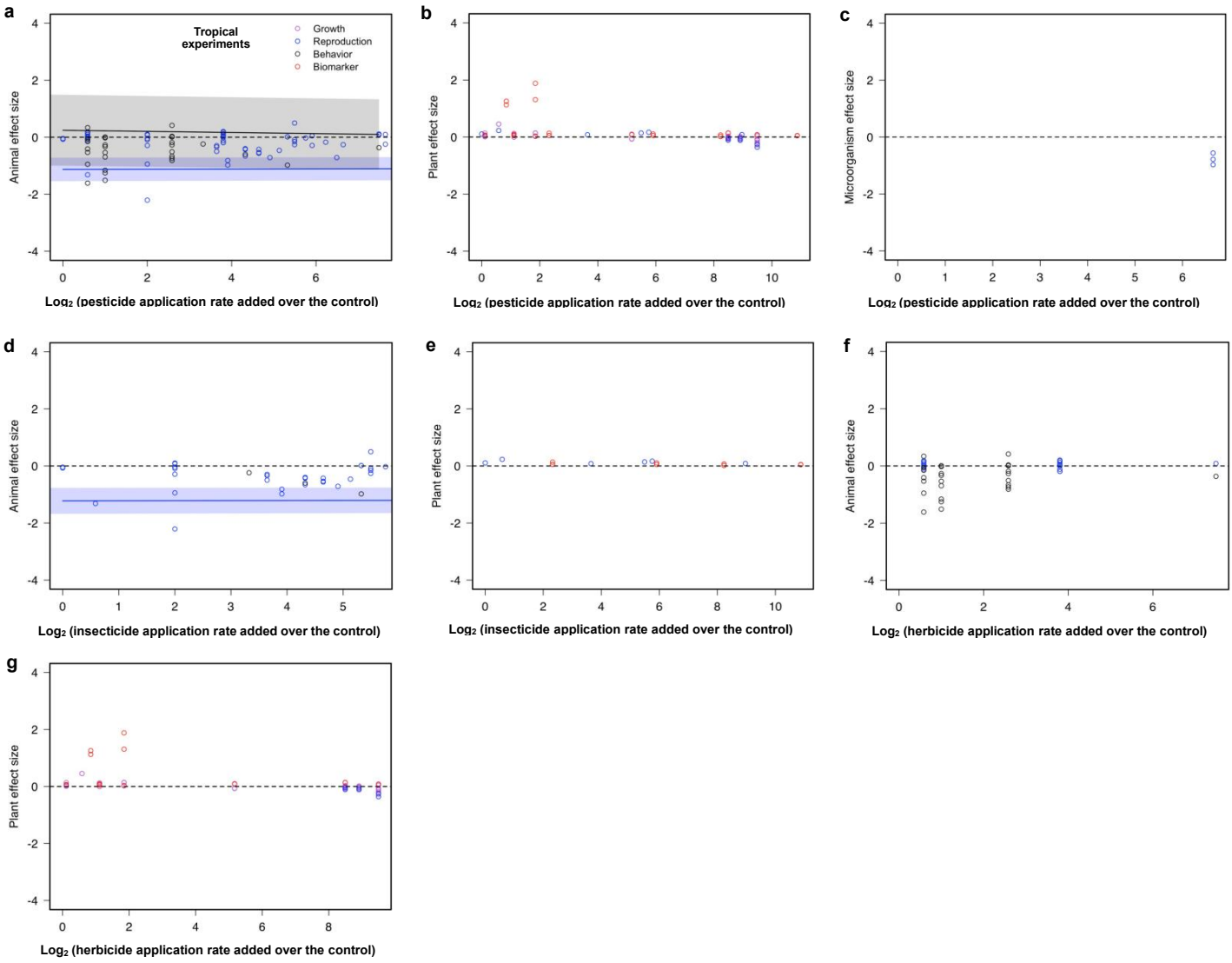
Supplementary Fig. 1 | Relationship between added application rates in the treatments of pesticides, insecticides, fungicides or herbicides over the control without any pesticides and the different effect sizes of animals, plants or microorganisms along with fitted meta-regression lines in laboratory experiments. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added pesticide application rates and animal growth (n=1382), reproduction (n=4518), behavior (n=1219)and biomarker (n=4439). **b** Scatter plot for added pesticide application rates and plant growth (n=2220), reproduction (n=528) and biomarker (n=1622). **c** Scatter plot for added pesticide application rates and microorganism growth (n=407), reproduction (n=663) and biomarker (n=1159). **d** Scatter plot for added insecticide application rates and animal growth (n=742), reproduction (n=3459), behavior (n=863) and biomarker (n=2694). **e** Scatter plot for added insecticide application rates and plant growth (n=573), reproduction (n=257) and biomarker (n=390). **f** Scatter plot for added insecticide application rates and microorganism growth (n=125) reproduction (n=257) and biomarker (n=516). **g** Scatter plot for added fungicide application rates and animal growth (n=159), reproduction (n=388), behavior (n=160) and biomarker (n=673). **h** Scatter plot for added fungicide application rates and plant growth (n=275), reproduction (n=80) and biomarker (n=196). **i** Scatter plot for added fungicide application rates and microorganism growth (n=58), reproduction (n=219) and biomarker (n=106). **j** Scatter plot for added herbicide application rates and animal growth (n=481), reproduction (n=671), behavior (n=196) and biomarker (n=1072). **k** Scatter plot for added herbicide application rates and plant growth (n=1372), reproduction (n=191) and biomarker (n=1036). **l** Scatter plot for added herbicide application rates and microorganism growth (n=537), reproduction (n=187) and biomarker (n=224). The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file. Source data are provided as a Source Data file.



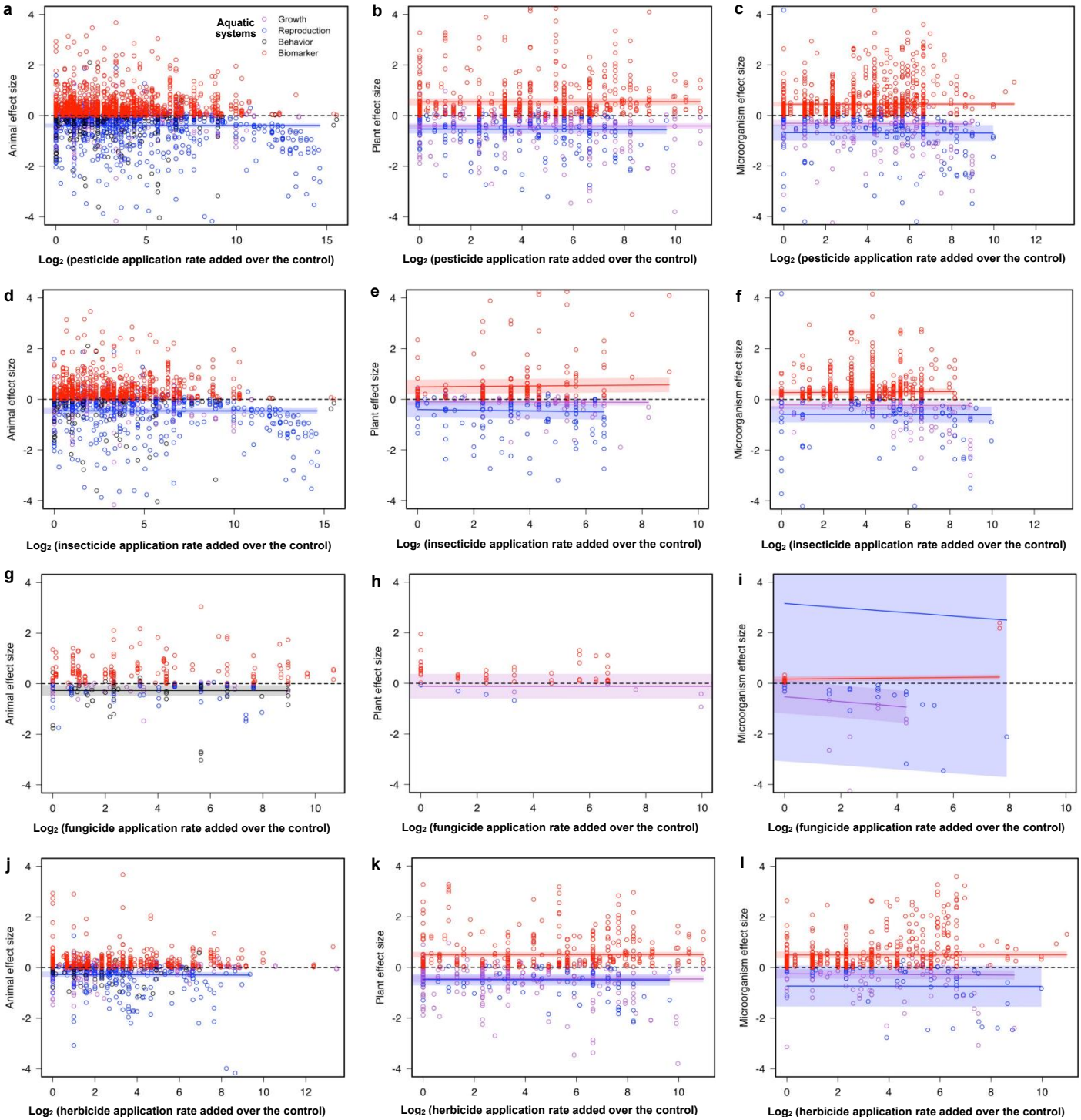
Supplementary Fig. 2 | Relationship between added application rates in the treatments of pesticides, insecticides, fungicides or herbicides over the control without any pesticides and the different effect sizes of animals, plants or microorganisms along with fitted meta-regression lines in field experiments. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added pesticide application rates and animal growth (n=123), reproduction (n=958), behavior (n=110) and biomarker (n=31). **b** Scatter plot for added pesticide application rates and plant growth (n=357), reproduction (n=141) and biomarker (n=189). **c** Scatter plot for added pesticide application rates and microorganism growth (n=16), reproduction (n=102) and biomarker (n=28). **d** Scatter plot for added insecticide application rates and animal growth (n=52,) reproduction (n=767), behavior (n=72) and biomarker (n=15). **e** Scatter plot for added insecticide application rates and plant growth (n=52), reproduction (n=37) and biomarker (n=32). **f** Scatter plot for added insecticide application rates and microorganism growth (n=8), reproduction (n=8) and biomarker (n=16). **g** Scatter plot for added fungicide application rates and animal growth (n=13), reproduction (n=61), behavior (n=5) and biomarker (n=11). **h** Scatter plot for added fungicide application rates and plant growth (n=72), reproduction (n=40) and biomarker (n=65). **i** Scatter plot for added fungicide application rates and microorganism growth (n=2), and biomarker (n=17). **j** Scatter plot for added herbicide application rates and animal growth (n=58), reproduction (n=130), behavior (n=33) and biomarker (n=5). **k** Scatter plot for added herbicide application rates and plant growth (n=233), reproduction (n=64) and biomarker (n=92). **l** Scatter plot for added herbicide application rates and microorganism growth (n=6), reproduction (n=77) and biomarker (n=12). The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



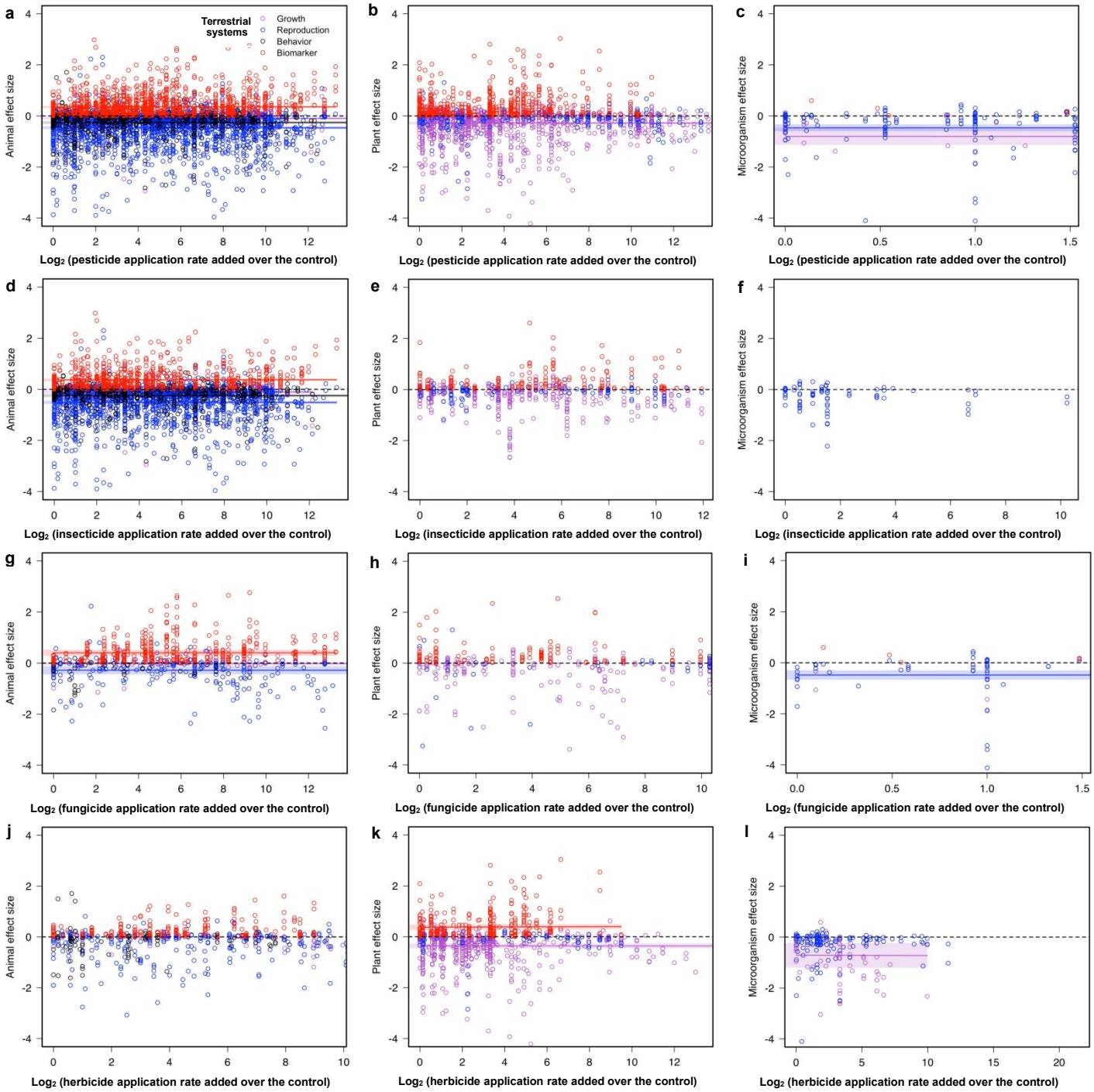
Supplementary Fig. 3 | Relationship between added application rates in the treatments of pesticides, insecticides, fungicides or herbicides over the control without any pesticides and the different effect sizes of animals, plants or microorganisms along with fitted meta-regression lines in temperate zones. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added pesticide application rates and animal growth (n=121), reproduction (n=826), behavior (n=78) and biomarker (n=31). **b** Scatter plot for added pesticide application rates and plant growth (n=295), reproduction (n=128) and biomarker (n=142). **c** Scatter plot for added pesticide application rates and microorganism growth (n=16), reproduction (n=87) and biomarker (n=28). **d** Scatter plot for added insecticide application rates and animal growth (n=50), reproduction (n=655), behavior (n=67) and biomarker (n=15). **e** Scatter plot for added insecticide application rates and plant growth (n=52), reproduction (n=30) and biomarker (n=21). **f** Scatter plot for added insecticide application rates and microorganism growth (n=8,) reproduction (n=5) and biomarker (n=16). **g** Scatter plot for added fungicide application rates and animal growth (n=13), reproduction (n=61), behavior (n=5) and biomarker (n=11). **h** Scatter plot for added fungicide application rates and plant growth (n=72), reproduction (n=40) and biomarker (n=65). **i** Scatter plot for added fungicide application rates and microorganism growth (n=2), reproduction (n=17). **j** Scatter plot for added herbicide application rates and animal growth (n=58), reproduction (n=110), behavior (n=6) and biomarker (n=5). **k** Scatter plot for added herbicide application rates and plant growth (n=171), reproduction (n=58) and biomarker (n=56). **l** Scatter plot for added herbicide application rates and microorganism growth (n=6), reproduction (n=65) and biomarker (n=12). The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



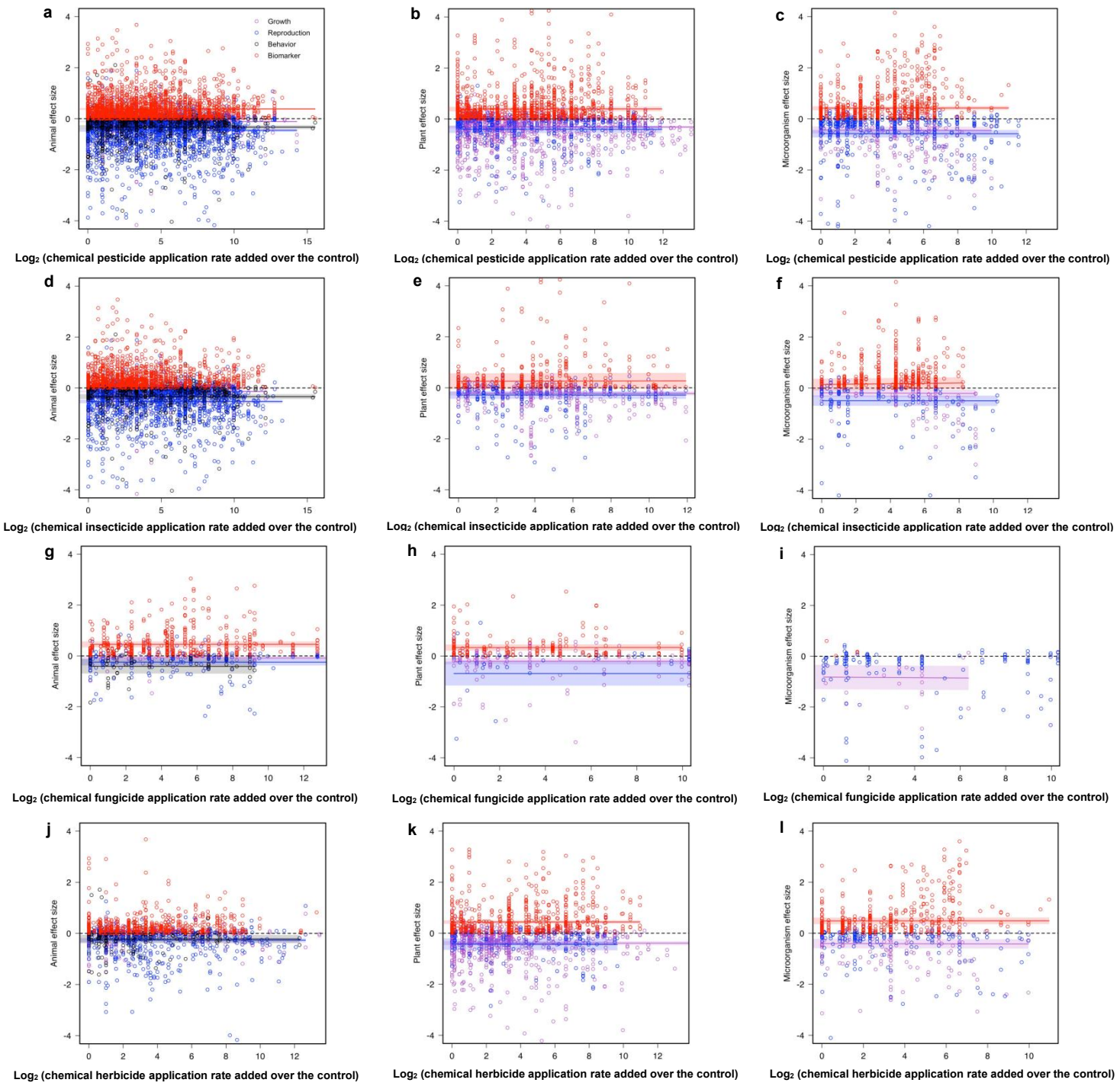
Supplementary Fig. 4 | Relationship between added application rates in the treatments of pesticides, insecticides, fungicides or herbicides over the control without any pesticides and the different effect sizes of animals, plants or microorganisms along with fitted meta-regression lines in tropical zones. The relationships between insecticide application rate added over the control and microorganism effect size, and the relationships between fungicide application rate added over the control and animal, plant or microorganism could not be estimated due to lack of data in tropical zone. Data from laboratory conditions were removed from the models with climatic predictors. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added pesticide application rates and the growth (n=2), reproduction (n=132), behavior (n=32) of animals. **b** Scatter plot for added pesticide application rates and the growth (n=62), reproduction (n=13) and biomarker (n=47) of plants. **c** Scatter plot for added pesticide application rates and the reproduction (n=15) of microorganisms. **d** Scatter plot for added insecticide application rates and the growth (n=2), reproduction (n=112), behavior (n=5) of animals. **e** Scatter plot for added insecticide application rates and the reproduction (n=7) and biomarker (n=11) of plants. **f** Scatter plot for added herbicide application rates and the reproduction (n=20), and behavior (n=27) of animals. **g** Scatter plot for added herbicide application rates and the growth (n=62), reproduction (n=6) and biomarker (n=36) of plants. The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



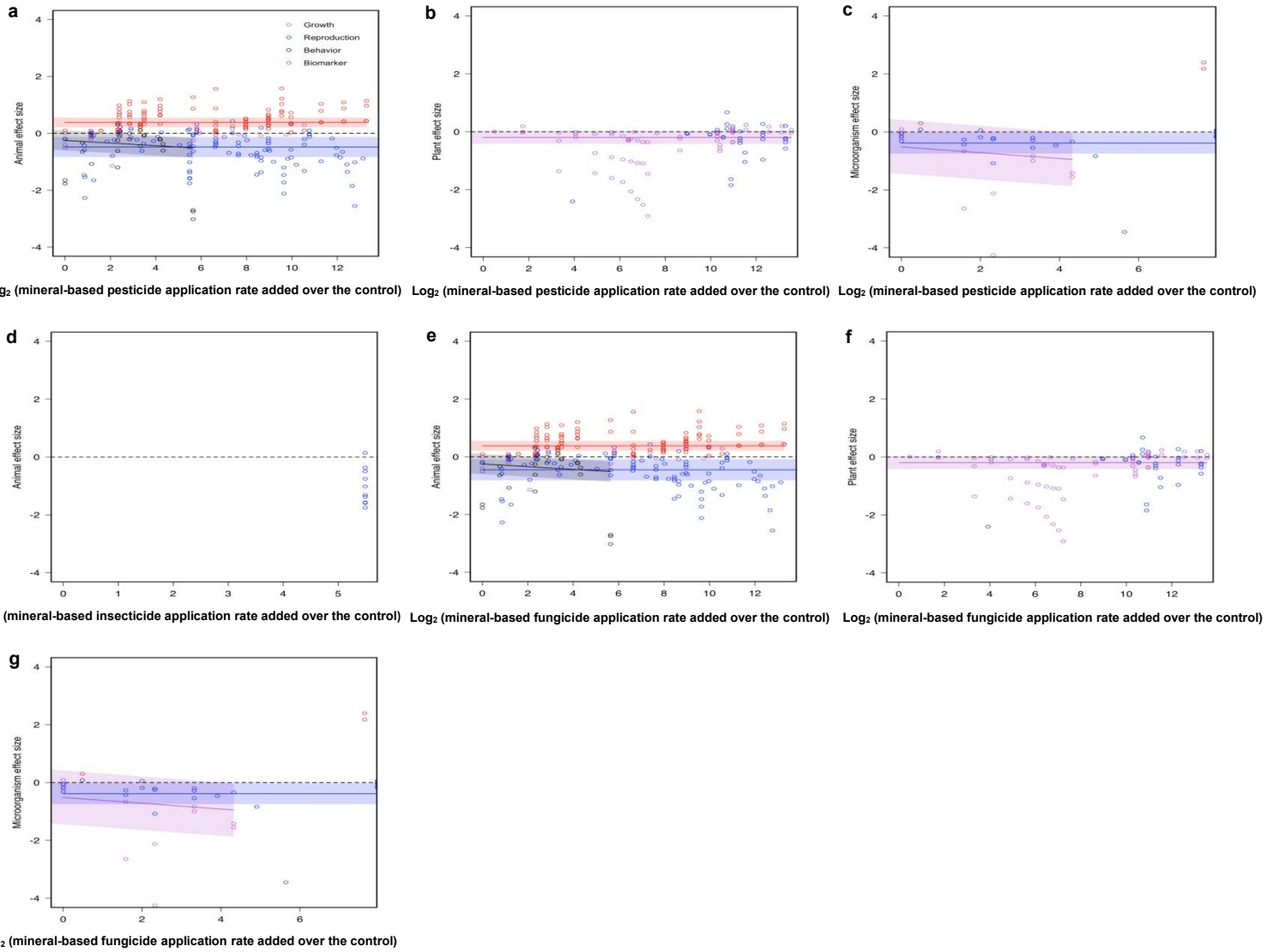
Supplementary Fig. 5 | Relationship between added application rates in the treatments of pesticides, insecticides, fungicides or herbicides over the control without any pesticides and the different effect sizes of animals, plants or microorganisms along with fitted meta-regression lines in aquatic system experiments. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added pesticide application rates and animal growth (n=916), reproduction (n=1278), behavior (n=387) and biomarker (n=2724). **b** Scatter plot for added pesticide application rates and plant growth (n=626), reproduction (n=262) and biomarker (n=812). **c** Scatter plot for added pesticide application rates and microorganism growth (n=301), reproduction (n=203) and biomarker (n=1182). **d** Scatter plot for added insecticide application rates and animal growth (n=395), reproduction (n=746), behavior (n=169) and biomarker (n=1737). **e** Scatter plot for added insecticide application rates and plant growth (n=138), reproduction (n=149) and biomarker (n=215). **f** Scatter plot for added insecticide application rates and microorganism growth (n=133), reproduction (n=107) and biomarker (n=532). **g** Scatter plot for added fungicide application rates and animal growth (n=98), reproduction (n=122), behavior (n=102) and biomarker (n=248). **h** Scatter plot for added fungicide application rates and plant growth (n=18), reproduction (n=6) and biomarker (n=74). **i** Scatter plot for added fungicide application rates and microorganism growth (n=22), reproduction (n=27) and biomarker (n=101). **j** Scatter plot for added herbicide application rates and animal growth (n=423), reproduction (n=410), behavior (n=116) and biomarker (n=739). **k** Scatter plot for added herbicide application rates and plant growth (n=470), reproduction (n=107) and biomarker (n=523). **l** Scatter plot for added herbicide application rates and microorganism growth (n=146), reproduction (n=69) and biomarker (n=549). The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



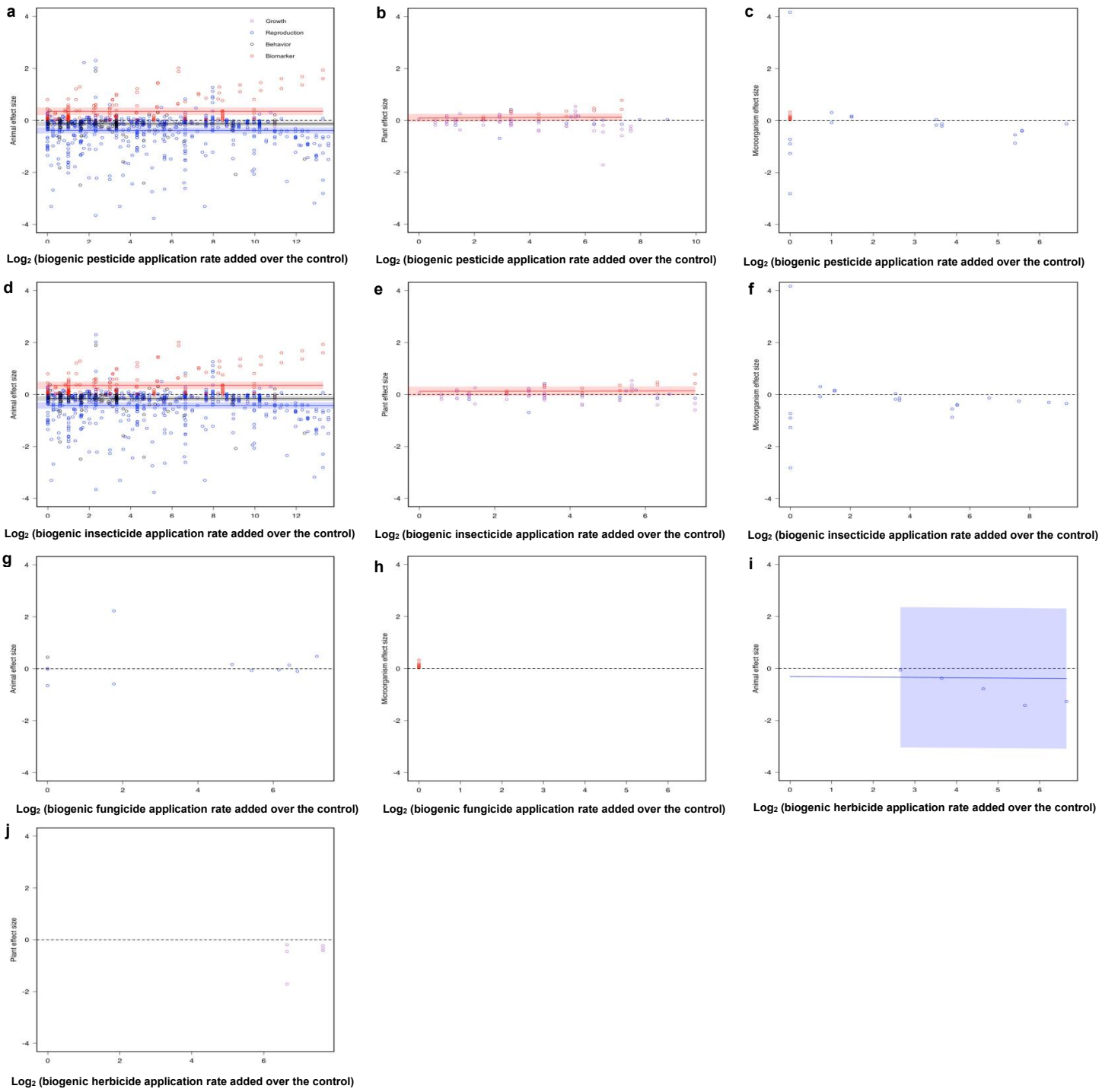
Supplementary Fig. 6 | Relationship between added application rates in the treatments of pesticides, insecticides, fungicides or herbicides over the control without any pesticides and the different effect sizes of animals, plants or microorganisms along with fitted meta-regression lines in terrestrial system experiments. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added pesticide application rates and animal growth (n=589), reproduction (n=4198), behavior (n=942) and biomarker (n=1746). **b** Scatter plot for added pesticide application rates and plant growth (n=1951), reproduction (n=407) and biomarker (n=999). **c** Scatter plot for added pesticide application rates and microorganism growth (n=122), reproduction (n=562) and biomarker (n=5). **d** Scatter plot for added insecticide application rates and animal growth (n=399), reproduction (n=3480), behavior (n=766) and biomarker (n=972). **e** Scatter plot for added insecticide application rates and plant growth (n=487), reproduction (n=145) and biomarker (n=207). **f** Scatter plot for added insecticide application rates and microorganism reproduction (n=158). **g** Scatter plot for added fungicide application rates and animal growth (n=74), reproduction (n=327), behavior (n=63) and biomarker (n=436). **h** Scatter plot for added fungicide application rates and plant growth (n=329), reproduction (n=114) and biomarker (n=187). **i** Scatter plot for added fungicide application rates and microorganism growth (n=38), reproduction (n=209) and biomarker (n=5). **j** Scatter plot for added herbicide application rates and animal growth (n=116), reproduction (n=391), behavior (n=113) and biomarker (n=338). **k** Scatter plot for added herbicide application rates and plant growth (n=1135), reproduction (n=148) and biomarker (n=605). **l** Scatter plot for added herbicide application rates and microorganism growth (n=84) and reproduction (n=195). The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



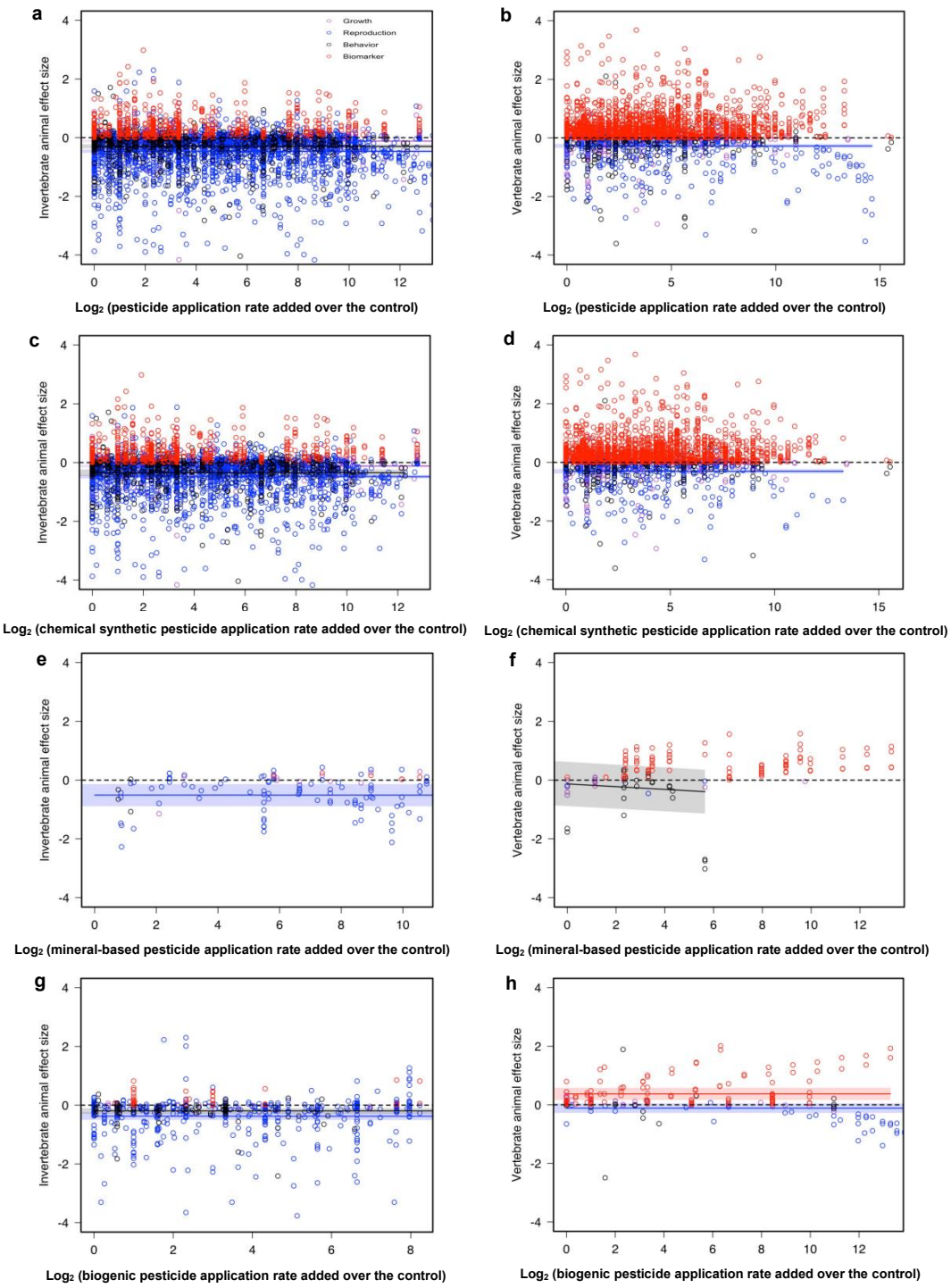
Supplementary Fig. 7 | Relationship between added application rates in the treatments of chemical synthetic pesticides, insecticides, fungicides or herbicides over the control without any pesticides and the different effect sizes of animals, plants or microorganisms along with fitted meta-regression lines across all studies. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added pesticide application rates and animal growth (n=1361), reproduction (n=4524), behavior (n=1147) and biomarker (n=4185). **b** Scatter plot for added pesticide application rates and plant growth (n=2440), reproduction (n=617) and biomarker (n=1795). **c** Scatter plot for added pesticide application rates and microorganism growth (n=405), reproduction (n=686) and biomarker (n=100). **d** Scatter plot for added insecticide application rates and animal growth (n=702), reproduction (n=3421), behavior (n=799) and biomarker (n=2529). **e** Scatter plot for added insecticide application rates and plant growth (n=566), reproduction (n=279) and biomarker (n=407). **f** Scatter plot for added insecticide application rates and microorganism growth (n=133), reproduction (n=238) and biomarker (n=532). **g** Scatter plot for added fungicide application rates and animal growth (n=120), reproduction (n=307), behavior (n=119) and biomarker (n=579). **h** Scatter plot for added fungicide application rates and plant growth (n=275), reproduction (n=83) and biomarker (n=260). **i** Scatter plot for added fungicide application rates and microorganism growth (n=42) reproduction (n=184) and biomarker (n=19). **j** Scatter plot for added herbicide application rates and animal growth (n=539), reproduction (n=796), behavior (n=229) and biomarker (n=1077). **k** Scatter plot for added herbicide application rates and plant growth (n=1599), reproduction (n=255) and biomarker (n=1128). **l** Scatter plot for added herbicide application rates and microorganism growth (n=230), reproduction (n=264) and biomarker (n=549). The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



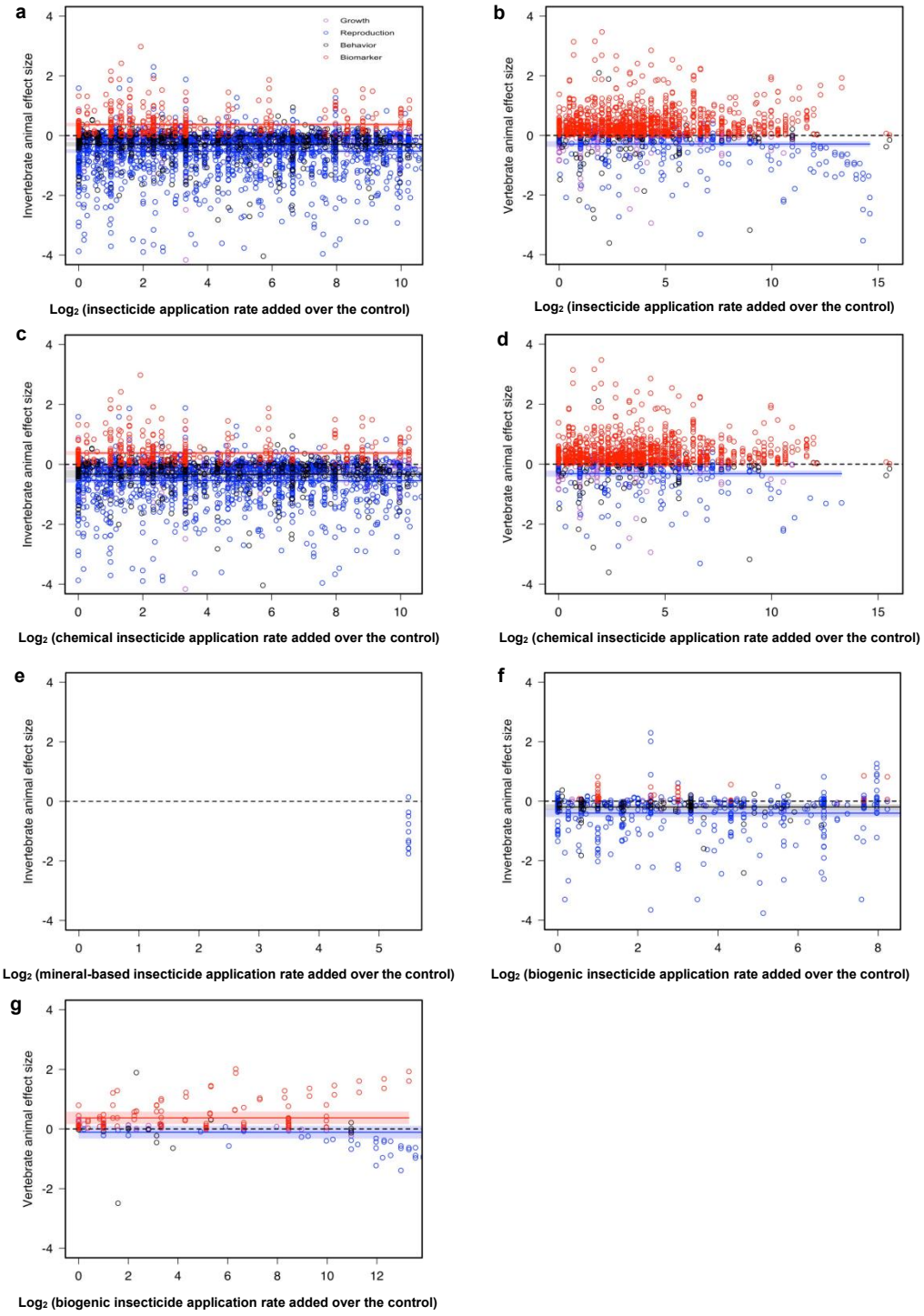
Supplementary Fig. 8 | Relationship between added application rates in the treatments of mineral-based pesticides, insecticides or fungicides over the control without any pesticides and the different effect sizes of animals, plants or microorganisms along with fitted meta-regression lines across all studies. The relationships between mineral-based insecticide application rate added over the control and plant or microorganism effect size, and the relationships between mineral-based herbicide application rate added over the control and animal, plant or microorganism could not be estimated due to lack of data. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added mineral-based pesticide application rates and the growth (n=45), reproduction (n=121), behavior (n=37) and biomarker (n=105) of animals. **b** Scatter plot for added mineral-based pesticide application rates and the growth (n=70) and reproduction (n=35) of plants. **c** Scatter plot for added mineral-based pesticide application rates and the growth (n=18), reproduction (n=52) and biomarker (n=3) of microorganisms. **d** Scatter plot for added mineral-based insecticide application rates and the growth (n=2), and reproduction (n=10) of animals. **e** Scatter plot for added mineral-based fungicide and the growth (n=43), reproduction (n=111), behavior (n=37) and biomarker (n=105) of animals. **f** Scatter plot for added minimal-based fungicide application rates and the growth (n=70) and reproduction (n=35) of plants. **g** Scatter plot for added minimal-based fungicide application rates and the growth (n=18), reproduction (n=52) and biomarker (n=3) of microorganisms. The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



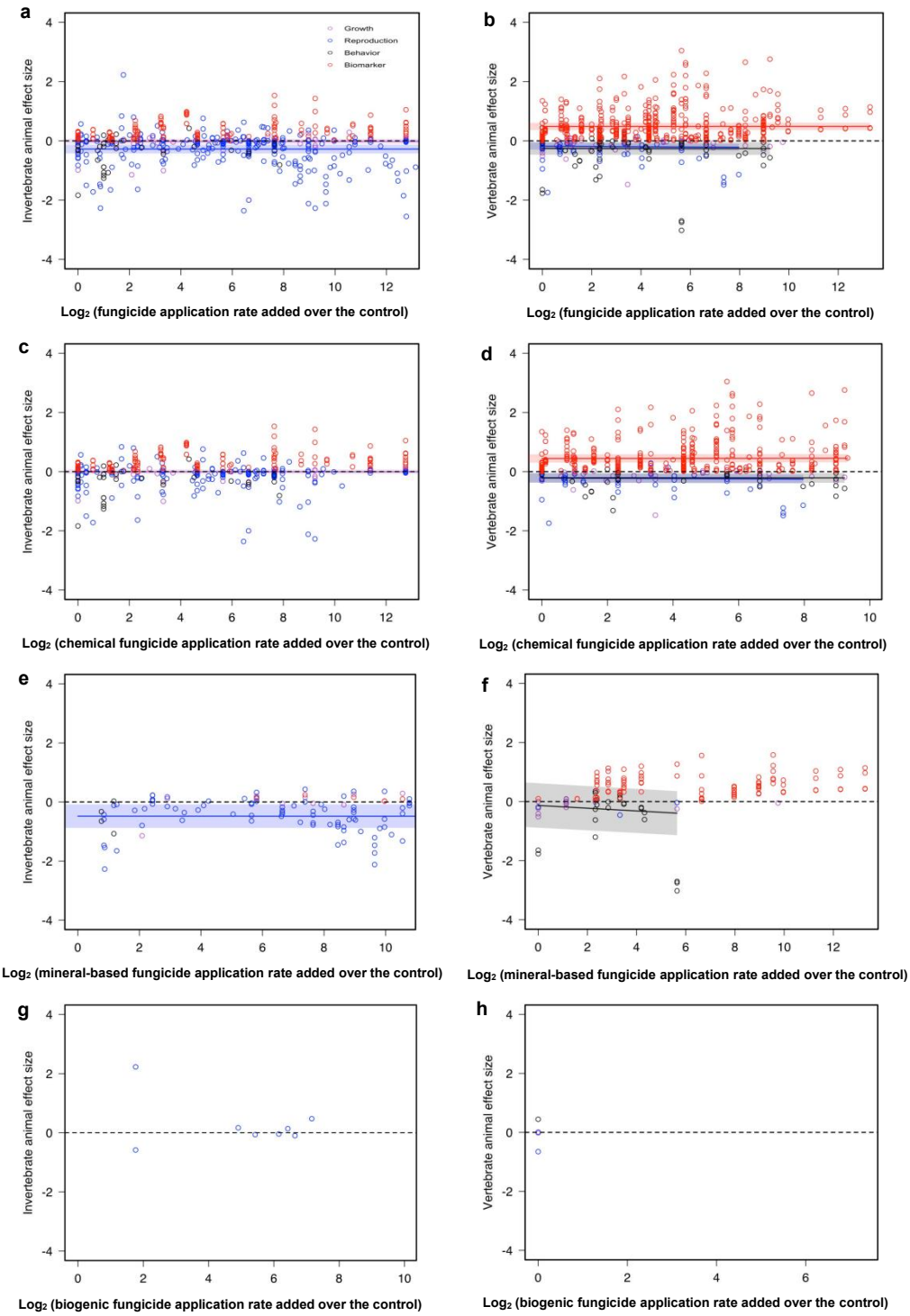
Supplementary Fig. 9 | Relationship between added application rates in the treatments of biogenic pesticides, insecticides or fungicides over the control without any pesticides and the different effect sizes of animals, plants or microorganisms along with fitted meta-regression lines across all studies. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added biogenic pesticide application rates and the growth (n=99), reproduction (n=831), behavior (n=145) and biomarker (n=180) of animals. **b** Scatter plot for added biogenic pesticide application rates and the growth (n=67), reproduction (n=17) and biomarker (n=16) of plants. **c** Scatter plot for added biogenic pesticide application rates and the reproduction (n=27), and biomarker (n=84) of microorganisms. **d** Scatter plot for added biogenic insecticide application rates and the growth (n=90), reproduction (n=795), behavior (n=136) and biomarker (n=180) of animals. **e** Scatter plot for added biogenic insecticide application rates and the growth (n=59), reproduction (n=15) and biomarker (n=15) of plants. **f** Scatter plot for added biogenic insecticides and the reproduction (n=27) of microorganisms. **g** Scatter plot for added biogenic fungicide application rates and the growth (n=9), reproduction (n=31) and behavior (n=9) of animals. **h** Scatter plot for added biogenic fungicide application rates and the biomarker (n=84) of microorganisms. **i** Scatter plot for added biogenic herbicide application rates and the reproduction (n=5) of animals. **j** Scatter plot for added biogenic herbicide application rates and the growth (n=6) of plants. The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



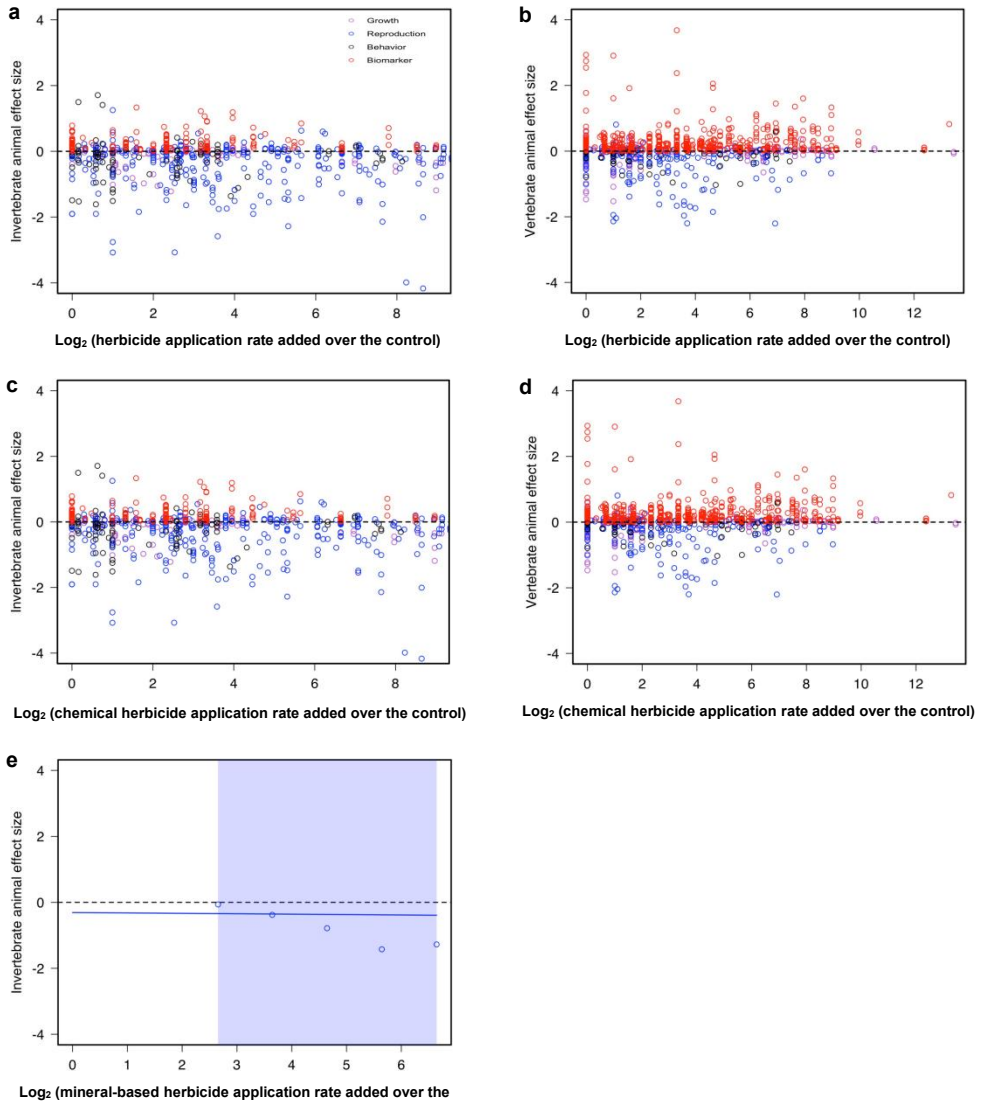
Supplementary Fig. 10 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic pesticides over the control without any pesticides and the different effect sizes of invertebrate or vertebrate animals along with fitted meta-regression lines across all studies. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added pesticide application rates and the growth (n=674), reproduction (n=4711), behavior (n=987) and biomarker (n=1187) of invertebrate animals. **b** Scatter plot for added pesticide application rates and the growth (n=831), reproduction (n=765), behavior (n=342) and biomarker (n=3283) of vertebrate animals. **c** Scatter plot for added chemical synthetic pesticide application rates and the growth (n=598), reproduction (n=3824), behavior (n=862) and biomarker (n=1129) of invertebrate animals. **d** Scatter plot for added chemical synthetic pesticide application rates and the growth (n=763), reproduction (n=695), behavior (n=285) and biomarker (n=3056) of vertebrate animals. **e** Scatter plot for added mineral-based pesticide application rates and the growth (n=13), reproduction (n=114), behavior (n=8) and biomarker (n=5) of invertebrate animals. **f** Scatter plot for added mineral-based pesticide application rates and the growth (n=32), reproduction (n=7), behavior (n=29) and biomarker (n=100) of vertebrate animals. **g** Scatter plot for added biogenic pesticide application rates and the growth (n=63), reproduction (n=768), behavior (n=117) and biomarker (n=53) of invertebrate animals. **h** Scatter plot for added biogenic pesticide application rates and the growth (n=36), reproduction (n=63), behavior (n=28) and biomarker (n=127) of vertebrate animals. The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



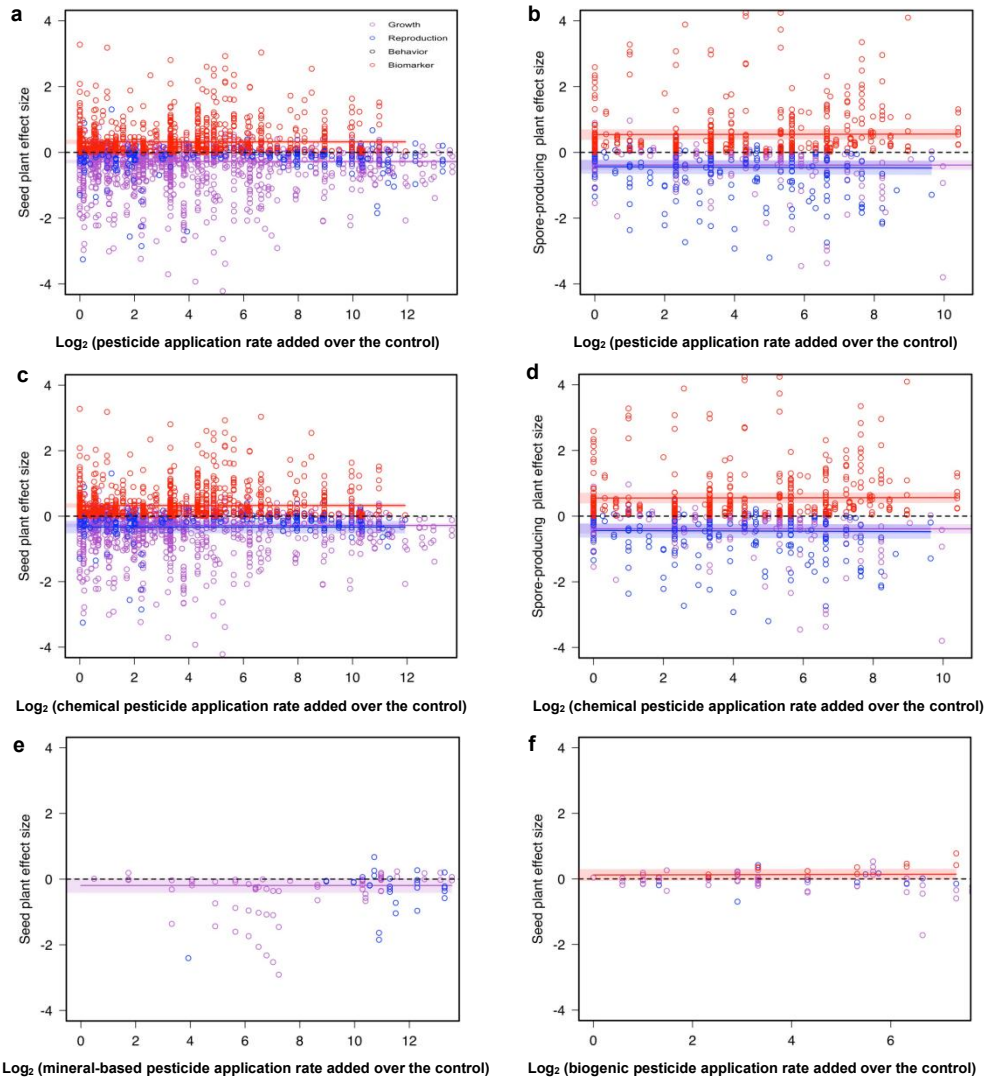
Supplementary Fig. 11 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic insecticide over the control without any pesticides and the different effect sizes of invertebrate or vertebrate animals along with fitted meta-regression lines across all studies. The relationships between mineral-based insecticide application rate added over the control and vertebrate animal could not be estimated due to lack of data. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added insecticide application rates and the growth (n=465), reproduction (n=3863), behavior (n=794) and biomarker (n=717) of invertebrate animals. **b** Scatter plot for added insecticide application rates and the growth (n=329), reproduction (n=363), behavior (n=141) and biomarker (n=1992) of vertebrate animals. **c** Scatter plot for added chemical synthetic insecticide application rates and the growth (n=400), reproduction (n=3106), behavior (n=677) and biomarker (n=664) of invertebrate animals. **d** Scatter plot for added chemical synthetic insecticide application rates and the growth (n=302), reproduction (n=315), behavior (n=122) and biomarker (n=1865) of vertebrate animals. **e** Scatter plot for added mineral-based insecticide application rates and the growth (n=2) and reproduction (n=10) of invertebrate animals. **f** Scatter plot for added biogenic insecticide application rates and the growth (n=63), reproduction (n=747), behavior (n=117) and biomarker (n=53) of invertebrate animals. **g** Scatter plot for added biogenic insecticide application rates and the growth (n=27), reproduction (n=48), behavior (n=19) and biomarker (n=127) of vertebrate animals. The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD.Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



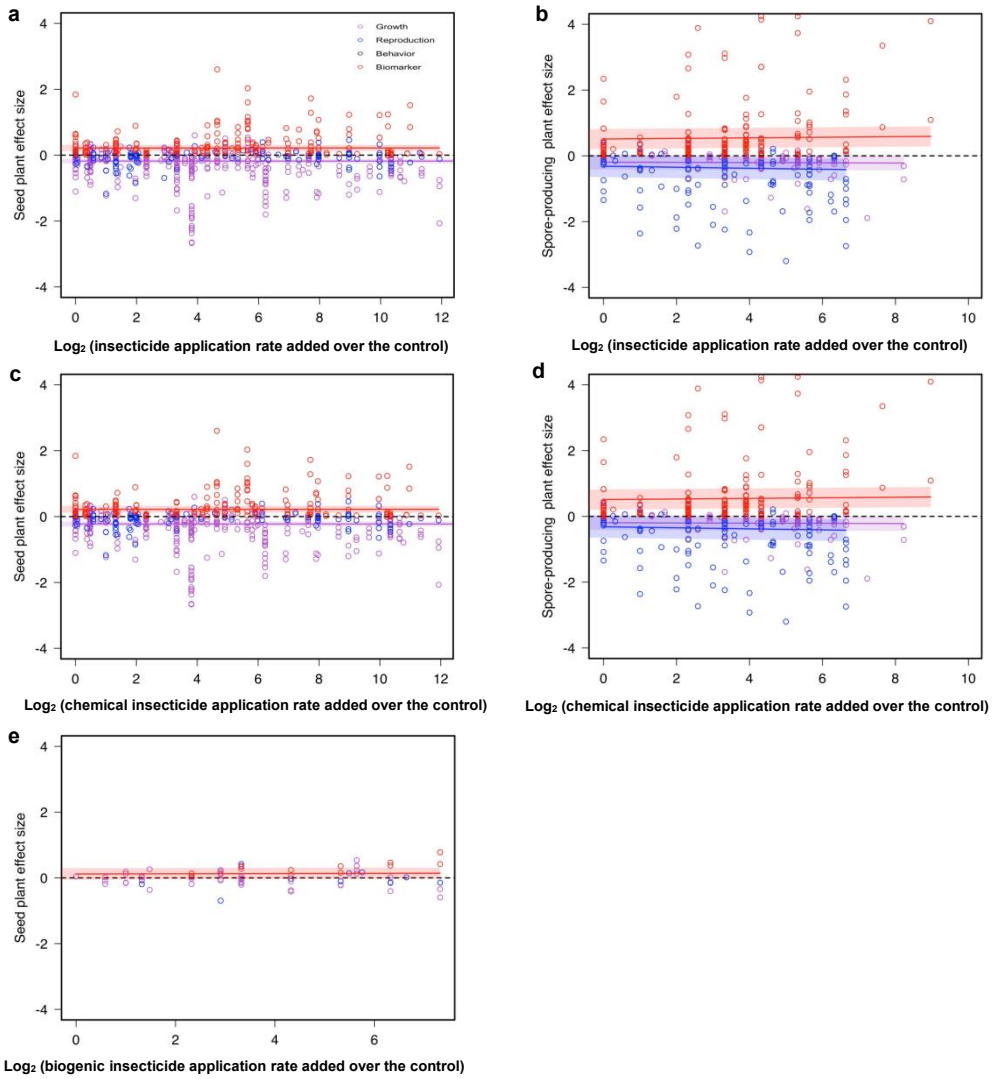
Supplementary Fig. 12 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic fungicide over the control without any pesticides and the different effect sizes of invertebrate or vertebrate animals along with fitted meta-regression lines across all studies. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added fungicide application rates and the growth (n=59), reproduction (n=357), behavior (n=67) and biomarker (n=158) of invertebrate animals. **b** Scatter plot for added fungicide application rates and the growth (n=113), reproduction (n=92), behavior (n=98) and biomarker (n=526) of vertebrate animals. **c** Scatter plot for added chemical synthetic fungicide application rates and the growth (n=48), reproduction (n=237), behavior (n=59) and biomarker (n=153) of invertebrate animals. **d** Scatter plot for added chemical synthetic fungicide application rates and the growth (n=72), reproduction (n=70), behavior (n=60) and biomarker (n=426) of vertebrate animals. **e** Scatter plot for added mineral-based fungicide application rates and the growth (n=11), reproduction (n=104), behavior (n=8) and biomarker (n=5) of invertebrate animals. **f** Scatter plot for added mineral-based fungicide application rates and the growth (n=32), reproduction (n=7), behavior (n=29) and biomarker (n=100) of vertebrate animals. **g** Scatter plot for added biogenic fungicide application rates and the reproduction (n=16) of invertebrate animals. **h** Scatter plot for added biogenic fungicide application rates and the growth (n=9), reproduction (n=15), behavior (n=9) of vertebrate animals. The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, biomarker and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



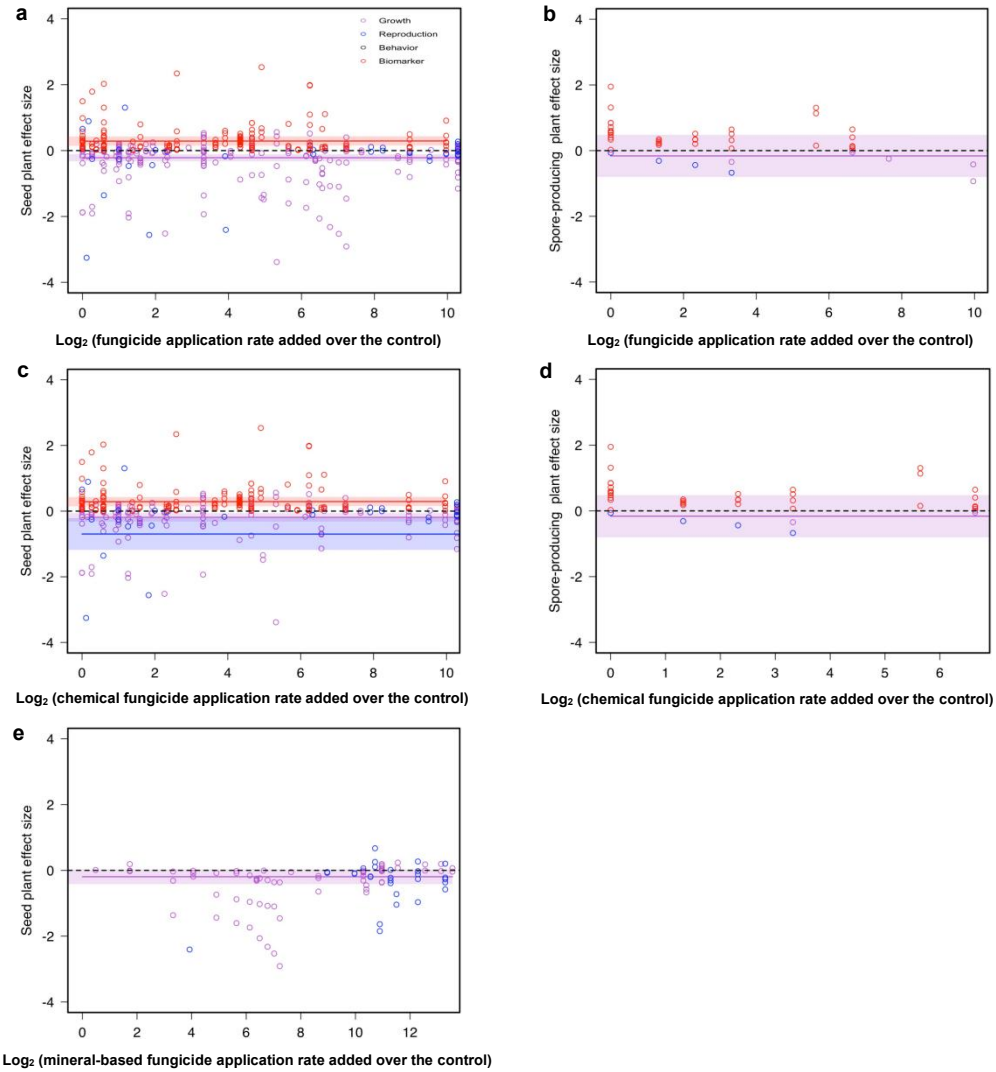
Supplementary Fig. 13 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic herbicide over the control without any pesticides and the different effect sizes of invertebrate or vertebrate animals along with fitted meta-regression lines across all studies. The relationships between mineral-based or biogenic herbicide application rate added over the control and invertebrate or vertebrate animal could not be estimated due to lack of data. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added herbicide application rates and the growth (n=150), reproduction (n=491), behavior (n=126) and biomarker (n=312) of invertebrate animals. **b** Scatter plot for added herbicide application rates and the growth (n=389), reproduction (n=310), behavior (n=103) and biomarker (n=765) of vertebrate animals. **c** Scatter plot for added chemical synthetic herbicide application rates and the growth (n=150), reproduction (n=486), behavior (n=126) and biomarker (n=312) of invertebrate animals. **d** Scatter plot for added chemical synthetic herbicide application rates and the growth (n=389), reproduction (n=310), behavior (n=103) and biomarker (n=765) of vertebrate animals. **e** Scatter plot for added mineral-based herbicide application rates and the reproduction (n=5) of vertebrate animals. The medium orchid, blue, black and red dots (or lines) represent the effects of growth, reproduction, behavior and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



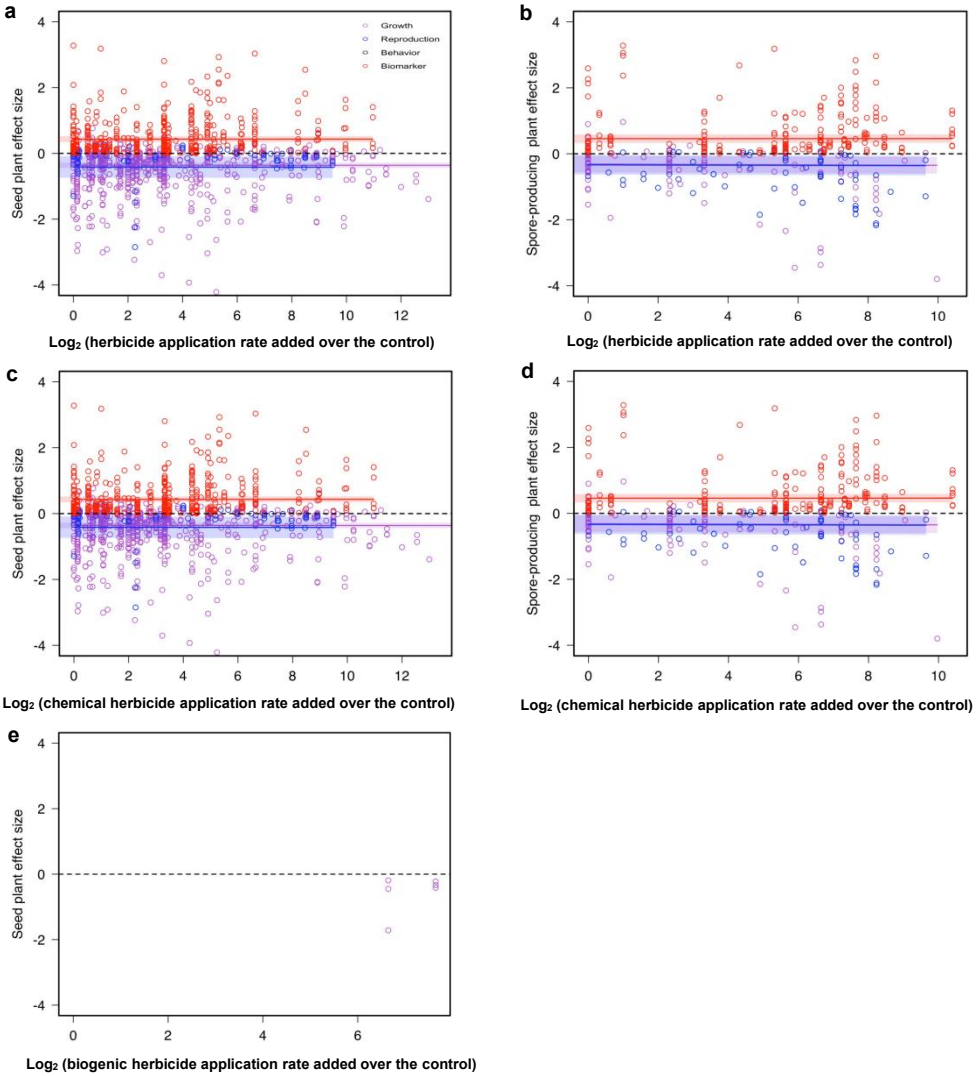
Supplementary Fig. 14 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic pesticide over the control without any pesticides and the different effect sizes of seed or spore-producing plants along with fitted meta-regression lines across all studies. The relationships between mineral-based or biogenic herbicide application rate added over the control and spore-producing plants could not be estimated due to lack of data. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added pesticide application rates and the growth (n=2273), reproduction (n=421) and biomarker (n=1208) of seed plants. **b** Scatter plot for added pesticide application rates and the growth (n=304), reproduction (n=248) and biomarker (n=603) of spore-producing plants. **c** Scatter plot for added chemical synthetic pesticide application rates and the growth (n=2136), reproduction (n=370) and biomarker (n=1193) of seed plants. **d** Scatter plot for added chemical synthetic pesticide application rates and the growth (n=304), reproduction (n=247) and biomarker (n=602) of spore-producing plants. **e** Scatter plot for added mineral-based pesticide application rates and the growth (n=70) and reproduction (n=35) of seed plants. **f** Scatter plot for added biogenic pesticide application rates and the growth (n=67), reproduction (n=16) and biomarker (n=15) of seed plants. The medium orchid, blue and red dots (or lines) represent the effects of growth, reproduction and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



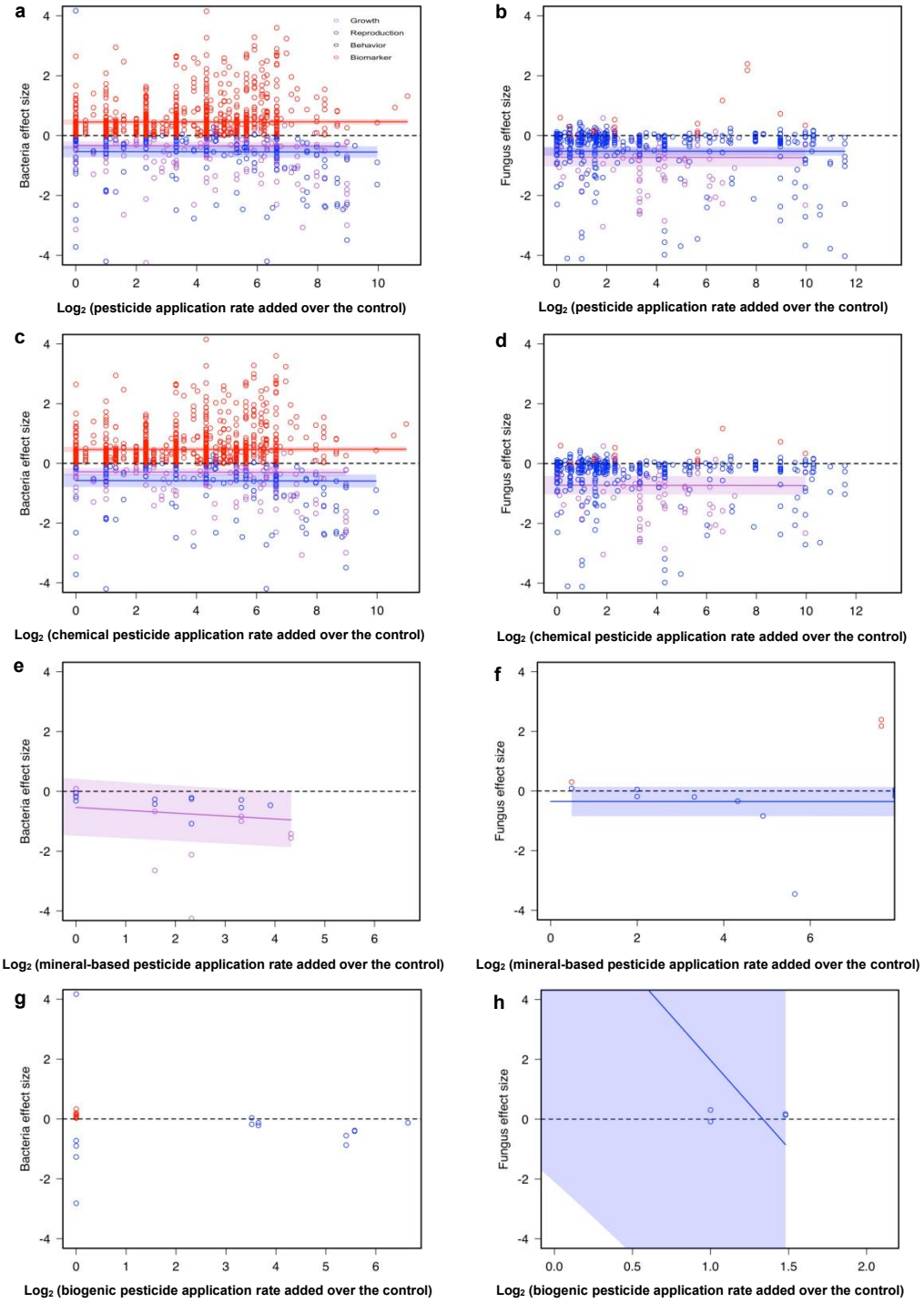
Supplementary Fig. 15 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic insecticide over the control without any pesticides and the different effect sizes of seed or spore-producing plants along with fitted meta-regression lines across all studies.The relationships between mineral-based insecticide application rate added over the control and seed or spore-producing plant effect size, and between biogenic insecticide application rate added over the control and spore-producing plant could not be estimated due to lack of data. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added insecticide application rates and the growth (n=491), reproduction (n=145) and biomarker (n=211) of seed plants. **b** Scatter plot for added insecticide application rates and the growth (n=134), reproduction (n=149) and biomarker (n=211) of spore-producing plants. **c** Scatter plot for added chemical synthetic insecticide application rates and the growth (n=432), reproduction (n=130) and biomarker (n=196) of seed plants. **d** Scatter plot for added chemical synthetic insecticide application rates and the growth (n=134), reproduction (n=149) and biomarker (n=211) of spore-producing plants. **e** Scatter plot for added biogenic insecticide application rates and the growth (n=59), reproduction (n=15) and biomarker (n=15) of seed plants. The medium orchid, blue and red dots (or lines) represent the effects of growth, reproduction and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



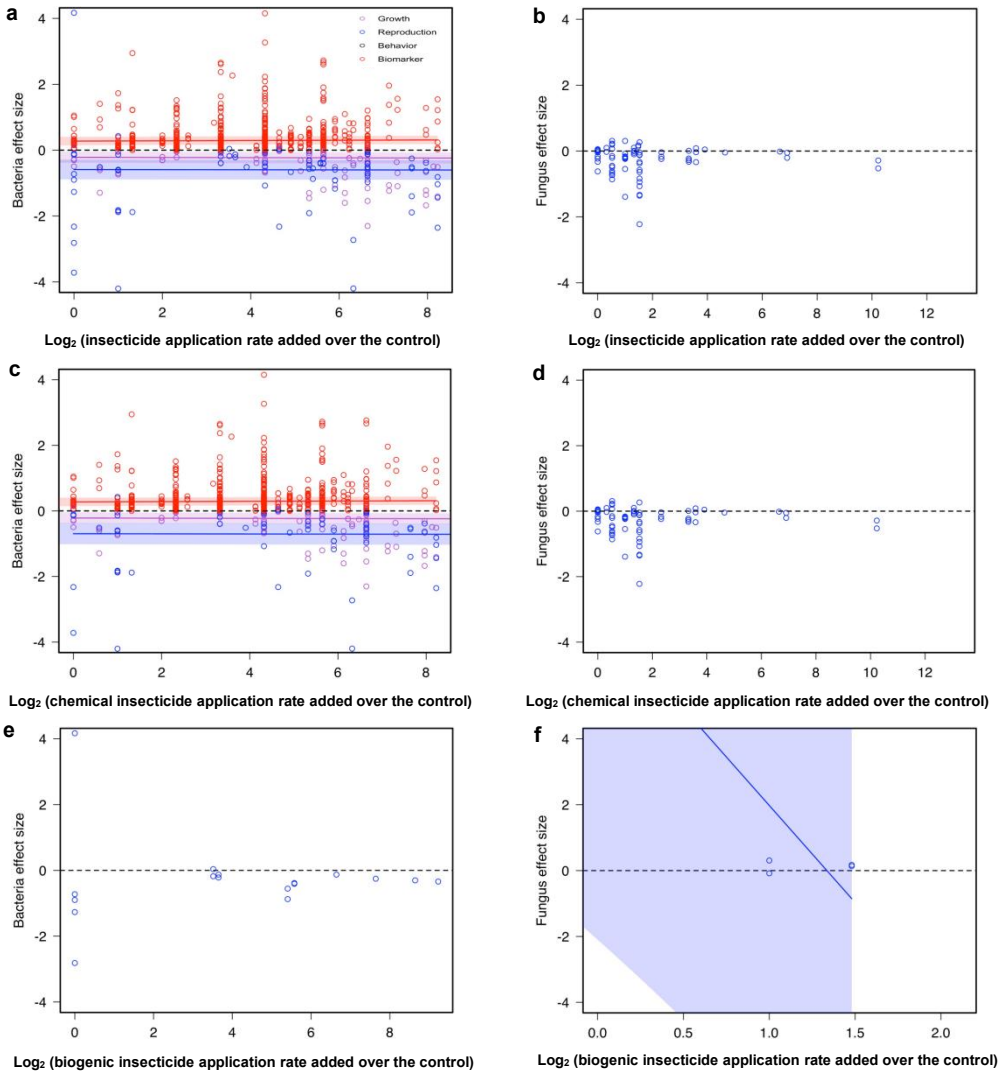
Supplementary Fig. 16 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic fungicide over the control without any pesticides and the different effect sizes of seed or spore-producing plants along with fitted meta-regression lines across all studies. The relationships between mineral-based or biogenic fungicide application rate added over the control and spore-producing plants effect size, and the relationship between biogenic fungicide application rate added over the control and spore-producing plants could not be estimated due to lack of data. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added fungicide application rates and the growth (n=333), reproduction (n=115) and biomarker (n=202) of seed plants. **b** Scatter plot for added fungicide application rates and the growth (n=14), reproduction (n=5) and biomarker (n=59) of spore-producing plants. **c** Scatter plot for added chemical synthetic fungicide application rates and the growth (n=261), reproduction (n=79) and biomarker (n=202) of seed plants. **d** Scatter plot for added chemical synthetic fungicide application rates and the growth (n=70) and reproduction (n=35) of spore-producing plants. **e** Scatter plot for added mineral-based fungicide application rates and the growth (n=2) and reproduction (n=1) of seed plants. The medium orchid, blue and red dots (or lines) represent the effects of growth, reproduction and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



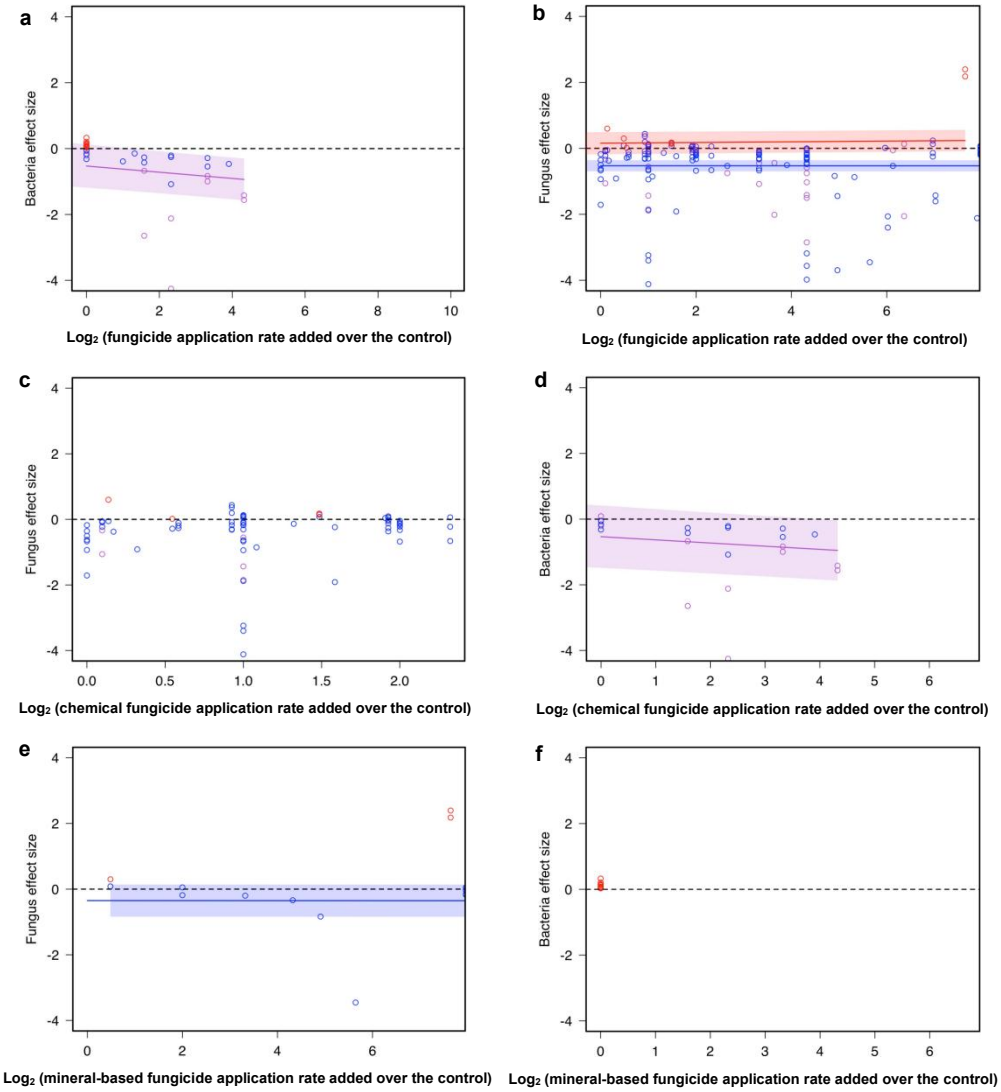
Supplementary Fig. 17 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic herbicide over the control without any pesticides and the different effect sizes of seed or spore-producing plants along with fitted meta-regression lines across all studies. The relationships between mineral-based or biogenic herbicide application rate added over the control and spore-producing plants effect size, and the relationship between mineral-based herbicide application rate added over the control and spore-producing plants could not be estimated due to lack of data. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added herbicide application rates and the growth (n=1449), reproduction (n=161) and biomarker (n=795) of seed plants. **b** Scatter plot for added herbicide application rates and the growth (n=156), reproduction (n=94) and biomarker (n=333) of spore-producing plants. **c** Scatter plot for added chemical synthetic herbicide application rates and the growth (n=1443), reproduction (n=161) and biomarker (n=795) of seed plants. **d** Scatter plot for added chemical synthetic herbicide application rates and the growth (n=156), reproduction (n=94) and biomarker (n=333) of spore-producing plants. **e** Scatter plot for added biogenic herbicide application rates and the growth (n=6) of seed plants. The medium orchid, blue and red dots (or lines) represent the effects of growth, reproduction and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



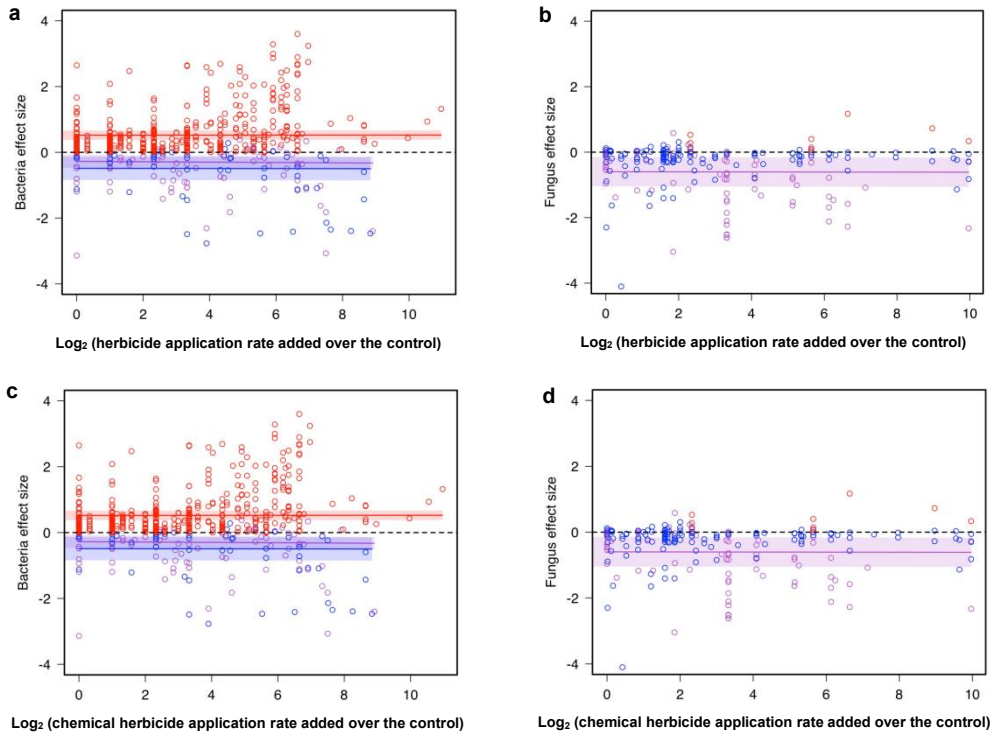
Supplementary Fig. 18 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic pesticides over the control without any pesticides and the different effect sizes of bacteria or fungus along with fitted meta-regression lines across all studies. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added pesticide application rates and the growth (n=295), reproduction (n=202) and biomarker (n=1163) of bacteria. **b** Scatter plot for added pesticide application rates and the growth (n=128), reproduction (n=563) and biomarker (n=24) of fungus. **c** Scatter plot for added chemical synthetic pesticide application rates and the growth (n=277), reproduction (n=168) and biomarker (n=1079) of bacteria. **d** Scatter plot for added chemical synthetic pesticide application rates and the growth (n=277), reproduction (n=168) and biomarker (n=1079) of fungus. **e** Scatter plot for added mineral-based pesticide application rates and the growth (n=128), reproduction (n=518) and biomarker (n=21) of bacteria. **f** Scatter plot for added mineral-based pesticide application rates and the growth (n=18) and reproduction (n=17) of fungus. **g** Scatter plot for added biogenic pesticide application rates and the reproduction (n=17) and biomarker (n=84) of bacteria. **h** Scatter plot for added biogenic pesticide application rates and the reproduction (n=10) of fungus. The medium orchid, blue and red dots (or lines) represent the effects of growth, reproduction and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



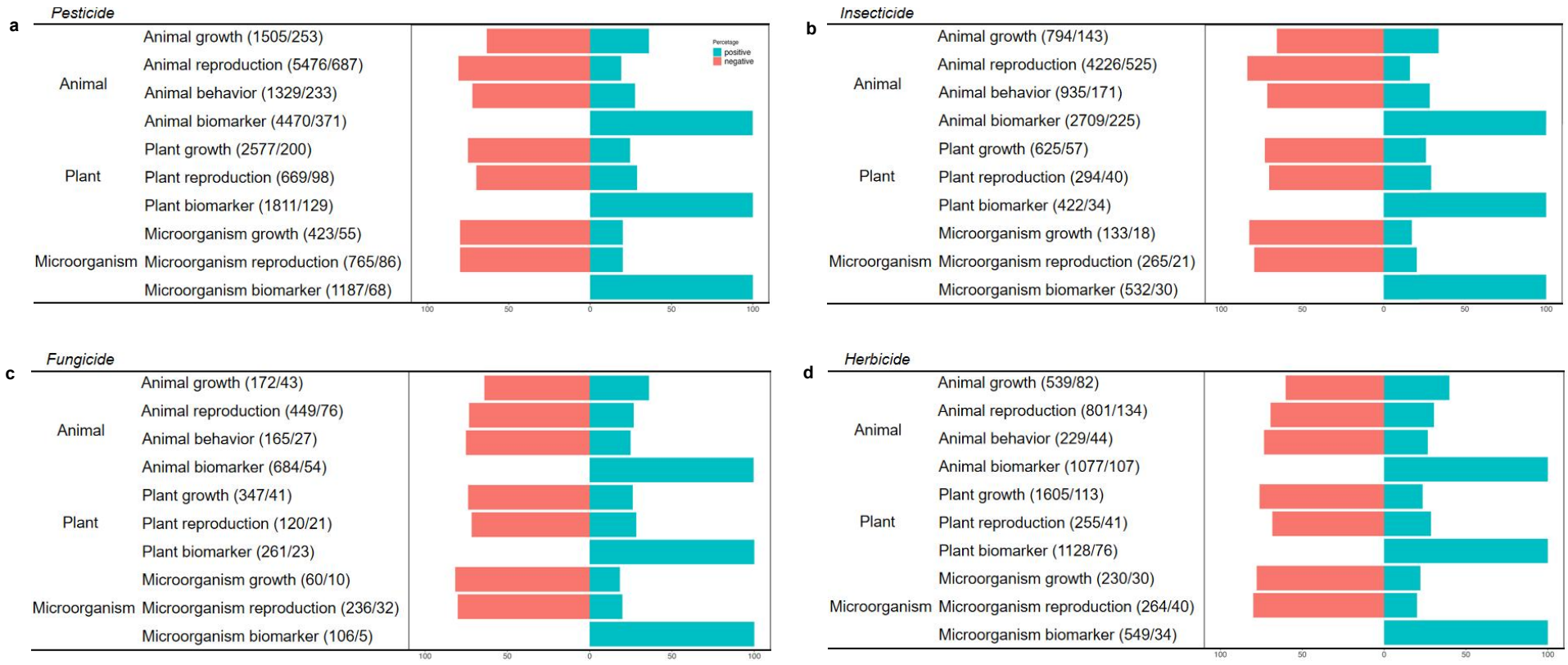
Supplementary Fig. 19 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic insecticides over the control without any pesticides and the different effect sizes of bacteria or fungus along with fitted meta-regression lines across all studies. The relationships between mineral-based insecticide application rate added over the control and bacteria or fungus could not be estimated due to lack of data. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added insecticide application rates and the growth (n=133), reproduction (n=110) and biomarker (n=529) of bacteria. **b** Scatter plot for added insecticide application rates and the reproduction (n=155) and biomarker (n=3) of fungus. **c** Scatter plot for added chemical synthetic insecticide application rates and the growth (n=133), reproduction (n=93) and biomarker (n=529) of bacteria. **d** Scatter plot for added chemical synthetic insecticide application rates and the reproduction (n=145) and biomarker (n=3) of fungus. **e** Scatter plot for added biogenic insecticide application rates and the reproduction (n=17) of bacteria. **f** Scatter plot for added biogenic insecticide application rates and the reproduction (n=10) of fungus. The medium orchid, blue and red dots (or lines) represent the effects of growth, reproduction and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



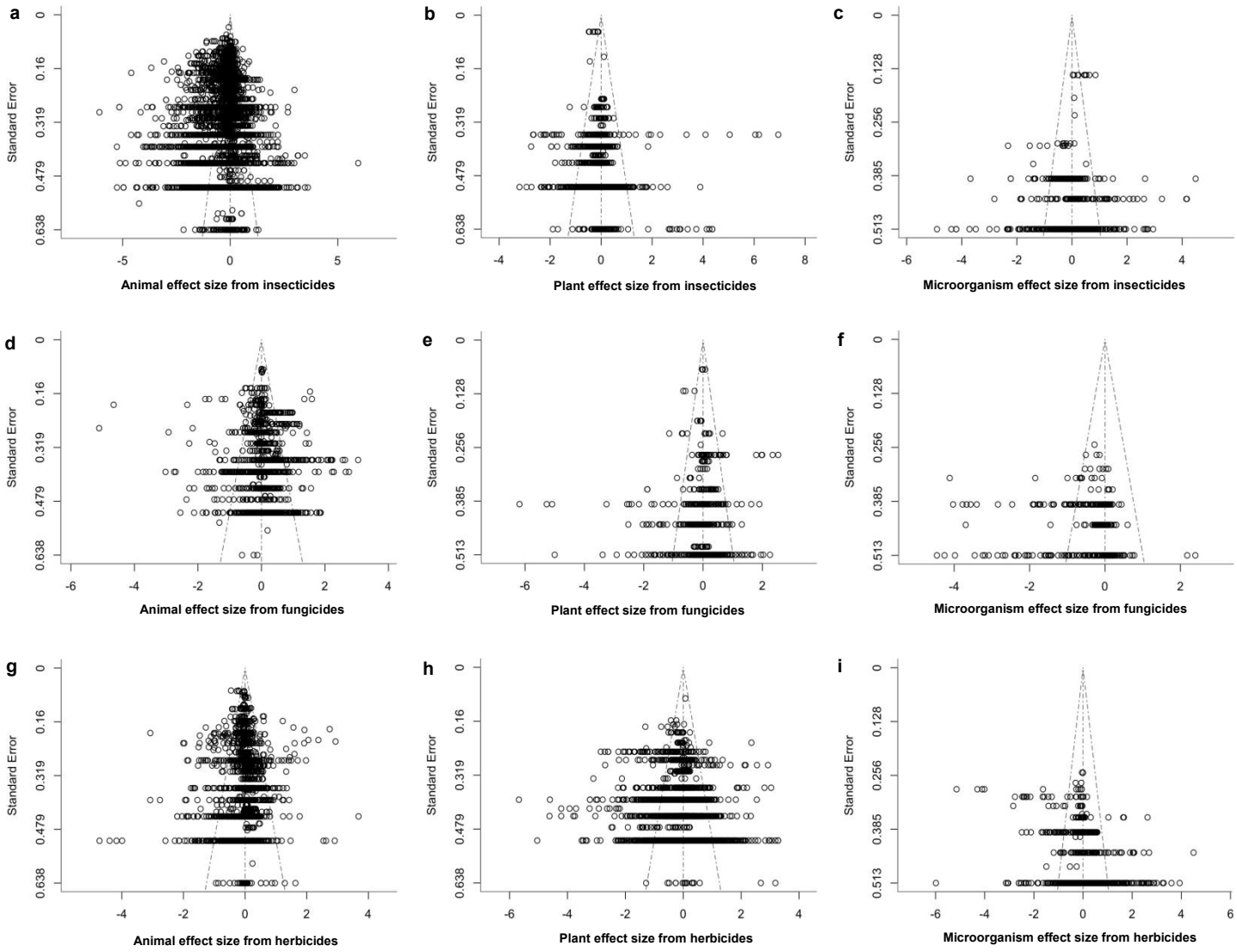
Supplementary Fig. 20 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic fungicides over the control without any pesticides and the different effect sizes of bacteria or fungus along with fitted meta-regression lines across all studies. The relationships between biogenic fungicide application rate added over the control and fungus could not be estimated due to lack of data. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added fungicide application rates and the growth (n=22), reproduction (n=19) and biomarker (n=94) of bacteria. **b** Scatter plot for added fungicide application rates and the growth (n=38), reproduction (n=217) and biomarker (n=12) of fungus. **c** Scatter plot for added chemical synthetic fungicide application rates and the growth (n=4), reproduction (n=2) and biomarker (n=10) of bacteria. **d** Scatter plot for added chemical synthetic fungicide application rates and the growth (n=38), reproduction (n=182) and biomarker (n=9) of fungus. **e** Scatter plot for added mineral-based fungicide application rates and the growth (n=18) and reproduction (n=17) of bacteria. **f** Scatter plot for added mineral-based fungicide application rates and the reproduction (n=35) of fungus. The medium orchid, blue and red dots (or lines) represent the effects of growth, reproduction and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



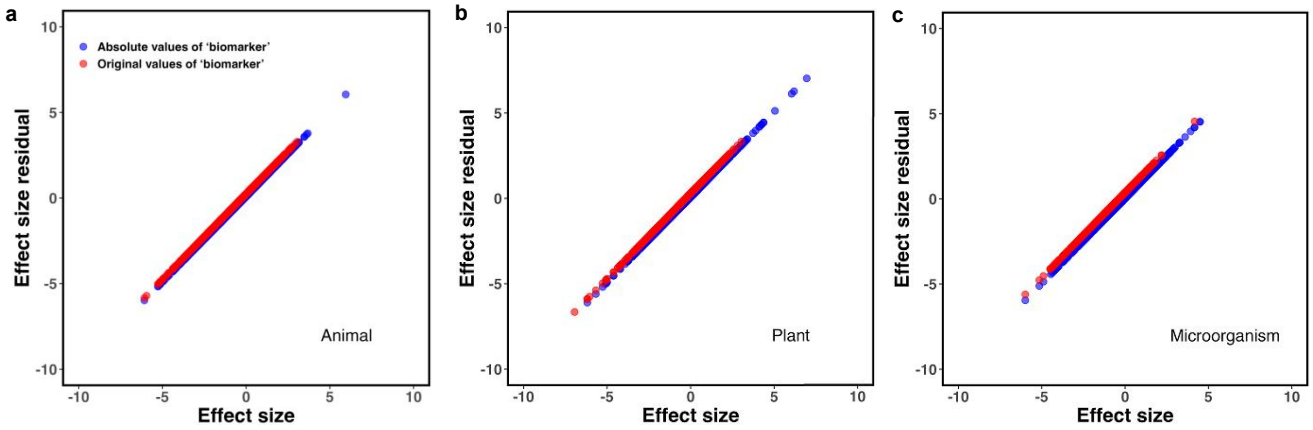
Supplementary Fig. 21 | Relationship between added application rates in the treatments of chemical synthetic, mineral-based or biogenic herbicide over the control without any pesticides and the different effect sizes of bacteria or fungus along with fitted meta-regression lines across all studies. The relationships between mineral-based or biogenic herbicide application rate added over the control and bacteria or fungus could not be estimated due to lack of data. T test is used for tests of individual coefficients. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Scatter plot for added herbicide application rates and the growth (n=140), reproduction (n=73) and biomarker (n=540) of bacteria. **b** Scatter plot for added herbicide application rates and the growth (n=90), reproduction (n=191) and biomarker (n=9) of fungus. **c** Scatter plot for added chemical synthetic herbicide application rates and the growth (n=140), reproduction (n=73) and biomarker (n=540) of bacteria. **d** Scatter plot for added chemical synthetic herbicide application rates and the growth (n=90), reproduction (n=191) and biomarker (n=9) of fungus. The medium orchid, blue and red dots (or lines) represent the effects of growth, reproduction and biomarker, respectively. The shaded region indicates the 95% confidence interval for the predicted average SMD. Absolute values of 'biomarker' values were taken. Regression lines were presented only when the slope was significant. The regression model intercepts, slopes and the P-values for the slopes are presented in Supplementary Data 8. Source data are provided as a Source Data file.



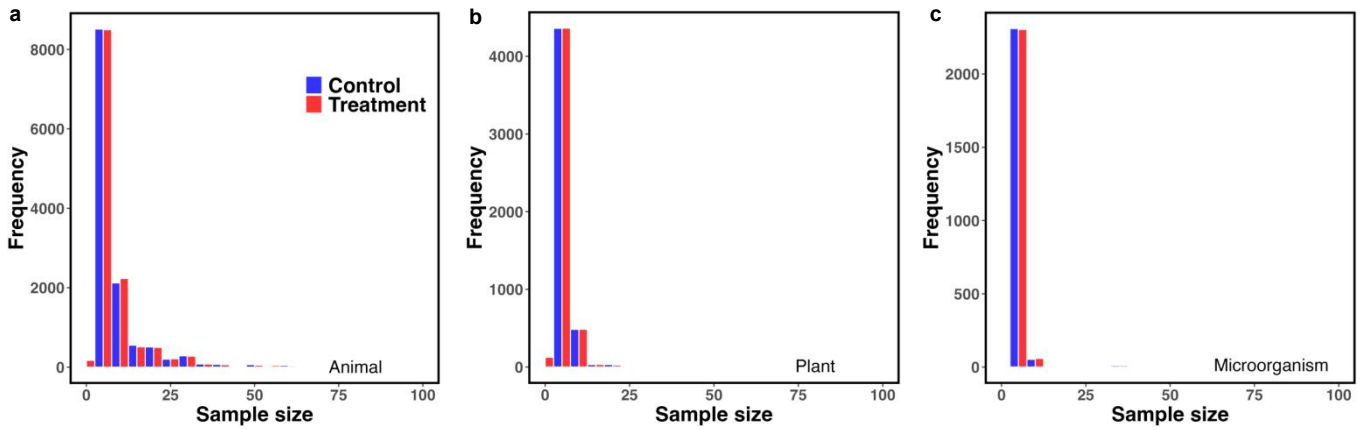
Supplementary Fig. 22 | Percentage of the negative and positive responses of the growth, reproduction, behaviour and biomarker of animals, plants or microorganisms to pesticides, insecticides, fungicides and herbicides, respectively. Horizontal blue and red rectangles indicate the percentages of the negative and positive responses, respectively; numbers in brackets indicate the numbers of observations and studies. Absolute values of 'biomarker' values were taken. **a** Pesticides. **b** Insecticides. **c** Fungicides. **d** Herbicides. Source data are provided as a Source Data file.



Supplementary Fig. 23 | Funnel plot of effect size standard error plotted against effect size. Animal effect sizes include the growth, reproduction, behaviour and biomarker of animals, plant effect sizes include the growth, reproduction and biomarker of plants, and microorganism effect sizes include the growth, reproduction and biomarker of microorganisms. Absolute values of 'biomarker' values were taken. Egger's test is used for publication bias test. Each test is two-sided and the original P value is reported with no multiple comparisons. **a** Animal effects from insecticides (N=8664). **b** Plant effects from insecticides (N=1341). **c** Microorganism effects from insecticides (N=930). **d** Animal effects from fungicides (N=1470). **e** Plant effects from fungicides (N=728). **f** Microorganism effects from fungicides (N=402). **g** Animal effects from herbicides (N=2646). **h** Plant effects from herbicides (N=2988). **i** Microorganism effects from herbicides (N=1043). Source data are provided as a Source Data file.



Supplementary Fig. 24 | Scatter plot of effect size residual plotted against effect size for meta-analyses of biomarker responses based on whether the value of 'biomarker' is treated as an absolute (blue dots) or raw value (including both negative and positive directionality - red dots). This is shown for the overall response to pesticides for animals, plant and microorganism. The horizontal axis represents the effect size, and the vertical axis represents the effect size residual. As can be seen the relationship between effect size and effect size residuals is linear and largely consistent with and without the treatment of biomarker responses as absolute values. These plots indicate that more broadly model assumption are met. **a** Scatter plot for animal biomarker responses (N=12780). **b** Scatter plot for plant biomarker responses (N=5057). **c** Scatter plot for microorganism biomarker responses (N=2375). Source data are provided as a Source Data file.



Supplementary Fig. 25 | Histogram plot for showing the distribution of sample size by type of organism and separately by control and treatment. Blue and red points indicate the count of corresponding sample size, respectively. The horizontal axis represents the sample size, and the vertical axis represents the count of corresponding sample size. **a** Histogram plot for animals by control and treatment group (N=12780). **b** Histogram plot for plants by control and treatment group (N=5057). **c** Histogram plot for microorganisms by control and treatment group (N=2375). Source data are provided as a Source Data file.

Supplementary Table 1 Overview of the meta-regression models used to test our research questions. For each model, the table gives the predictor variables included, the Akaike information criterion (AIC), the reference model (model 1) for the log-likelihood ratio test, and the statistics of the log-likelihood ratio tests (log-likelihoods [L-L], X^2, degrees of freedom compared to the reference model [df] and the corresponding P-value) based on model comparisons. Model 1 was nested within Model 1.1–1.8; and Model 2 was nested within Model 2.1–2.8. Type of experimental study was divided into laboratory and field experiments. Climatic zone type was divided into tropical and temperate climatic zones. Types of pesticide classification by controlling target organisms included insecticides, herbicides and fungicides. Types of pesticide classification by source included mineral-based, biogenic and chemical synthetic pesticides. Types of organism exposure to pesticides included aquatic and terrestrial systems. Types of pesticide use history included old and new pesticides. Types of experimental organisms includes model and non-model species. Conflict of interest status was one binary variable (0=no conflict; 1=conflict). Publication year was one continuous variable. ANOVA test is used to check the significance between full model and null model. Each test is two-sided and the original P value is reported with no multiple comparisons.

Supplementary Table 1.1) The response variable in all models was the effect size of the responses of animals, plants and microorganisms to different comparison groups. Taxonomic group included animals, plants and microorganisms. Taxonomic group response category included animal growth, animal reproduction, animal behaviour, animal biomarker, plant growth, plant reproduction, plant biomarker, microorganism growth, microorganism reproduction and microorganism biomarker. Absolute values of 'biomarker' values were taken. Data from laboratory conditions were removed from the models with climatic predictors. The model with suffix "A" is compared with base model (Model 1 or 2). The model with suffix "B" is compared with the nearest model with suffix "A". We used mixed effect model meta-analysis, where organisms (unique species name and unique non-level species groups), traits (growth, reproduction, biomarker and behavior), pesticide identity (active ingredients pesticide names) and study identity were included as random effects.

Model	Question	Predictor variables	Ref.	AIC	L–L	X^2	df	P	n
1	1	Taxonomic group	-	62509.9910	-31247.9955	NA	3	NA	20212
1.1A	2	Taxonomic group + Type of experimental study	1	62499.3303	-31241.6652	12.6606	8	3.7344×10^{-4}	20212
1.1B	2	Taxonomic group + Type of experimental study + Taxonomic group × Type of experimental study	1.1A	62501.2633	-31240.6316	2.0670	10	0.3558	20212
1.2A	2	Taxonomic group + Climatic zone type	1	6361.3957	-3172.6979	0.2881	8	0.5914	2054
1.2B	2	Taxonomic group + Climatic zone type + Taxonomic group × Climatic zone type	1.2A	6363.7218	-3171.8609	1.6740	10	0.4330	2054
1.3A	2	Taxonomic group + Types of pesticide classification by controlling target organisms	1	62509.2143	-31245.6072	4.7766	9	0.0918	20212
1.3B	2	Taxonomic group + Types of pesticide classification by controlling target organisms + Taxonomic group × Types of pesticide classification by controlling target organisms	1.3A	62375.4220	-31174.7110	141.7924	13	1.1665×10^{-29}	20212
1.4A	2	Taxonomic group + Types of pesticide classification by source	1	62500.2190	-31241.1095	13.7720	9	0.0010	20212
1.4B	2	Taxonomic group + Types of pesticide classification by source + Taxonomic group × Types of pesticide classification by source	1.4A	62469.2394	-31221.6197	38.9796	13	7.0345×10^{-8}	20212
1.5A	2	Taxonomic group + Types of organism exposure to pesticides	1	62508.2835	-31246.1418	3.7074	8	0.0542	20212
1.5B	2	Taxonomic group + Types of organism exposure to pesticides + Taxonomic group × Types of organism exposure to pesticides	1.5A	62499.2616	-31239.6308	13.0219	10	0.0015	20212
1.6A	2	Taxonomic group + Types of pesticide use history	1	62511.8421	-31247.9211	0.1489	8	0.6996	20212
1.6B	2	Taxonomic group + Types of pesticide use history + Taxonomic group × Types of pesticide use history	1.6A	62397.6277	-31188.8139	118.2144	10	2.1383×10^{-26}	20212
1.7A	2	Taxonomic group + Types of experimental organisms	1	62510.7814	-31247.3907	1.2095	8	0.2714	20212
1.7B	2	Taxonomic group + Types of experimental organisms + Taxonomic group × Types of experimental organisms	1.7A	62512.8902	-31246.4451	1.8912	10	0.3884	20212
1.8A	2	Taxonomic group + Conflict of interest status	1	62509.0083	-31245.5041	4.9827	9	0.0828	20212
1.8B	2	Taxonomic group + Conflict of interest status + Taxonomic group × Conflict of interest status	1.8A	62513.7943	-31244.8971	1.2140	12	0.7496	20212
1.9A	2	Taxonomic group + Publication year	1	62510.4722	-31247.2361	1.5188	8	0.2178	20212
1.9B	2	Taxonomic group + Publication year + Taxonomic group × Publication year	1.9A	62507.5717	-31243.7859	6.9005	10	0.0317	20212
1.10A	1	Taxonomic group + Log_2 (added pesticide dosage over control)	1	61424.2617	-30704.1308	1087.7293	8	1.5341×10^{-238}	20212
1.10B	1	Taxonomic group + Log_2 (added pesticide dosage over control) + Taxonomic group × Log_2 (added pesticide dosage over control)	1.10A	61426.2525	-30703.1262	2.0092	10	0.3662	20212
2	1	Taxonomic group response category	1	62105.9987	-31038.9994	417.9922	14	3.2969×10^{-86}	20212
2.1A	2	Taxonomic group response category + Type of experimental study	2	62093.2156	-31031.6078	432.7754	15	1.8097×10^{-88}	20212
2.1B	2	Taxonomic group response category + Type of experimental study + Taxonomic group response category × Type of experimental study	2.1A	61903.5636	-30927.7818	207.6520	24	8.2248×10^{-40}	20212
2.2A	2	Taxonomic group response category + Climatic zone type	2	6338.0983	-3154.0492	37.5855	15	8.9783×10^{-6}	2054
2.2B	2	Taxonomic group response category + Climatic zone type + Taxonomic group response category × Climatic zone type	2.2A	6333.5848	-3145.7924	16.5135	21	0.0112	2054
2.3A	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms	2	62105.5918	-31036.7959	422.3992	16	2.2656×10^{-85}	20212
2.3B	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms + Taxonomic group response category × Types of pesticide classification by controlling target organisms	2.3A	61802.7327	-30867.3664	338.8591	34	4.6233×10^{-61}	20212
2.4A	2	Taxonomic group response category + Types of pesticide classification by source	2	62097.0484	-31032.5242	430.9425	16	3.3909×10^{-87}	20212
2.4B	2	Taxonomic group response category + Types of pesticide classification by source + Taxonomic group response category × Types of pesticide classification by source	2.4A	62002.0354	-30969.0177	127.0131	32	2.4354×10^{-19}	20212
2.5A	2	Taxonomic group response category + Types of organism exposure to pesticides	2	62102.5654	-31036.2827	423.4256	15	1.8178×10^{-86}	20212
2.5B	2	Taxonomic group response category + Types of organism exposure to pesticides + Taxonomic group response category × Types of organism exposure to pesticides	2.5A	61904.2072	-30928.1036	216.3582	24	1.2202×10^{-41}	20212
2.6A	2	Taxonomic group response category + Types of pesticide use history	2	62107.8534	-31038.9267	418.1375	15	2.4635×10^{-85}	20212
2.6B	2	Taxonomic group response category + Types of pesticide use history + Taxonomic group response category × Types of pesticide use history	2.6A	61951.3930	-30951.6965	174.4604	24	7.2554×10^{-33}	20212
2.7A	2	Taxonomic group response category + Types of experimental organisms	1	62106.5142	-31038.2571	419.4768	15	1.2732×10^{-85}	20212
2.7B	2	Taxonomic group response category + Types of experimental organisms + Taxonomic group response category × Types of experimental organisms	2.7A	61972.7279	-30962.3639	151.7864	24	3.7610×10^{-28}	20212
2.8A	2	Taxonomic group response category + Conflict of interest status	1	62106.1018	-31037.0509	421.8891	16	2.9115×10^{-85}	20212
2.8B	2	Taxonomic group response category + Conflict of interest status + Taxonomic group response category × Conflict of interest status	2.8A	62065.8495	-31001.9247	70.2524	31	4.0277×10^{-9}	20212
2.9A	2	Taxonomic group response category + Publication year	1	62106.8107	-31038.4054	419.1803	15	1.4735×10^{-85}	20212
2.9B	2	Taxonomic group response category + Publication year + Taxonomic group response category × Publication year	2.9A	62061.5407	-31006.7704	63.2700	24	3.1274×10^{-10}	20212
2.10A	2	Taxonomic group response category + Log_2 (added pesticide dosage over control)	2	61021.6410	-30495.8205	1504.3500	15	0.0000	20212
2.10B	2	Taxonomic group response category+ Log_2 (added pesticide dosage over control) + Taxonomic group response category × Log_2 (added pesticide dosage over control)	2.10A	58315.0367	-29133.5183	2724.6043	24	0.0000	20212

Supplementary Table 1.2) The response variable in all models was the effect size of the responses of invertebrates, vertebrates, seed plants, spore-producing plants, bacteria and fungus to the different comparison groups. Taxonomic group included invertebrates, vertebrates, seed plants, spore-producing plants, bacteria and fungus. Taxonomic group response category included invertebrate growth, invertebrate reproduction, invertebrate behaviour, invertebrate biomarker, vertebrate growth, vertebrate reproduction, vertebrate behaviour, vertebrate biomarker, seed plant growth, seed plant reproduction, seed plant biomarker, spore-producing plant growth, spore-producing plant reproduction, spore-producing plant biomarker, bacteria growth, bacteria reproduction, bacteria biomarker, fungus growth, fungus reproduction and fungus biomarker. Absolute values of 'biomarker' values were taken. Data from laboratory conditions were removed from the models with climatic predictors. The model with suffix "A" is compared with base model (Model 1 or 2). The model with suffix "B" is compared with the nearest model with suffix "A". We used mixed effect model meta-analysis, where organisms (unique species name and unique non-level species groups), traits (growth, reproduction, biomarker and behavior), pesticide identity (active ingredients pesticide names) and study identity were included as random effects.

Model	Question	Predictor variables	Ref.	AIC	L—L	X^2	df	P	n
1	1	Taxonomic group	-	62503.6920	-31241.8460	NA	6	NA	20212
1.1A	2	Taxonomic group + Type of experimental study	1	62493.6525	-31235.8263	12.0395	11	0.0005	20212
1.1B	2	Taxonomic group + Type of experimental study + Taxonomic group × Type of experimental study	1.1A	62495.4197	-31231.7098	8.2329	16	0.1439	20212
1.2A	2	Taxonomic group + Climatic zone type	1	6359.8386	-3168.9193	0.6806	11	0.4094	2054
1.2B	2	Taxonomic group + Climatic zone type + Taxonomic group × Climatic zone type	1.2A	6368.0647	-3168.0323	1.7740	16	0.8795	2054
1.3A	2	Taxonomic group + Types of pesticide classification by controlling target organisms	1	62502.3910	-31239.1955	5.3010	12	0.0706	20212
1.3B	2	Taxonomic group + Types of pesticide classification by controlling target organisms + Taxonomic group × Types of pesticide classification by controlling target organisms	1.3A	62255.1236	-31105.5618	267.2674	22	1.2594×10^{-51}	20212
1.4A	2	Taxonomic group + Types of pesticide classification by source	1	62493.6174	-31234.8087	14.0746	12	0.0009	20212
1.4B	2	Taxonomic group + Types of pesticide classification by source + Taxonomic group × Types of pesticide classification by source	1.4A	62415.6681	-31186.8340	95.9493	21	1.0350×10^{-16}	20212
1.5A	2	Taxonomic group + Types of organism exposure to pesticides	1	62505.3259	-31241.6629	0.3661	11	0.5451	20212
1.5B	2	Taxonomic group + Types of organism exposure to pesticides + Taxonomic group × Types of organism exposure to pesticides	1.5A	62493.6571	-31231.8285	19.6688	15	0.0006	20212
1.6A	2	Taxonomic group + Types of pesticide use history	1	62505.5583	-31241.7791	0.1337	11	0.7146	20212
1.6B	2	Taxonomic group + Types of pesticide use history + Taxonomic group × Types of pesticide use history	1.6A	62386.9571	-31177.4786	128.6012	16	4.7139×10^{-26}	20212
1.7A	2	Taxonomic group + Types of experimental organisms	1	62504.9941	-31241.4970	0.6979	11	0.4035	20212
1.7B	2	Taxonomic group + Types of experimental organisms + Taxonomic group × Types of experimental organisms	1.7A	62509.8896	-31239.9448	3.1045	15	0.5405	20212
1.8A	2	Taxonomic group + Conflict of interest status	1	62503.0160	-31239.5080	4.6759	12	0.0965	20212
1.8B	2	Taxonomic group + Conflict of interest status + Taxonomic group × Conflict of interest status	1.8A	62510.0423	-31236.0211	6.9738	19	0.4316	20212
1.9A	2	Taxonomic group + Publication year	1	62504.4620	-31241.2310	1.2300	11	0.2674	20212
1.9B	2	Taxonomic group + Publication year + Taxonomic group × Publication year	1.9A	62491.0429	-31229.5215	23.4190	16	2.8065×10^{-4}	20212
1.10A	1	Taxonomic group + Log_2 (added pesticide dosage over control)	1	61418.4660	-30698.2330	1087.2259	11	1.9736×10^{-238}	20212
1.10B	1	Taxonomic group + Log_2 (added pesticide dosage over control) + Taxonomic group × Log_2 (added pesticide dosage over control)	1.10A	60833.8974	-30400.9487	594.5687	16	3.0156×10^{-126}	20212
2	1	Taxonomic group response category	1	61990.4137	-30971.2068	541.2783	24	1.6204×10^{-106}	20212
2.1A	2	Taxonomic group response category + Type of experimental study	2	61977.5650	-30963.7825	556.1270	25	7.3046×10^{-109}	20212
2.1B	2	Taxonomic group response category + Type of experimental study + Taxonomic group response category × Type of experimental study	2.1A	61836.0382	-30876.0191	175.5268	42	2.2429×10^{-28}	20212
2.2A	2	Taxonomic group response category + Climatic zone type	2	6343.4748	-3148.7374	41.0444	23	9.3719×10^{-5}	2054
2.2B	2	Taxonomic group response category + Climatic zone type + Taxonomic group response category × Climatic zone type	2.2A	6340.6928	-3139.3464	18.7821	31	0.0161	2054
2.3A	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms	2	61989.8050	-30968.9025	545.8870	26	6.6599×10^{-106}	20212
2.3B	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms + Taxonomic group response category × Types of pesticide classification by controlling target organisms	2.3A	61563.5770	-30718.7885	500.2280	63	1.5847×10^{-82}	20212
2.4A	2	Taxonomic group response category + Types of pesticide classification by source	2	61981.3307	-30964.6653	554.3613	26	1.0714×10^{-107}	20212
2.4B	2	Taxonomic group response category + Types of pesticide classification by source + Taxonomic group response category × Types of pesticide classification by source	2.4A	61699.7108	-30795.8554	337.6198	54	7.6427×10^{-55}	20212
2.5A	2	Taxonomic group response category + Types of organism exposure to pesticides	2	61991.2595	-30970.6297	542.4325	25	5.8505×10^{-106}	20212
2.5B	2	Taxonomic group response category + Types of organism exposure to pesticides + Taxonomic group response category × Types of organism exposure to pesticides	2.5A	61763.0919	-30842.5460	256.1676	39	1.5213×10^{-46}	20212
2.6A	2	Taxonomic group response category + Types of pesticide use history	2	61992.3098	-30971.1549	541.3822	25	9.7681×10^{-106}	20212
2.6B	2	Taxonomic group response category + Types of pesticide use history + Taxonomic group response category × Types of pesticide use history	2.6A	61823.1162	-30867.5581	207.1936	44	1.2563×10^{-33}	20212
2.7A	2	Taxonomic group response category + Types of experimental organisms	1	61991.6514	-30970.8257	542.0406	25	7.0837×10^{-106}	20212
2.7B	2	Taxonomic group response category + Types of experimental organisms + Taxonomic group response category × Types of experimental organisms	2.7A	61821.0394	-30869.5197	202.6120	41	2.3504×10^{-34}	20212
2.8A	2	Taxonomic group response category + Conflict of interest status	1	61990.7192	-30969.3596	544.9728	26	1.0397×10^{-105}	20212
2.8B	2	Taxonomic group response category + Conflict of interest status + Taxonomic group response category × Conflict of interest status	2.8A	61904.3092	-30899.1546	140.4100	53	2.7569×10^{-17}	20212
2.9A	2	Taxonomic group response category + Publication year	1	61991.3516	-30970.6758	542.3404	25	6.1195×10^{-106}	20212
2.9B	2	Taxonomic group response category + Publication year + Taxonomic group response category × Publication year	2.9A	61832.9356	-30872.4678	196.4160	44	1.7552×10^{-31}	20212
2.10A	1	Taxonomic group response category + Log_2 (added pesticide dosage over control)	2	60908.3986	-30429.1993	1625.2934	25	0.0000	20212
2.10B	1	Taxonomic group response category+ Log_2 (added pesticide dosage over control) + Taxonomic group response category × Log_2 (added pesticide dosage over control)	2.10A	58053.6545	-28982.8273	2892.7441	44	0.0000	20212

Supplementary Table 1.3) The response variable in all models was the effect size of the responses of dicotyledonous, monocotyledonous and algae plants to the different comparison groups. Taxonomic group included dicotyledonous, monocotyledonous and algae plants. Taxonomic group response category included dicotyledonous plant growth, dicotyledonous plant reproduction, dicotyledonous plant biomarker, monocotyledonous plant growth, monocotyledonous plant reproduction and monocotyledonous plant biomarker, algae plant growth, algae plant reproduction and algae plant biomarker. Absolute values of 'biomarker' values were taken. Data from laboratory conditions were removed from the models with climatic predictors. The model with suffix "A" is compared with base model (Model 1 or 2). The model with suffix "B" is compared with the nearest model with suffix "A". We used mixed effect model meta-analysis, where plant species (excluding non-level species groups), traits (growth, reproduction, biomarker and behavior), pesticide identity (active ingredients pesticide names) and study identity were included as random effects with phylogenetic relatedness as part of the correlation structure, in which 192 plant species were included in the correlation structure.

Model	Question	Predictor variables	Ref.	AIC	L–L	X^2	df	P	n
1	1	Taxonomic group	-	14846.6655	-7415.3328	NA	4	NA	4961
1.1A	2	Taxonomic group + Type of experimental study	1	14841.5476	-7411.7738	7.1180	9	0.0076	4961
1.1B	2	Taxonomic group + Type of experimental study + Taxonomic group × Type of experimental study	1.1A	14842.6965	-7410.3483	2.8510	11	0.2404	4961
1.2A	2	Taxonomic group + Climatic zone type	1	1275.7567	-629.8784	4.7589	8	0.0291	684
1.2B	2	Taxonomic group + Climatic zone type + Taxonomic group × Climatic zone type	1.2A	1277.6250	-629.8125	0.1317	9	0.7166	684
1.3A	2	Taxonomic group + Types of pesticide classification by controlling target organisms	1	14845.0152	-7412.5076	5.6504	10	0.0593	4961
1.3B	2	Taxonomic group + Types of pesticide classification by controlling target organisms + Taxonomic group × Types of pesticide classification by controlling target organisms	1.3A	14819.8703	-7394.9351	35.1449	15	1.4077×10^{-6}	4961
1.4A	2	Taxonomic group + Types of pesticide classification by source	1	14849.6876	-7414.8438	0.9780	10	0.6133	4961
1.4B	2	Taxonomic group + Types of pesticide classification by source + Taxonomic group × Types of pesticide classification by source	1.4A	14853.5616	-7414.7808	0.1260	12	0.9389	4961
1.5A	2	Taxonomic group + Types of organism exposure to pesticides	1	14848.6482	-7415.3241	0.0173	9	0.8953	4961
1.5B	2	Taxonomic group + Types of organism exposure to pesticides + Taxonomic group × Types of organism exposure to pesticides	1.5A	14850.3689	-7415.1844	0.2793	10	0.5972	4961
1.6A	2	Taxonomic group + Types of pesticide use history	1	14844.4344	-7413.2172	4.2312	9	0.0397	4961
1.6B	2	Taxonomic group + Types of pesticide use history + Taxonomic group × Types of pesticide use history	1.6A	14833.1764	-7404.5882	17.2580	12	0.0006	4961
1.7A	2	Taxonomic group + Types of experimental organisms	1	14847.8448	-7414.9224	0.8207	9	0.3650	4961
1.7B	2	Taxonomic group + Types of experimental organisms + Taxonomic group × Types of experimental organisms	1.7A	14846.6693	-7413.3346	3.1755	10	0.0747	4961
1.8A	2	Taxonomic group + Conflict of interest status	1	14847.4173	-7413.7086	3.2483	10	0.1971	4961
1.8B	2	Taxonomic group + Conflict of interest status + Taxonomic group × Conflict of interest status	1.8A	14849.0211	-7411.5105	4.3962	13	0.2217	4961
1.9A	2	Taxonomic group + Publication year	1	14847.4645	-7414.7323	1.2010	9	0.2731	4961
1.9B	2	Taxonomic group + Publication year + Taxonomic group × Publication year	1.9A	14850.3544	-7413.1772	3.1101	12	0.3750	4961
1.10A	1	Taxonomic group + Log_2 (added pesticide dosage over control)	1	14643.8966	-7312.9483	204.7690	9	1.9019×10^{-46}	4961
1.10B	1	Taxonomic group + Log_2 (added pesticide dosage over control) + Taxonomic group × Log_2 (added pesticide dosage over control)	1.10A	14581.7583	-7278.8792	68.1382	12	1.0687×10^{-14}	4961
2	1	Taxonomic group response category	1	14630.0338	-7300.0169	230.6317	15	3.6437×10^{-46}	4961
2.1A	2	Taxonomic group response category + Type of experimental study	2	14624.3565	-7296.1783	7.6773	16	0.0056	4961
2.1B	2	Taxonomic group response category + Type of experimental study + Taxonomic group response category × Type of experimental study	2.1A	14529.2022	-7242.6011	107.1543	22	8.0331×10^{-21}	4961
2.2A	2	Taxonomic group response category + Climatic zone type	2	1276.1434	-626.0717	4.3600	12	0.0368	684
2.2B	2	Taxonomic group response category + Climatic zone type + Taxonomic group response category × Climatic zone type	2.2A	1266.3328	-616.1664	19.8106	17	0.0014	684
2.3A	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms	2	14628.8461	-7297.4231	5.1877	17	0.0747	4961
2.3B	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms + Taxonomic group response category × Types of pesticide classification by controlling target organisms	2.3A	14483.7260	-7206.8630	181.1201	35	5.7533×10^{-29}	4961
2.4A	2	Taxonomic group response category + Types of pesticide classification by source	2	14632.9758	-7299.4879	1.0580	17	0.5892	4961
2.4B	2	Taxonomic group response category + Types of pesticide classification by source + Taxonomic group response category × Types of pesticide classification by source	2.4A	14635.1000	-7292.5500	13.8758	25	0.0851	4961
2.5A	2	Taxonomic group response category + Types of organism exposure to pesticides	2	14632.0260	-7300.0130	0.0078	16	0.9295	4961
2.5B	2	Taxonomic group response category + Types of organism exposure to pesticides + Taxonomic group response category × Types of organism exposure to pesticides	2.5A	14558.0514	-7258.0257	83.9746	21	1.2348×10^{-16}	4961
2.6A	2	Taxonomic group response category + Types of pesticide use history	2	14628.0781	-7298.0390	3.9557	16	0.0467	4961
2.6B	2	Taxonomic group response category + Types of pesticide use history + Taxonomic group response category × Types of pesticide use history	2.6A	14598.1408	-7273.0704	49.9372	26	2.7409×10^{-7}	4961
2.7A	2	Taxonomic group response category + Types of experimental organisms	1	14630.8618	-7299.4309	1.1720	16	0.2790	4961
2.7B	2	Taxonomic group response category + Types of experimental organisms + Taxonomic group response category × Types of experimental organisms	2.7A	14565.6088	-7261.8044	75.2531	21	8.2377×10^{-15}	4961
2.8A	2	Taxonomic group response category + Conflict of interest status	1	14631.0918	-7298.5459	2.9420	17	0.2297	4961
2.8B	2	Taxonomic group response category + Conflict of interest status + Taxonomic group response category × Conflict of interest status	2.8A	14605.3213	-7274.6607	47.7705	28	1.5686×10^{-6}	4961
2.9A	2	Taxonomic group response category + Publication year	1	14631.2362	-7299.6181	0.7976	16	0.3718	4961
2.9B	2	Taxonomic group response category + Publication year + Taxonomic group response category × Publication year	2.9A	14612.4777	-7281.2389	36.7585	25	2.9062×10^{-5}	4961
2.10A	1	Taxonomic group response category + Log_2 (added pesticide dosage over control)	2	14426.7206	-7197.3603	205.3132	16	1.4469×10^{-46}	4961
2.10B	1	Taxonomic group response category+ Log_2 (added pesticide dosage over control) + Taxonomic group response category × Log_2 (added pesticide dosage over control)	2.10A	13541.3435	-6744.6718	905.3771	26	4.4330×10^{-188}	4961

Supplementary Table 1.4) The response variable in all models was the effect size of the responses of invertebrate and vertebrate animals to the different comparison groups. Taxonomic group included invertebrates (i.e., Protozoa, Coelenterata, Rotifera, Platyhelminthes, Nemathelminthes, annelids, molluscs, arthropods, echinoderms) and vertebrates (i.e., fish, amphibians, reptiles, birds and mammals). Taxonomic group response category included the growth, reproduction, behaviour and biomarkers of inverterbrates and the growth, reproduction, behaviour and biomarkers of verterbrates. Absolute values of 'biomarker' values were taken. Data from laboratory conditions were removed from the models with climatic predictors. The model with suffix "A" is compared with base model (Model 1 or 2). The model with suffix "B" is compared with the nearest model with suffix "A". We used mixed effect model meta-analysis, where animal species (excluding non-level species groups), traits (growth, reproduction, biomarker and behavior), pesticide identity (active ingredients pesticide names) and study identity were included as random effects with phylogenetic relatedness as part of the correlation structure, in which 553 animal species were included in the correlation structure.

Model	Question	Predictor variables	Ref.	AIC	L–L	X^2	df	P	n
1	1	Taxonomic group	-	34716.9027	-17352.4513	NA	2	NA	11952
1.1A	2	Taxonomic group + Type of experimental study	1	34710.5134	-17348.2567	8.3893	7	0.0038	11952
1.1B	2	Taxonomic group + Type of experimental study + Taxonomic group × Type of experimental study	1.1A	34711.6618	-17347.8309	0.8516	8	0.3561	11952
1.2A	2	Taxonomic group + Climatic zone type	1	2309.9755	-1147.9877	1.0917	7	0.2961	790
1.2B	2	Taxonomic group + Climatic zone type + Taxonomic group × Climatic zone type	1.2A	2311.9306	-1147.9653	0.0449	8	0.8322	790
1.3A	2	Taxonomic group + Types of pesticide classification by controlling target organisms	1	34719.9323	-17351.9661	0.9704	8	0.6156	11952
1.3B	2	Taxonomic group + Types of pesticide classification by controlling target organisms + Taxonomic group × Types of pesticide classification by controlling target organisms	1.3A	34682.9722	-17331.4861	40.9600	10	1.2754×10^{-9}	11952
1.4A	2	Taxonomic group + Types of pesticide classification by source	1	34715.0163	-17349.5081	5.8864	8	0.0527	11952
1.4B	2	Taxonomic group + Types of pesticide classification by source + Taxonomic group × Types of pesticide classification by source	1.4A	34688.8512	-17334.4256	30.1651	10	2.8166×10^{-7}	11952
1.5A	2	Taxonomic group + Types of organism exposure to pesticides	1	34718.1282	-17352.0641	0.7745	7	0.3788	11952
1.5B	2	Taxonomic group + Types of organism exposure to pesticides + Taxonomic group × Types of organism exposure to pesticides	1.5A	34719.8670	-17351.9335	0.2613	8	0.6093	11952
1.6A	2	Taxonomic group + Types of pesticide use history	1	34718.5007	-17352.2503	0.4020	7	0.5261	11952
1.6B	2	Taxonomic group + Types of pesticide use history + Taxonomic group × Types of pesticide use history	1.6A	34714.2056	-17349.1028	6.2950	8	0.0121	11952
1.7A	2	Taxonomic group + Types of experimental organisms	1	34718.2302	-17352.1151	0.6725	7	0.4122	11952
1.7B	2	Taxonomic group + Types of experimental organisms + Taxonomic group × Types of experimental organisms	1.7A	34719.4267	-17351.7133	0.8035	8	0.3700	11952
1.8A	2	Taxonomic group + Conflict of interest status	1	34714.9143	-17349.4571	5.9884	8	0.0501	11952
1.8B	2	Taxonomic group + Conflict of interest status + Taxonomic group × Conflict of interest status	1.8A	34718.2479	-17349.1240	0.6664	10	0.7166	11952
1.9A	2	Taxonomic group + Publication year	1	34717.9332	-17351.9666	0.9695	7	0.3248	11952
1.9B	2	Taxonomic group + Publication year + Taxonomic group × Publication year	1.9A	34716.0802	-17350.0401	3.8530	8	0.0497	11952
1.10A	1	Taxonomic group + Log_2 (added pesticide dosage over control)	1	33995.9227	-16990.9614	722.9800	7	3.0107×10^{-159}	11952
1.10B	1	Taxonomic group + Log_2 (added pesticide dosage over control) + Taxonomic group × Log_2 (added pesticide dosage over control)	1.10A	33621.6513	-16802.8257	376.2714	8	8.0678×10^{-84}	11952
2	1	Taxonomic group response category	1	34683.6586	-17329.8293	45.2441	12	4.1855×10^{-8}	11952
2.1A	2	Taxonomic group response category + Type of experimental study	2	34677.2271	-17325.6136	8.4315	13	0.0037	11952
2.1B	2	Taxonomic group response category + Type of experimental study + Taxonomic group response category × Type of experimental study	2.1A	34679.8705	-17319.9353	11.3566	20	0.1238	11952
2.2A	2	Taxonomic group response category + Climatic zone type	2	2301.7795	-1137.8898	1.1843	13	0.2765	790
2.2B	2	Taxonomic group response category + Climatic zone type + Taxonomic group response category × Climatic zone type	2.2A	2303.1455	-1135.5728	4.6340	16	0.2006	790
2.3A	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms	2	34686.6809	-17329.3404	0.9777	14	0.6133	11952
2.3B	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms + Taxonomic group response category × Types of pesticide classification by controlling target organisms	2.3A	34524.2511	-17234.1255	190.4298	28	4.9152×10^{-33}	11952
2.4A	2	Taxonomic group response category + Types of pesticide classification by source	2	34681.8729	-17326.9364	5.7857	14	0.0554	11952
2.4B	2	Taxonomic group response category + Types of pesticide classification by source + Taxonomic group response category × Types of pesticide classification by source	2.4A	34495.1159	-17219.5580	214.7569	28	5.2363×10^{-38}	11952
2.5A	2	Taxonomic group response category + Types of organism exposure to pesticides	2	34684.7686	-17329.3843	0.8900	13	0.3455	11952
2.5B	2	Taxonomic group response category + Types of organism exposure to pesticides + Taxonomic group response category × Types of organism exposure to pesticides	2.5A	34645.1855	-17302.5927	53.5831	20	2.8434×10^{-9}	11952
2.6A	2	Taxonomic group response category + Types of pesticide use history	2	34685.2453	-17329.6227	0.4132	13	0.5203	11952
2.6B	2	Taxonomic group response category + Types of pesticide use history + Taxonomic group response category × Types of pesticide use history	2.6A	34674.6530	-17317.3265	24.5923	20	0.0009	11952
2.7A	2	Taxonomic group response category + Types of experimental organisms	1	34684.9633	-17329.4816	0.6953	13	0.4044	11952
2.7B	2	Taxonomic group response category + Types of experimental organisms + Taxonomic group response category × Types of experimental organisms	2.7A	34650.4161	-17305.2080	48.5472	20	2.7829×10^{-8}	11952
2.8A	2	Taxonomic group response category + Conflict of interest status	1	34681.4884	-17326.7442	6.1701	14	0.0457	11952
2.8B	2	Taxonomic group response category + Conflict of interest status + Taxonomic group response category× Conflict of interest status	2.8A	34633.6865	-17290.8433	71.8019	26	1.4716×10^{-10}	11952
2.9A	2	Taxonomic group response category + Publication year	1	34333.5139	-17109.7570	155.3004	57	4.7413×10^{-14}	11952
2.9B	2	Taxonomic group response category + Publication year + Taxonomic group response category× Publication year	2.9A	33743.3143	-16655.6572	908.1996	216	2.8405×10^{-105}	11952
2.10A	1	Taxonomic group response category + Log_2 (added pesticide dosage over control)	2	33963.6623	-16968.8312	721.9963	13	4.9269×10^{-159}	11952
2.10B	1	Taxonomic group response category+ Log_2 (added pesticide dosage over control) + Taxonomic group response category × Log_2 (added pesticide dosage over control)	2.10A	32625.0671	-16292.5335	1352.5952	20	6.9671×10^{-288}	11952

Supplementary Table 1.5) The response variable in all models was the effect size of the responses of bacteria and fungi to the different comparison groups. Taxonomic group included bacteria (i.e., cocci, Bacillus and Spirillum) and fungi (i.e., Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina and Glomeromycota). Taxonomic group response category included the growth, reproduction and biomarkers of bacteria and the growth, reproduction and biomarkers of fungi. Absolute values of 'biomarker' values were taken. Data from laboratory conditions were removed from the models with climatic predictors. The model with suffix "A" is compared with base model (Model 1 or 2). The model with suffix "B" is compared with the nearest model with suffix "A". We used mixed effect model meta-analysis, where microorganism species (excluding non-level species groups), traits (growth, reproduction, biomarker and behavior), pesticide identity (active ingredients pesticide names) and study identity were included as random effects with phylogenetic relatedness as part of the correlation structure, in which 78 microorganism species were included in the correlation structure.

Model	Question	Predictor variables	Ref.	AIC	L—L	X^2	df	P	n
1	1	Taxonomic group	-	3796.4867	-1892.2434	NA	2	NA	884
1.1A	2	Taxonomic group + Type of experimental study	1	3791.1259	-1888.5629	7.3609	7	0.0067	884
1.1B	2	Taxonomic group + Type of experimental study + Taxonomic group × Type of experimental study	1.1A	3790.4659	-1887.2330	2.6599	8	0.1029	884
1.2A	2	Taxonomic group + Climatic zone type	1	37.6068	-12.8034	5.4213	6	0.0199	10
1.2B	2	Taxonomic group + Climatic zone type + Taxonomic group × Climatic zone type	1.2A	NA	NA	NA	NA	NA	10
1.3A	2	Taxonomic group + Types of pesticide classification by controlling target organisms	1	3797.7375	-1890.8688	2.7492	8	0.2529	884
1.3B	2	Taxonomic group + Types of pesticide classification by controlling target organisms + Taxonomic group × Types of pesticide classification by controlling target organisms	1.3A	3800.9328	-1890.4664	0.8048	10	0.6687	884
1.4A	2	Taxonomic group + Types of pesticide classification by source	1	3795.7444	-1889.8722	4.7423	8	0.0934	884
1.4B	2	Taxonomic group + Types of pesticide classification by source + Taxonomic group × Types of pesticide classification by source	1.4A	3792.4303	-1887.2152	5.3141	9	0.0212	884
1.5A	2	Taxonomic group + Types of organism exposure to pesticides	1	3791.3106	-1888.6553	7.1761	7	0.0074	884
1.5B	2	Taxonomic group + Types of organism exposure to pesticides + Taxonomic group × Types of organism exposure to pesticides	1.5A	3791.0970	-1887.5485	2.2136	8	0.1368	884
1.6A	2	Taxonomic group + Types of pesticide use history	1	3796.3664	-1891.1832	2.1203	7	0.1454	884
1.6B	2	Taxonomic group + Types of pesticide use history + Taxonomic group × Types of pesticide use history	1.6A	3797.0283	-1890.5142	1.3381	8	0.2474	884
1.7A	2	Taxonomic group + Types of experimental organisms	1	3797.6115	-1891.8057	0.8752	7	0.3495	884
1.7B	2	Taxonomic group + Types of experimental organisms + Taxonomic group × Types of experimental organisms	1.7A	3799.2089	-1891.6045	0.4026	8	0.5258	884
1.8A	2	Taxonomic group + Conflict of interest status	1	3798.1557	-1892.0779	0.3310	7	0.5651	884
1.8B	2	Taxonomic group + Conflict of interest status + Taxonomic group × Conflict of interest status	1.8A	3799.7605	-1891.8803	0.3952	8	0.5296	884
1.9A	2	Taxonomic group + Publication year	1	3798.1456	-1892.0728	0.3411	7	0.5592	884
1.9B	2	Taxonomic group + Publication year + Taxonomic group × Publication year	1.9A	3799.7311	-1891.8656	0.4145	8	0.5197	884
1.10A	1	Taxonomic group + Log_2 (added pesticide dosage over control)	1	3790.4610	-1888.2305	8.0257	7	0.0046	884
1.10B	1	Taxonomic group + Log_2 (added pesticide dosage over control) + Taxonomic group × Log_2 (added pesticide dosage over control)	1.10A	3676.0029	-1830.0015	116.4581	8	3.7726×10^{-27}	884
2	1	Taxonomic group response category	1	3790.0764	-1885.0382	14.4103	10	0.0061	884
2.1A	2	Taxonomic group response category + Type of experimental study	2	3784.4366	-1881.2183	7.6398	11	0.0057	884
2.1B	2	Taxonomic group response category + Type of experimental study + Taxonomic group response category × Type of experimental study	2.1A	3783.5664	-1879.7832	2.8701	12	0.0902	884
2.2A	2	Taxonomic group response category + Climatic zone type	2	37.6068	-12.8034	5.4213	6	0.0199	10
2.2B	2	Taxonomic group response category + Climatic zone type + Taxonomic group response category × Climatic zone type	2.2A	NA	NA	NA	NA	NA	10
2.3A	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms	2	3791.4528	-1883.7264	2.6236	12	0.2693	884
2.3B	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms + Taxonomic group response category × Types of pesticide classification by controlling target organisms	2.3A	3767.4513	-1862.7256	42.0015	21	3.2845×10^{-6}	884
2.4A	2	Taxonomic group response category + Types of pesticide classification by source	2	3789.4118	-1882.7059	4.6645	12	0.0971	884
2.4B	2	Taxonomic group response category + Types of pesticide classification by source + Taxonomic group response category × Types of pesticide classification by source	2.4A	3773.7070	-1872.8535	19.7049	14	5.2619E-05	884
2.5A	2	Taxonomic group response category + Types of organism exposure to pesticides	2	3784.7870	-1881.3935	7.2894	11	0.0069	884
2.5B	2	Taxonomic group response category + Types of organism exposure to pesticides + Taxonomic group response category × Types of organism exposure to pesticides	2.5A	3705.0819	-1839.5409	83.7051	13	6.6629×10^{-19}	884
2.6A	2	Taxonomic group response category + Types of pesticide use history	2	3789.9108	-1883.9554	2.1656	11	0.1411	884
2.6B	2	Taxonomic group response category + Types of pesticide use history + Taxonomic group response category × Types of pesticide use history	2.6A	3786.8757	-1877.4379	13.0351	16	0.0231	884
2.7A	2	Taxonomic group response category + Types of experimental organisms	1	3791.2337	-1884.6168	0.8427	11	0.3586	884
2.7B	2	Taxonomic group response category + Types of experimental organisms + Taxonomic group response category × Types of experimental organisms	2.7A	3765.8656	-1867.9328	33.3681	15	1.0042×10^{-6}	884
2.8A	2	Taxonomic group response category + Conflict of interest status	1	3791.7907	-1884.8954	0.2856	11	0.5930	884
2.8B	2	Taxonomic group response category + Conflict of interest status + Taxonomic group response category× Conflict of interest status	2.8A	3784.7117	-1877.3558	15.0791	15	0.0045	884
2.9A	2	Taxonomic group response category + Publication year	1	3791.6941	-1884.8471	0.3822	11	0.5364	884
2.9B	2	Taxonomic group response category + Publication year + Taxonomic group response category× Publication year	2.9A	3737.0198	-1852.5099	64.6744	16	1.3093×10^{-12}	884
2.10A	1	Taxonomic group response category + Log_2 (added pesticide dosage over control)	2	3784.4100	-1881.2050	7.6664	11	0.0056	884
2.10B	1	Taxonomic group response category+ Log_2 (added pesticide dosage over control) + Taxonomic group response category × Log_2 (added pesticide dosage over control)	2.10A	3491.5744	-1729.7872	302.8356	16	2.4604×10^{-63}	884

Supplementary Table 2 Results of publication bias assessment based on the residuals from the various models. The results include the test-statistics and P-values of the regression tests. Type of experimental study was divided into laboratory and field experiments. Climatic zone type was divided into tropical and temperate climatic zones. Types of pesticide classification by controlling target organisms included insecticides, herbicides and fungicides. Types of pesticide classification by source included mineral-based, biogenic and chemical synthetic pesticides. Types of organism exposure to pesticides included aquatic and terrestrial systems. Types of pesticide use history included old and new pesticides. Types of experimental organisms includes model and non-model species. Conflict of interest status was one binary variable (0=no conflict; 1=coflict). Publication year was one continuous variable. A publication bias test called Egger's test is used. Each test is two-sided and the original P value is reported with no multiple comparisons.

Supplementary Table 2.1) The response variable in all models was the effect size of the responses of animals, plants and microorganisms to the different comparison groups. Taxonomic group included animals, plants and microorganisms. Taxonomic group response category included animal growth, animal reproduction, animal behaviour, animal biomarker, plant growth, plant reproduction, plant biomarker, microorganism growth, microorganism reproduction, and microorganism biomarker. Absolute values of 'biomarker' values were taken. Data from laboratory conditions were removed from the models with climatic predictors. The model with suffix "A" is compared with base model (Model 1 or 2). The model with suffix "B" is compared with the nearest model with suffix "A". We used mixed effect model meta-analysis, where organisms (unique species name and unique non-level species groups), traits (growth, reproduction, biomarker and behavior), pesticide identity (active ingredients pesticide names) and study identity were included as random effects.

Model	Question	Predictor variables	n	Regression test value	*P*-value
1	1	Taxonomic group	20212	-24.8788	1.3427×10^{-134}
1.1A	2	Taxonomic group + Type of experimental study	20212	-25.0622	1.5686×10^{-136}
1.1B	2	Taxonomic group + Type of experimental study + Taxonomic group × Type of experimental study	20212	-24.7104	7.7734×10^{-133}
1.2A	2	Taxonomic group + Climatic zone type	2054	-12.9514	6.20277×10^{-37}
1.2B	2	Taxonomic group + Climatic zone type + Taxonomic group × Climatic zone type	2054	-11.7771	4.98621×10^{-31}
1.3A	2	Taxonomic group + Types of pesticide classification by controlling target organisms	20212	-23.5790	2.7566×10^{-121}
1.3B	2	Taxonomic group + Types of pesticide classification by controlling target organisms + Taxonomic group × Types of pesticide classification by controlling target organisms	20212	-19.7024	1.31096×10^{-85}
1.4A	2	Taxonomic group + Types of pesticide classification by source	20212	-21.5048	1.93×10^{-101}
1.4B	2	Taxonomic group + Types of pesticide classification by source + Taxonomic group × Types of pesticide classification by source	20212	-21.3801	2.64956×10^{-100}
1.5A	2	Taxonomic group + Types of organism exposure to pesticides	20212	-25.8641	3.8907×10^{-145}
1.5B	2	Taxonomic group + Types of organism exposure to pesticides + Taxonomic group × Types of organism exposure to pesticides	20212	-25.8502	5.5212×10^{-145}
1.6A	2	Taxonomic group + Types of pesticide use history	20212	-24.9609	1.8397×10^{-135}
1.6B	2	Taxonomic group + Types of pesticide use history + Taxonomic group × Types of pesticide use history	20212	-23.6351	7.5786×10^{-122}
1.7A	2	Taxonomic group + Types of experimental organisms	20212	-24.9651	1.66×10^{-135}
1.7B	2	Taxonomic group + Types of experimental organisms + Taxonomic group × Types of experimental organisms	20212	-24.7535	2.7562×10^{-133}
1.8A	2	Taxonomic group + Conflict of interest status	20212	-24.4311	6.1462×10^{-130}
1.8B	2	Taxonomic group + Conflict of interest status + Taxonomic group × Conflict of interest status	20212	-24.1961	1.5998×10^{-127}
1.9A	2	Taxonomic group + Publication year	20212	-25.1275	3.1896×10^{-137}
1.9B	2	Taxonomic group + Publication year + Taxonomic group × Publication year	20212	-25.2773	8.1752×10^{-139}
1.10A	1	Taxonomic group + Log_2 (added pesticide dosage over control)	20212	-18.7952	3.84206×10^{-78}
1.10B	1	Taxonomic group + Log_2 (added pesticide dosage over control) + Taxonomic group × Log_2 (added pesticide dosage over control)	20212	-18.9149	4.1549×10^{-79}
2	1	Taxonomic group response category	20212	-9.0802	1.1813×10^{-19}
2.1A	2	Taxonomic group response category + Type of experimental study	20212	-9.4822	2.7584×10^{-21}
2.1B	2	Taxonomic group response category + Type of experimental study + Taxonomic group response category × Type of experimental study	20212	-10.5367	6.832×10^{-26}
2.2A	2	Taxonomic group response category + Climatic zone type	2054	-10.3605	1.49335×10^{-24}
2.2B	2	Taxonomic group response category + Climatic zone type + Taxonomic group response category × Climatic zone type	2054	-9.1459	1.38272×10^{-19}
2.3A	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms	20212	-8.2884	1.21912×10^{-16}
2.3B	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms + Taxonomic group response category × Types of pesticide classification by controlling target organisms	20212	-7.5113	6.09737×10^{-14}
2.4A	2	Taxonomic group response category + Types of pesticide classification by source	20212	-7.7774	7.75694×10^{-15}
2.4B	2	Taxonomic group response category + Types of pesticide classification by source + Taxonomic group response category × Types of pesticide classification by source	20212	-7.1397	9.67158×10^{-13}
2.5A	2	Taxonomic group response category + Types of organism exposure to pesticides	20212	-8.1544	3.713×10^{-16}
2.5B	2	Taxonomic group response category + Types of organism exposure to pesticides + Taxonomic group response category × Types of organism exposure to pesticides	20212	-7.9573	1.85069×10^{-15}
2.6A	2	Taxonomic group response category + Types of pesticide use history	20212	-9.0078	2.28432×10^{-19}
2.6B	2	Taxonomic group response category + Types of pesticide use history + Taxonomic group response category × Types of pesticide use history	20212	-8.8796	7.26077×10^{-19}
2.7A	2	Taxonomic group response category + Types of experimental organisms	20212	-9.6624	4.86359×10^{-22}
2.7B	2	Taxonomic group response category + Types of experimental organisms + Taxonomic group response category × Types of experimental organisms	20212	-9.5267	1.80111×10^{-21}
2.8A	2	Taxonomic group response category + Conflict of interest status	20212	-9.2971	1.58611×10^{-20}
2.8B	2	Taxonomic group response category + Conflict of interest status + Taxonomic group response category × Conflict of interest status	20212	-10.0596	9.4783×10^{-24}
2.9A	2	Taxonomic group response category + Publication year	20212	-9.3001	1.54212×10^{-20}
2.9B	2	Taxonomic group response category + Publication year + Taxonomic group response category × Publication year	20212	-8.8756	7.52159×10^{-19}
2.10A	1	Taxonomic group response category + Log_2 (added pesticide dosage over control)	20212	-9.0565	1.46613×10^{-19}
2.10B	1	Taxonomic group response category+ Log_2 (added pesticide dosage over control) + Taxonomic group response category × Log_2 (added pesticide dosage over control)	20212	-7.5887	3.37035×10^{-14}

Supplementary Table 2.2) The response variable in all models was the effect size of the responses of invertebrates, vertebrates, seed plants, spore-producing plants, bacteria and fungus to the different comparison groups. Taxonomic group included invertebrates, vertebrates, seed plants, spore-producing plants, bacteria and fungus. Taxonomic group response category included invertebrate growth, invertebrate reproduction, invertebrate behaviour, invertebrate biomarker, vertebrate growth, vertebrate reproduction, vertebrate behaviour, vertebrate biomarker, seed plant growth, seed plant reproduction, seed plant biomarker, spore-producing plant growth, spore-producing plant reproduction, spore-producing plant biomarker, bacteria growth, bacteria reproduction, bacteria biomarker, fungus growth, fungus reproduction, and fungus biomarker. Absolute values of 'biomarker' values were taken. Data from laboratory conditions were removed from the models with climatic predictors. The model with suffix "A" is compared with base model (Model 1 or 2). The model with suffix "B" is compared with the nearest model with suffix "A". We used mixed effect model meta-analysis, where organisms (unique species name and unique non-level species groups), traits (growth, reproduction, biomarker and behavior), pesticide identity (active ingredients pesticide names) and study identity were included as random effects.

Model	Question	Predictor variables	n	Regression test value	*P*-value
1	1	Taxonomic group	20212	-26.9716	1.9566×10^{-157}
1.1A	2	Taxonomic group + Type of experimental study	20212	-26.6412	1.0244×10^{-153}
1.1B	2	Taxonomic group + Type of experimental study + Taxonomic group × Type of experimental study	20212	-26.4043	4.4821×10^{-151}
1.2A	2	Taxonomic group + Climatic zone type	2054	-10.8369	1.1940×10^{-26}
1.2B	2	Taxonomic group + Climatic zone type + Taxonomic group × Climatic zone type	2054	-9.6209	1.8378×10^{-21}
1.3A	2	Taxonomic group + Types of pesticide classification by controlling target organisms	20212	-25.1307	2.9531×10^{-137}
1.3B	2	Taxonomic group + Types of pesticide classification by controlling target organisms + Taxonomic group × Types of pesticide classification by controlling target organisms	20212	-19.5636	1.9132×10^{-84}
1.4A	2	Taxonomic group + Types of pesticide classification by source	20212	-22.8449	4.5888×10^{-114}
1.4B	2	Taxonomic group + Types of pesticide classification by source + Taxonomic group × Types of pesticide classification by source	20212	-22.2692	1.4910×10^{-108}
1.5A	2	Taxonomic group + Types of organism exposure to pesticides	20212	-27.0008	9.1424×10^{-158}
1.5B	2	Taxonomic group + Types of organism exposure to pesticides + Taxonomic group × Types of organism exposure to pesticides	20212	-27.0493	2.5714×10^{-158}
1.6A	2	Taxonomic group + Types of pesticide use history	20212	-26.6063	2.5203×10^{-153}
1.6B	2	Taxonomic group + Types of pesticide use history + Taxonomic group × Types of pesticide use history	20212	-25.7833	2.9441×10^{-144}
1.7A	2	Taxonomic group + Types of experimental organisms	20212	-26.1059	8.8456×10^{-148}
1.7B	2	Taxonomic group + Types of experimental organisms + Taxonomic group × Types of experimental organisms	20212	-26.6138	2.0750×10^{-153}
1.8A	2	Taxonomic group + Conflict of interest status	20212	-26.1897	1.0573×10^{-148}
1.8B	2	Taxonomic group + Conflict of interest status + Taxonomic group × Conflict of interest status	20212	-25.9687	2.8163×10^{-146}
1.9A	2	Taxonomic group + Publication year	20212	-26.6863	3.2000×10^{-154}
1.9B	2	Taxonomic group + Publication year + Taxonomic group × Publication year	20212	-26.1838	1.2295×10^{-148}
1.10A	1	Taxonomic group + Log_2 (added pesticide dosage over control)	20212	-19.2542	7.0643×10^{-82}
1.10B	1	Taxonomic group + Log_2 (added pesticide dosage over control) + Taxonomic group × Log_2 (added pesticide dosage over control)	20212	-21.8223	2.2914×10^{-104}
2	1	Taxonomic group response category	20212	-8.8354	1.0771×10^{-18}
2.1A	2	Taxonomic group response category + Type of experimental study	20212	-9.0414	1.6829×10^{-19}
2.1B	2	Taxonomic group response category + Type of experimental study + Taxonomic group response category × Type of experimental study	20212	-10.2039	2.1836×10^{-24}
2.2A	2	Taxonomic group response category + Climatic zone type	2054	-10.5198	3.0365×10^{-25}
2.2B	2	Taxonomic group response category + Climatic zone type + Taxonomic group response category × Climatic zone type	2054	-9.0773	2.5408×10^{-19}
2.3A	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms	20212	-8.0670	7.6031×10^{-16}
2.3B	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms + Taxonomic group response category × Types of pesticide classification by controlling target organisms	20212	-4.6421	3.4702×10^{-6}
2.4A	2	Taxonomic group response category + Types of pesticide classification by source	20212	-7.8362	4.8721×10^{-15}
2.4B	2	Taxonomic group response category + Types of pesticide classification by source + Taxonomic group response category × Types of pesticide classification by source	20212	-6.3093	2.8617×10^{-10}
2.5A	2	Taxonomic group response category + Types of organism exposure to pesticides	20212	-8.7010	3.5392×10^{-18}
2.5B	2	Taxonomic group response category + Types of organism exposure to pesticides + Taxonomic group response category × Types of organism exposure to pesticides	20212	-8.6007	8.4927×10^{-18}
2.6A	2	Taxonomic group response category + Types of pesticide use history	20212	-8.8648	8.2903×10^{-19}
2.6B	2	Taxonomic group response category + Types of pesticide use history + Taxonomic group response category × Types of pesticide use history	20212	-8.4738	2.5361×10^{-17}
2.7A	2	Taxonomic group response category + Types of experimental organisms	20212	-8.8582	8.7877×10^{-19}
2.7B	2	Taxonomic group response category + Types of experimental organisms + Taxonomic group response category × Types of experimental organisms	20212	-8.6119	7.7042×10^{-18}
2.8A	2	Taxonomic group response category + Conflict of interest status	20212	-8.7975	1.5089×10^{-18}
2.8B	2	Taxonomic group response category + Conflict of interest status + Taxonomic group response category × Conflict of interest status	20212	-8.9080	5.6257×10^{-19}
2.9A	2	Taxonomic group response category + Publication year	20212	-8.6805	4.2347×10^{-18}
2.9B	2	Taxonomic group response category + Publication year + Taxonomic group response category × Publication year	20212	-8.8740	7.6320×10^{-19}
2.10A	1	Taxonomic group response category + Log_2 (added pesticide dosage over control)	20212	-8.4528	3.0354×10^{-17}
2.10B	1	Taxonomic group response category+ Log_2 (added pesticide dosage over control) + Taxonomic group response category × Log_2 (added pesticide dosage over control)	20212	-6.1640	7.2263×10^{-10}

Supplementary Table 2.3) The response variable in all models was the effect size of the responses of dicotyledonous, monocotyledonous and algae plants to the different comparison groups. Taxonomic group included dicotyledonous, monocotyledonous and algae plants. Taxonomic group response category included dicotyledonous plant growth, dicotyledonous plant reproduction, dicotyledonous plant biomarker, monocotyledonous plant growth, monocotyledonous plant reproduction and monocotyledonous plant biomarker, algae plant growth, algae plant reproduction and algae plant biomarker. Absolute values of 'biomarker' values were taken. Data from laboratory conditions were removed from the models with climatic predictors. The model with suffix "A" is compared with base model (Model 1 or 2). The model with suffix "B" is compared with the nearest model with suffix "A". We used mixed effect model meta-analysis, where plant species (excluding non-level species groups), traits (growth, reproduction, biomarker and behavior), pesticide identity (active ingredients pesticide names) and study identity were included as random effects with phylogenetic relatedness as part of the correlation structure, in which 192 plant species were included in the correlation structure.

Model	Question	Predictor variables	n	Regression test value	*P*-value
1	1	Taxonomic group	4961	20.5404	4.7817×10^{-90}
1.1A	2	Taxonomic group + Type of experimental study	4961	19.6808	4.3409×10^{-83}
1.1B	2	Taxonomic group + Type of experimental study + Taxonomic group × Type of experimental study	4961	19.6200	1.3196×10^{-82}
1.2A	2	Taxonomic group + Climatic zone type	684	-3.6725	0.0003
1.2B	2	Taxonomic group + Climatic zone type + Taxonomic group × Climatic zone type	684	-4.0868	4.8942×10^{-5}
1.3A	2	Taxonomic group + Types of pesticide classification by controlling target organisms	4961	20.0976	1.9742×10^{-86}
1.3B	2	Taxonomic group + Types of pesticide classification by controlling target organisms + Taxonomic group × Types of pesticide classification by controlling target organisms	4961	15.5044	5.5803×10^{-53}
1.4A	2	Taxonomic group + Types of pesticide classification by source	4961	20.6899	2.7758×10^{-91}
1.4B	2	Taxonomic group + Types of pesticide classification by source + Taxonomic group × Types of pesticide classification by source	4961	20.7340	1.1952×10^{-91}
1.5A	2	Taxonomic group + Types of organism exposure to pesticides	4961	20.3803	9.8668×10^{-89}
1.5B	2	Taxonomic group + Types of organism exposure to pesticides + Taxonomic group × Types of organism exposure to pesticides	4961	20.8049	3.0733×10^{-92}
1.6A	2	Taxonomic group + Types of pesticide use history	4961	20.8322	1.8227×10^{-92}
1.6B	2	Taxonomic group + Types of pesticide use history + Taxonomic group × Types of pesticide use history	4961	19.2839	5.8241×10^{-80}
1.7A	2	Taxonomic group + Types of experimental organisms	4961	21.3384	9.9293×10^{-97}
1.7B	2	Taxonomic group + Types of experimental organisms + Taxonomic group × Types of experimental organisms	4961	21.1141	7.8756×10^{-95}
1.8A	2	Taxonomic group + Conflict of interest status	4961	20.8603	1.0612×10^{-92}
1.8B	2	Taxonomic group + Conflict of interest status + Taxonomic group × Conflict of interest status	4961	21.0862	1.3556×10^{-94}
1.9A	2	Taxonomic group + Publication year	4961	20.4623	2.0975×10^{-89}
1.9B	2	Taxonomic group + Publication year + Taxonomic group × Publication year	4961	18.0912	6.8163×10^{-71}
1.8A	1	Taxonomic group + Log_2 (added pesticide dosage over control)	4961	21.5415	1.8300×10^{-98}
1.8B	1	Taxonomic group + Log_2 (added pesticide dosage over control) + Taxonomic group × Log_2 (added pesticide dosage over control)	4961	18.8687	9.5272×10^{-77}
2	1	Taxonomic group response category	4961	12.2643	4.3695×10^{-34}
2.1A	2	Taxonomic group response category + Type of experimental study	4961	10.7933	7.3474×10^{-27}
2.1B	2	Taxonomic group response category + Type of experimental study + Taxonomic group response category × Type of experimental study	4961	10.4071	4.1654×10^{-25}
2.2A	2	Taxonomic group response category + Climatic zone type	684	-4.8914	1.2499×10^{-6}
2.2B	2	Taxonomic group response category + Climatic zone type + Taxonomic group response category × Climatic zone type	684	-4.6484	4.0167×10^{-6}
2.3A	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms	4961	13.6680	8.9321×10^{-42}
2.3B	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms + Taxonomic group response category × Types of pesticide classification by controlling target organisms	4961	6.2839	3.5855×10^{-10}
2.4A	2	Taxonomic group response category + Types of pesticide classification by source	4961	12.2031	9.0898×10^{-34}
2.4B	2	Taxonomic group response category + Types of pesticide classification by source + Taxonomic group response category × Types of pesticide classification by source	4961	12.2811	3.5759×10^{-34}
2.5A	2	Taxonomic group response category + Types of organism exposure to pesticides	4961	12.2132	8.0564×10^{-34}
2.5B	2	Taxonomic group response category + Types of organism exposure to pesticides + Taxonomic group response category × Types of organism exposure to pesticides	4961	15.2830	1.4615×10^{-51}
2.6A	2	Taxonomic group response category + Types of pesticide use history	4961	13.7328	3.7839×10^{-42}
2.6B	2	Taxonomic group response category + Types of pesticide use history + Taxonomic group response category × Types of pesticide use history	4961	8.3715	7.3227×10^{-17}
2.7A	2	Taxonomic group response category + Types of experimental organisms	4961	13.4241	2.2004×10^{-40}
2.7B	2	Taxonomic group response category + Types of experimental organisms + Taxonomic group response category × Types of experimental organisms	4961	13.3922	3.3315×10^{-40}
2.8A	2	Taxonomic group response category + Conflict of interest status	4961	12.1349	2.0450×10^{-33}
2.8B	2	Taxonomic group response category + Conflict of interest status + Taxonomic group response category× Conflict of interest status	4961	11.9718	1.3989×10^{-32}
2.9A	2	Taxonomic group response category + Publication year	4961	13.5354	5.1317×10^{-41}
2.9B	2	Taxonomic group response category + Publication year + Taxonomic group response category × Publication year	4961	12.9056	1.6714×10^{-37}
2.10A	1	Taxonomic group response category + Log_2 (added pesticide dosage over control)	4961	12.9075	1.6317×10^{-37}
2.10B	1	Taxonomic group response category+ Log_2 (added pesticide dosage over control) + Taxonomic group response category × Log_2 (added pesticide dosage over control)	4961	15.6728	4.5174×10^{-54}

Supplementary Table 2.4) The response variable in all models was the effect size of the responses of invertebrate and vertebrate animals to the different comparison groups. Taxonomic group included invertebrates (i.e., Protozoa, Coelenterata, Rotifera, Platyhelminthes, Nemathelminthes, annelids, molluscs, arthropods, echinoderms) and vertebrates (i.e., fish, amphibians, reptiles, birds and mammals). Taxonomic group response category included the growth, reproduction, behaviour and biomarkers of inverterbrates and the growth, reproduction, behaviour and biomarkers of verterbrates. Absolute values of 'biomarker' values were taken. Data from laboratory conditions were removed from the models with climatic predictors. The model with suffix "A" is compared with base model (Model 1 or 2). The model with suffix "B" is compared with the nearest model with suffix "A". We used mixed effect model meta-analysis, where animal species (excluding non-level species groups), traits (growth, reproduction, biomarker and behavior), pesticide identity (active ingredients pesticide names) and study identity were included as random effects with phylogenetic relatedness as part of the correlation structure, in which 553 animal species were included in the correlation structure.

Model	Question	Predictor variables	n	Regression test value	*P*-value
1	1	Taxonomic group	11952	-20.3441	1.7703×10^{-90}
1.1A	2	Taxonomic group + Type of experimental study	11952	-20.4145	4.4084×10^{-91}
1.1B	2	Taxonomic group + Type of experimental study + Taxonomic group × Type of experimental study	11952	-20.2331	1.5673×10^{-89}
1.2A	2	Taxonomic group + Climatic zone type	790	-5.1161	3.9214×10^{-7}
1.2B	2	Taxonomic group + Climatic zone type + Taxonomic group × Climatic zone type	790	-5.1910	2.6634×10^{-7}
1.3A	2	Taxonomic group + Types of pesticide classification by controlling target organisms	11952	-20.2487	1.1543×10^{-89}
1.3B	2	Taxonomic group + Types of pesticide classification by controlling target organisms + Taxonomic group × Types of pesticide classification by controlling target organisms	11952	-19.2763	1.4614×10^{-81}
1.4A	2	Taxonomic group + Types of pesticide classification by source	11952	-18.0478	7.3651×10^{-72}
1.4B	2	Taxonomic group + Types of pesticide classification by source + Taxonomic group × Types of pesticide classification by source	11952	-16.4713	2.7189×10^{-60}
1.5A	2	Taxonomic group + Types of organism exposure to pesticides	11952	-20.5441	3.3714×10^{-92}
1.5B	2	Taxonomic group + Types of organism exposure to pesticides + Taxonomic group × Types of organism exposure to pesticides	11952	-20.8754	4.4098×10^{-95}
1.6A	2	Taxonomic group + Types of pesticide use history	11952	-20.0258	8.9596×10^{-88}
1.6B	2	Taxonomic group + Types of pesticide use history + Taxonomic group × Types of pesticide use history	11952	-20.7882	2.5563×10^{-94}
1.7A	2	Taxonomic group + Types of experimental organisms	11952	-20.7809	2.9610×10^{-94}
1.7B	2	Taxonomic group + Types of experimental organisms + Taxonomic group × Types of experimental organisms	11952	-19.6754	7.6646×10^{-85}
1.8A	2	Taxonomic group + Conflict of interest status	11952	-19.1580	1.3335×10^{-80}
1.8B	2	Taxonomic group + Conflict of interest status + Taxonomic group × Conflict of interest status	11952	-19.4123	1.1315×10^{-82}
1.9A	2	Taxonomic group + Publication year	11952	-20.5289	4.5585×10^{-92}
1.9B	2	Taxonomic group + Publication year + Taxonomic group × Publication year	11952	-20.6492	4.1501×10^{-93}
1.8A	1	Taxonomic group + Log_2 (added pesticide dosage over control)	11952	-12.4615	2.0084×10^{-35}
1.8B	1	Taxonomic group + Log_2 (added pesticide dosage over control) + Taxonomic group × Log_2 (added pesticide dosage over control)	11952	-8.3234	9.4718×10^{-17}
2	1	Taxonomic group response category	11952	-11.6800	2.3886×10^{-31}
2.1A	2	Taxonomic group response category + Type of experimental study	11952	-11.8162	4.8503×10^{-32}
2.1B	2	Taxonomic group response category + Type of experimental study + Taxonomic group response category × Type of experimental study	11952	-12.6237	2.6627×10^{-36}
2.2A	2	Taxonomic group response category + Climatic zone type	790	-6.2491	6.7540×10^{-10}
2.2B	2	Taxonomic group response category + Climatic zone type + Taxonomic group response category × Climatic zone type	790	-6.5643	9.4785×10^{-11}
2.3A	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms	11952	-11.0545	2.8578×10^{-28}
2.3B	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms + Taxonomic group response category × Types of pesticide classification by controlling organisms	11952	-8.8148	1.3645×10^{-18}
2.4A	2	Taxonomic group response category + Types of pesticide classification by source	11952	-11.0193	4.2096×10^{-28}
2.4B	2	Taxonomic group response category + Types of pesticide classification by source + Taxonomic group response category × Types of pesticide classification by source	11952	-9.5311	1.8552×10^{-21}
2.5A	2	Taxonomic group response category + Types of organism exposure to pesticides	11952	-9.9092	4.6614×10^{-23}
2.5B	2	Taxonomic group response category + Types of organism exposure to pesticides + Taxonomic group response category × Types of organism exposure to pesticides	11952	-10.4974	1.1486×10^{-25}
2.6A	2	Taxonomic group response category + Types of pesticide use history	11952	-11.7511	1.0411×10^{-31}
2.6B	2	Taxonomic group response category + Types of pesticide use history + Taxonomic group response category × Types of pesticide use history	11952	-12.1309	1.1426×10^{-33}
2.7A	2	Taxonomic group response category + Types of experimental organisms	11952	-12.7027	9.8682×10^{-37}
2.7B	2	Taxonomic group response category + Types of experimental organisms + Taxonomic group response category × Types of experimental organisms	11952	-11.7767	7.7205×10^{-32}
2.8A	2	Taxonomic group response category + Conflict of interest status	11952	-11.2052	5.3637×10^{-29}
2.8B	2	Taxonomic group response category + Conflict of interest status + Taxonomic group response category × Conflict of interest status	11952	-11.2157	4.7702×10^{-29}
2.9A	2	Taxonomic group response category + Publication year	11952	-9.2979	1.6814×10^{-20}
2.9B	2	Taxonomic group response category + Publication year + Taxonomic group response category × Publication year	11952	-10.6998	1.3473×10^{-26}
2.10A	1	Taxonomic group response category + Log_2 (added pesticide dosage over control)	11952	-12.7906	3.2444×10^{-37}
2.10B	1	Taxonomic group response category+ Log_2 (added pesticide dosage over control) + Taxonomic group response category × Log_2 (added pesticide dosage over control)	11952	-6.3464	2.2841×10^{-10}

Supplementary Table 2.5) The response variable in all models was the effect size of the responses of bacteria and fungi to the different comparison groups. Taxonomic group included bacteria (i.e., cocci, Bacillus and Spirillum) and fungi (i.e., Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina and Glomeromycota). Taxonomic group response category included the growth, reproduction and biomarkers of bacteria and the growth, reproduction and biomarkers of fungi. Absolute values of 'biomarker' values were taken. Data from laboratory conditions were removed from the models with climatic predictors. The model with suffix "A" is compared with base model (Model 1 or 2). The model with suffix "B" is compared with the nearest model with suffix "A". We used mixed effect model meta-analysis, where microorganism species (excluding non-level species groups), traits (growth, reproduction, biomarker and behavior), pesticide identity (active ingredients pesticide names) and study identity were included as random effects with phylogenetic relatedness as part of the correlation structure, in which 78 microorganism species were included in the correlation structure.

Model	Question	Predictor variables	n	Regression test value	*P*-value
1	1	Taxonomic group	884	-6.9951	5.2405×10^{-12}
1.1A	2	Taxonomic group + Type of experimental study	884	-7.5320	1.2362×10^{-13}
1.1B	2	Taxonomic group + Type of experimental study + Taxonomic group × Type of experimental study	884	-8.2943	4.0601×10^{-16}
1.2A	2	Taxonomic group + Climatic zone type	10	-1.7516×10^{-10}	1.0000
1.2B	2	Taxonomic group + Climatic zone type + Taxonomic group × Climatic zone type	10	-1.7516×10^{-10}	1.0000
1.3A	2	Taxonomic group + Types of pesticide classification by controlling target organisms	884	-5.1802	2.7473×10^{-7}
1.3B	2	Taxonomic group + Types of pesticide classification by controlling target organisms + Taxonomic group × Types of pesticide classification by controlling target organisms	884	-5.2023	2.4492×10^{-7}
1.4A	2	Taxonomic group + Types of pesticide classification by source	884	-6.1490	1.1808×10^{-9}
1.4B	2	Taxonomic group + Types of pesticide classification by source + Taxonomic group × Types of pesticide classification by source	884	-6.8861	1.0887×10^{-11}
1.5A	2	Taxonomic group + Types of organism exposure to pesticides	884	-6.7029	3.6414×10^{-11}
1.5B	2	Taxonomic group + Types of organism exposure to pesticides + Taxonomic group × Types of organism exposure to pesticides	884	-3.4230	0.0006
1.6A	2	Taxonomic group + Types of pesticide use history	884	-6.4838	1.4877×10^{-10}
1.6B	2	Taxonomic group + Types of pesticide use history + Taxonomic group × Types of pesticide use history	884	-7.0873	2.7998×10^{-12}
1.7A	2	Taxonomic group + Types of experimental organisms	884	-6.3316	3.8601×10^{-10}
1.7B	2	Taxonomic group + Types of experimental organisms + Taxonomic group × Types of experimental organisms	884	-6.9542	6.9033×10^{-12}
1.8A	2	Taxonomic group + Conflict of interest status	884	-6.7474	2.7238×10^{-11}
1.8B	2	Taxonomic group + Conflict of interest status + Taxonomic group × Conflict of interest status	884	-6.7448	2.7707×10^{-11}
1.9A	2	Taxonomic group + Publication year	884	-7.0840	2.8633×10^{-12}
1.9B	2	Taxonomic group + Publication year + Taxonomic group × Publication year	884	-6.0409	2.2572×10^{-9}
1.8A	1	Taxonomic group + Log_2 (added pesticide dosage over control)	884	-7.0319	4.0842×10^{-12}
1.8B	1	Taxonomic group + Log_2 (added pesticide dosage over control) + Taxonomic group × Log_2 (added pesticide dosage over control)	884	-6.3734	2.9769×10^{-10}
2	1	Taxonomic group response category	884	-0.7893	0.4302
2.1A	2	Taxonomic group response category + Type of experimental study	884	4.6160	4.4931×10^{-6}
2.1B	2	Taxonomic group response category + Type of experimental study + Taxonomic group response category × Type of experimental study	884	3.9945	7.0230×10^{-5}
2.2A	2	Taxonomic group response category + Climatic zone type	10	-1.7516×10^{-10}	1.0000
2.2B	2	Taxonomic group response category + Climatic zone type + Taxonomic group response category × Climatic zone type	10	-1.7516×10^{-10}	1.0000
2.3A	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms	884	0.2641	0.7917
2.3B	2	Taxonomic group response category + Types of pesticide classification by controlling target organisms + Taxonomic group response category × Types of pesticide classification by controlling organisms	884	-7.5757	9.0192×10^{-14}
2.4A	2	Taxonomic group response category + Types of pesticide classification by source	884	-2.1638	0.0307
2.4B	2	Taxonomic group response category + Types of pesticide classification by source + Taxonomic group response category × Types of pesticide classification by source	884	-8.7838	8.1224×10^{-18}
2.5A	2	Taxonomic group response category + Types of organism exposure to pesticides	884	5.6095	2.7164×10^{-8}
2.5B	2	Taxonomic group response category + Types of organism exposure to pesticides + Taxonomic group response category × Types of organism exposure to pesticides	884	8.1784	9.9775×10^{-16}
2.6A	2	Taxonomic group response category + Types of pesticide use history	884	1.9700	0.0491
2.6B	2	Taxonomic group response category + Types of pesticide use history + Taxonomic group response category × Types of pesticide use history	884	4.3066	1.8442×10^{-5}
2.7A	2	Taxonomic group response category + Types of experimental organisms	884	0.1444	0.8852
2.7B	2	Taxonomic group response category + Types of experimental organisms + Taxonomic group response category × Types of experimental organisms	884	4.9331	9.6717×10^{-7}
2.8A	2	Taxonomic group response category + Conflict of interest status	884	-0.4955	0.6204
2.8B	2	Taxonomic group response category+ Conflict of interest status + Taxonomic group response category × Conflict of interest status	884	-0.7994	0.4243
2.9A	2	Taxonomic group response category + Publication year	884	-3.8455	0.0001
2.9B	2	Taxonomic group response category + Publication year + Taxonomic group response category × Publication year	884	-0.5801	0.5620
2.10A	1	Taxonomic group response category + Log_2 (added pesticide dosage over control)	884	1.5165	0.1297
2.10B	1	Taxonomic group response caeory+ Log_2 (added pesticide dosage over control) + Taxonomic group response category × Log_2 (added pesticide dosage over control)	884	0.5632	0.5735

Supplementary Table 3 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	Lower Bound of Confidence Interval (CI_{lb})	Upper Bound of Confidence Interval (CI_{ub})
Pesticide	Animal growth response	1505	253	-0.0912	-4.8958	1504	9.7930×10^{-7}	-0.1277	-0.0547
	Animal reproduction response	5476	687	-0.3953	-11.2506	5475	2.2994×10^{-29}	-0.4642	-0.3264
	Animal behaviour response	1329	233	-0.3127	-5.9881	1328	2.1227×10^{-9}	-0.4151	-0.2104
	Animal biomarker response	4470	371	0.3836	16.3737	4469	2.9496×10^{-60}	0.3377	0.4295
	Plant growth response	2577	200	-0.3383	-7.9559	2576	1.7788×10^{-15}	-0.4216	-0.2549
	Plant reproduction response	669	98	-0.3464	-3.5403	668	3.9963×10^{-4}	-0.5382	-0.1546
	Plant biomarker response	1811	129	0.3964	7.4328	1810	1.0630×10^{-13}	0.2919	0.5009
	Microorganism growth response	423	55	-0.5506	-6.1698	422	6.8372×10^{-10}	-0.7256	-0.3757
	Microorganism reproduction response	765	86	-0.7866	-6.4572	764	1.0667×10^{-10}	-1.0254	-0.5479
	Microorganism biomarker response	1187	68	0.5150	9.7175	1186	2.5400×10^{-22}	0.4111	0.6188
Insecticide	Animal growth response	794	143	-0.1232	-4.5645	793	5.0063×10^{-6}	-0.1760	-0.0703
	Animal reproduction response	4226	525	-0.4661	-10.9052	4225	1.0883×10^{-27}	-0.5499	-0.3823
	Animal behaviour response	935	171	-0.3111	-5.5648	934	2.6242×10^{-8}	-0.4207	-0.2016
	Animal biomarker response	2709	225	0.3823	12.9717	2708	1.7713×10^{-38}	0.3246	0.4401
	Plant growth response	625	57	-0.2100	-4.2212	624	2.4296×10^{-5}	-0.3074	-0.1125
	Plant reproduction response	294	40	-0.3078	-4.2923	293	1.7680×10^{-5}	-0.4483	-0.1672
	Plant biomarker response	422	34	0.4095	2.9061	421	0.0037	0.1333	0.6857
	Microorganism growth response	133	18	-0.4850	-4.1845	132	2.8583×10^{-5}	-0.7122	-0.2578
	Microorganism reproduction response	265	21	-0.4964	-3.9783	264	6.9413×10^{-5}	-0.7409	-0.2518
	Microorganism biomarker response	532	30	0.4443	7.4068	531	1.2937×10^{-13}	0.3267	0.5619
Fungicide	Animal growth response	172	43	-0.0790	-2.0913	171	0.0365	-0.1530	-0.0050
	Animal reproduction response	449	76	-0.2604	-1.9561	448	0.0505	-0.5213	0.0005
	Animal behaviour response	165	27	-0.4190	-3.0011	164	0.0027	-0.6926	-0.1453
	Animal biomarker response	684	54	0.4426	7.1489	683	8.7445×10^{-13}	0.3213	0.5640
	Plant growth response	347	41	-0.2391	-2.4145	346	0.0158	-0.4331	-0.0450
	Plant reproduction response	120	21	-0.3717	-0.9090	119	0.3634	-1.1730	0.4297
	Plant biomarker response	261	23	0.3222	4.7834	260	1.7240×10^{-6}	0.1902	0.4542
	Microorganism growth response	60	10	-0.8592	-2.1065	59	0.0352	-1.6586	-0.0598
	Microorganism reproduction response	236	32	-0.7484	-4.4441	235	8.8255×10^{-6}	-1.0785	-0.4183
	Microorganism biomarker response	106	5	0.5875	1.4578	105	0.1449	-0.2024	1.3774
Herbicide	Animal growth response	539	82	-0.0012	-0.0389	538	0.9690	-0.0605	0.0581
	Animal reproduction response	801	134	-0.2531	-4.5699	800	4.8795×10^{-6}	-0.3616	-0.1445
	Animal behaviour response	229	44	-0.3006	-3.3739	228	7.4101×10^{-4}	-0.4753	-0.1260
	Animal biomarker response	1077	107	0.3300	8.5950	1076	8.3252×10^{-18}	0.2547	0.4052
	Plant growth response	1605	113	-0.4819	-7.8437	1604	4.3731×10^{-15}	-0.6024	-0.3615
	Plant reproduction response	255	41	-0.4305	-4.4773	254	7.5598×10^{-6}	-0.6190	-0.2421
	Plant biomarker response	1128	76	0.4615	9.8149	1127	9.7092×10^{-23}	0.3694	0.5537
	Microorganism growth response	230	30	-0.5102	-5.4528	229	4.9578×10^{-8}	-0.6935	-0.3268
	Microorganism reproduction response	264	40	-1.0194	-3.6290	263	2.8454×10^{-4}	-1.5700	-0.4689
	Microorganism biomarker response	549	34	0.5662	6.8008	548	1.0402×10^{-11}	0.4030	0.7293

Supplementary Table 4 Results of the meta-regression analysis for the responses of taxonomic groups (invertebrates, vertebrates, seed plants, spore-producing plants, bacteria and fungus) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Pesticide category	Non-target organism	Non-target organism response category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Pesticide	Animal	Vertebrate growth response	831	148	-0.0664	-2.5864	830	0.0097	-0.1167	-0.0161
	Animal	Vertebrate reproduction response	765	141	-0.3188	-7.1010	764	1.2389×10^{-12}	-0.4067	-0.2308
	Animal	Vertebrate behaviour response	342	74	-0.2807	-3.8321	341	1.2705×10^{-4}	-0.4243	-0.1371
	Animal	Vertebrate biomarker response	3283	262	0.3992	14.9026	3282	3.1701×10^{-50}	0.3467	0.4518
	Animal	Invertebrate growth response	674	108	-0.1138	-4.9322	673	8.1321×10^{-7}	-0.1590	-0.0686
	Animal	Invertebrate reproduction response	4711	553	-0.4230	-11.0613	4710	1.9326×10^{-28}	-0.4979	-0.3480
	Animal	Invertebrate behaviour response	987	159	-0.3172	-5.2663	986	1.3919×10^{-7}	-0.4352	-0.1991
	Animal	Invertebrate biomarker response	1187	110	0.3492	8.8489	1186	8.8404×10^{-19}	0.2718	0.4265
	Plant	Spore-producing plant growth response	304	29	-0.6167	-5.2633	303	1.4151×10^{-7}	-0.8464	-0.3871
	Plant	Spore-producing plant reproduction response	248	33	-0.5531	-6.9772	247	3.0122×10^{-12}	-0.7085	-0.3977
	Plant	Spore-producing plant biomarker response	603	38	0.5915	4.4562	602	8.3440×10^{-6}	0.3313	0.8516
	Plant	Seed plant growth response	2273	171	-0.2867	-6.6711	2272	2.5390×10^{-11}	-0.3709	-0.2024
	Plant	Seed plant reproduction response	421	66	-0.2954	-2.3985	420	0.0165	-0.5369	-0.0540
	Plant	Seed plant biomarker response	1208	93	0.3607	9.3493	1207	8.8262×10^{-21}	0.2851	0.4363
	Microorganism	Bacteria growth response	295	43	-0.4942	-6.4013	294	1.5405×10^{-10}	-0.6455	-0.3429
	Microorganism	Bacteria reproduction response	202	27	-0.6599	-4.7104	201	2.4726×10^{-6}	-0.9345	-0.3853
	Microorganism	Bacteria biomarker response	1163	62	0.5246	9.8264	1162	8.6621×10^{-23}	0.4200	0.6292
	Microorganism	Fungus growth response	128	12	-0.7126	-2.4099	127	0.0160	-1.2921	-0.1330
	Microorganism	Fungus reproduction response	563	60	-0.7878	-5.5742	562	2.4869×10^{-8}	-1.0649	-0.5108
	Microorganism	Fungus biomarker response	24	6	0.5641	1.7281	23	0.0840	-0.0757	1.2039
Insecticide	Animal	Vertebrate growth response	329	68	-0.1099	-2.4026	328	0.0163	-0.1995	-0.0202
	Animal	Vertebrate reproduction response	363	69	-0.3869	-5.7154	362	1.0943×10^{-8}	-0.5196	-0.2543
	Animal	Vertebrate behaviour response	141	39	-0.2647	-1.8722	140	0.0612	-0.5419	0.0124
	Animal	Vertebrate biomarker response	1992	157	0.3778	12.0376	1991	2.2539×10^{-33}	0.3163	0.4393
	Animal	Invertebrate growth response	465	75	-0.1144	-3.9627	464	7.4093×10^{-5}	-0.1710	-0.0578
	Animal	Invertebrate reproduction response	3863	463	-0.4932	-11.1590	3862	6.4686×10^{-29}	-0.5798	-0.4066
	Animal	Invertebrate behaviour response	794	132	-0.3324	-5.7885	793	7.1030×10^{-9}	-0.4449	-0.2198
	Animal	Invertebrate biomarker response	717	69	0.3721	7.2851	716	3.2148×10^{-13}	0.2720	0.4721
	Plant	Spore-producing plant growth response	134	10	-0.4243	-2.3533	133	0.0186	-0.7777	-0.0709
	Plant	Spore-producing plant reproduction response	149	16	-0.6493	-4.3818	148	1.1768×10^{-5}	-0.9397	-0.3589
	Plant	Spore-producing plant biomarker response	211	12	0.6936	1.9730	210	0.0485	0.0046	1.3826
	Plant	Seed plant growth response	491	47	-0.1896	-3.5271	490	0.0004	-0.2949	-0.0842
	Plant	Seed plant reproduction response	145	24	-0.1031	-1.7071	144	0.0878	-0.2215	0.0153
	Plant	Seed plant biomarker response	211	23	0.2668	3.7252	210	1.9515×10^{-4}	0.1264	0.4071
	Microorganism	Bacteria growth response	133	18	-0.4850	-4.1845	132	2.8583×10^{-5}	-0.7122	-0.2578
	Microorganism	Bacteria reproduction response	110	11	-0.7535	-5.3728	109	7.7502×10^{-8}	-1.0284	-0.4786
	Microorganism	Bacteria biomarker response	529	29	0.4756	7.9590	528	1.7348×10^{-15}	0.3585	0.5928
	Microorganism	Fungus growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism	Fungus reproduction response	155	10	-0.1914	-1.5326	154	0.1254	-0.4361	0.0534
	Microorganism	Fungus biomarker response	3	1	0.0692	0.3743	2	0.7082	-0.2933	0.4318
Fungicide	Animal	Vertebrate growth response	113	28	-0.1123	-2.5316	112	0.0114	-0.1992	-0.0254
	Animal	Vertebrate reproduction response	92	14	-0.2028	-2.3207	91	0.0203	-0.3740	-0.0315
	Animal	Vertebrate behaviour response	98	14	-0.3351	-3.1079	97	0.0019	-0.5465	-0.1238
	Animal	Vertebrate biomarker response	526	39	0.4771	7.0446	525	1.8600×10^{-12}	0.3443	0.6098
	Animal	Invertebrate growth response	59	15	-0.0454	-0.6791	58	0.4970	-0.1763	0.0856
	Animal	Invertebrate reproduction response	357	62	-0.2064	-1.3753	356	0.1690	-0.5006	0.0878
	Animal	Invertebrate behaviour response	67	13	-0.3891	-2.2752	66	0.0229	-0.7244	-0.0539
	Animal	Invertebrate biomarker response	158	15	0.3691	2.8230	157	0.0048	0.1129	0.6254
	Plant	Spore-producing plant growth response	14	2	-0.1722	-0.3000	13	0.7642	-1.2975	0.9530
	Plant	Spore-producing plant reproduction response	5	2	-0.3711	-1.7228	4	0.0849	-0.7933	0.0511
	Plant	Spore-producing plant biomarker response	59	8	0.3391	2.9377	58	0.0033	0.1129	0.5653
	Plant	Seed plant growth response	333	39	-0.2422	-2.4417	332	0.0146	-0.4366	-0.0478
	Plant	Seed plant reproduction response	115	20	-0.4959	-1.2436	114	0.2136	-1.2775	0.2857
	Plant	Seed plant biomarker response	202	15	0.3121	3.8653	201	1.1094×10^{-4}	0.1539	0.4704
	Microorganism	Bacteria growth response	22	2	-0.7852	-2.1350	21	0.0328	-1.5060	-0.0644
	Microorganism	Bacteria reproduction response	19	2	-0.3055	-1.2391	18	0.2153	-0.7888	0.1778
	Microorganism	Bacteria biomarker response	94	2	0.2247	0.8536	93	0.3933	-0.2912	0.7405

	Microorganism	Fungus growth response	38	8	-0.8908	-1.6711	37	0.0947	-1.9357	0.1540
	Microorganism	Fungus reproduction response	217	30	-0.7581	-4.2428	216	2.2073×10^{-5}	-1.1083	-0.4079
	Microorganism	Fungus biomarker response	12	3	0.8474	1.2061	11	0.2278	-0.5296	2.2244
Herbicide	Animal	Vertebrate growth response	389	59	0.0312	0.9060	388	0.3650	-0.0363	0.0987
	Animal	Vertebrate reproduction response	310	63	-0.2532	-3.0628	309	0.0022	-0.4153	-0.0912
	Animal	Vertebrate behaviour response	103	23	-0.3388	-2.5130	102	0.0120	-0.6031	-0.0746
	Animal	Vertebrate biomarker response	765	74	0.3676	6.8501	764	7.3809×10^{-12}	0.2624	0.4728
	Animal	Invertebrate growth response	150	26	-0.1163	-2.9506	149	0.0032	-0.1936	-0.0391
	Animal	Invertebrate reproduction response	491	72	-0.2523	-3.7281	490	1.9291×10^{-4}	-0.3849	-0.1197
	Animal	Invertebrate behaviour response	126	21	-0.3064	-2.5161	125	0.0119	-0.5451	-0.0677
	Animal	Invertebrate biomarker response	312	33	0.2608	6.0467	311	1.4787×10^{-9}	0.1763	0.3454
	Plant	Spore-producing plant growth response	156	19	-0.7215	-4.7968	155	1.6123×10^{-6}	-1.0163	-0.4267
	Plant	Spore-producing plant reproduction response	94	18	-0.5334	-5.3678	93	7.9700×10^{-8}	-0.7281	-0.3386
	Plant	Spore-producing plant biomarker response	333	21	0.5935	7.3755	332	1.6373×10^{-13}	0.4358	0.7513
	Plant	Seed plant growth response	1449	94	-0.4259	-6.4630	1448	1.0265×10^{-10}	-0.5551	-0.2968
	Plant	Seed plant reproduction response	161	24	-0.4360	-2.7957	160	0.0052	-0.7417	-0.1303
	Plant	Seed plant biomarker response	795	56	0.4039	6.5070	794	7.6672×10^{-11}	0.2823	0.5256
	Microorganism	Bacteria growth response	140	24	-0.4525	-4.4468	139	8.7166×10^{-6}	-0.6520	-0.2531
	Microorganism	Bacteria reproduction response	73	15	-0.6326	-2.9482	72	0.0032	-1.0532	-0.2121
	Microorganism	Bacteria biomarker response	540	32	0.5693	6.3708	539	1.8800×10^{-10}	0.3941	0.7444
	Microorganism	Fungus growth response	90	6	-0.7542	-2.5977	89	0.0094	-1.3233	-0.1852
	Microorganism	Fungus reproduction response	191	26	-1.1543	-3.2657	190	0.0011	-1.8470	-0.4615
	Microorganism	Fungus biomarker response	9	2	0.4132	1.6835	8	0.0923	-0.0679	0.8943

Supplementary Table 5 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to chemical synthetic, mineral-based and biogenic pesticides, insecticides, fungicides or herbicides. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Chemical synthetic pesticide	Animal growth response	1361	233	-0.0934	-4.6514	1360	3.2970×10^{-6}	-0.1328	-0.0541
	Animal reproduction response	4524	602	-0.4193	-11.0471	4523	2.2644×10^{-28}	-0.4937	-0.3449
	Animal behaviour response	1147	210	-0.3244	-5.3347	1146	9.5684×10^{-8}	-0.4436	-0.2052
	Animal biomarker response	4185	354	0.3876	16.1199	4184	1.8498×10^{-58}	0.3405	0.4348
	Plant growth response	2440	193	-0.3572	-7.7410	2439	9.8640×10^{-15}	-0.4476	-0.2667
	Plant reproduction response	617	93	-0.3617	-3.3241	616	8.8719×10^{-4}	-0.5749	-0.1484
	Plant biomarker response	1795	128	0.4061	7.4424	1794	9.8843×10^{-14}	0.2991	0.5130
	Microorganism growth response	405	54	-0.5398	-6.0224	404	1.7186×10^{-9}	-0.7154	-0.3641
	Microorganism reproduction response	686	84	-0.7277	-5.5475	685	2.8976×10^{-8}	-0.9848	-0.4706
	Microorganism biomarker response	1100	66	0.4983	9.7816	1099	1.3506×10^{-22}	0.3984	0.5981
Mineral-based pesticide	Animal growth response	45	11	-0.0779	-0.9917	44	0.3214	-0.2318	0.0760
	Animal reproduction response	121	23	-0.5468	-1.1612	120	0.2456	-1.4698	0.3762
	Animal behaviour response	37	6	-0.6799	-2.4855	36	0.0129	-1.2160	-0.1438
	Animal biomarker response	105	6	0.4598	4.2831	104	1.8429×10^{-5}	0.2494	0.6703
	Plant growth response	70	10	-0.0644	-1.3450	69	0.1786	-0.1584	0.0295
	Plant reproduction response	35	8	-0.6757	-2.1366	34	0.0326	-1.2955	-0.0559
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	18	1	-0.9655	-1.9700	17	0.0488	-1.9260	-0.0049
	Microorganism reproduction response	52	8	-0.7738	-2.1964	51	0.0281	-1.4642	-0.0833
	Microorganism biomarker response	3	2	1.2927	1.3005	2	0.1934	-0.6556	3.2410
Biogenic pesticide	Animal growth response	99	20	-0.0295	-0.5771	98	0.5639	-0.1297	0.0707
	Animal reproduction response	831	185	-0.4005	-6.0033	830	1.9340×10^{-9}	-0.5313	-0.2698
	Animal behaviour response	145	31	-0.0955	-1.2549	144	0.2095	-0.2446	0.0536
	Animal biomarker response	180	19	0.3333	4.8015	179	1.5748×10^{-6}	0.1972	0.4693
	Plant growth response	67	11	-0.0245	-0.2593	66	0.7954	-0.2097	0.1607
	Plant reproduction response	17	7	-0.0899	-0.6616	16	0.5082	-0.3560	0.1763
	Plant biomarker response	16	4	0.1141	0.6536	15	0.5133	-0.2281	0.4564
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	27	5	-0.4590	-1.6337	26	0.1023	-1.0097	0.0917
	Microorganism biomarker response	84	1	0.1618	0.4436	83	0.6574	-0.5530	0.8766
Chemical synthetic insecticide	Animal growth response	702	130	-0.1338	-4.5127	701	6.4004×10^{-6}	-0.1918	-0.0757
	Animal reproduction response	3421	456	-0.5137	-10.5798	3420	3.6983×10^{-26}	-0.6088	-0.4185
	Animal behaviour response	799	153	-0.3302	-4.8948	798	9.8394×10^{-7}	-0.4624	-0.1980
	Animal biomarker response	2529	213	0.3915	12.7614	2528	2.6934×10^{-37}	0.3314	0.4517
	Plant growth response	566	52	-0.2436	-4.4614	565	8.1444×10^{-6}	-0.3506	-0.1366
	Plant reproduction response	279	38	-0.3305	-4.4326	278	9.3120×10^{-6}	-0.4766	-0.1844
	Plant biomarker response	407	33	0.4281	2.8765	406	0.0040	0.1364	0.7198
	Microorganism growth response	133	18	-0.4850	-4.1845	132	2.8583×10^{-5}	-0.7122	-0.2578
	Microorganism reproduction response	238	19	-0.5806	-4.4839	237	7.3293×10^{-6}	-0.8344	-0.3268
	Microorganism biomarker response	532	30	0.4443	7.4068	531	1.2937×10^{-13}	0.3267	0.5619
Mineral-based insecticide	Animal growth response	2	1	0.0310	0.1950	1	0.8454	-0.2806	0.3426
	Animal reproduction response	10	1	-1.0112	-3.0967	9	0.0020	-1.6512	-0.3712
	Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Biogenic insecticide	Animal growth response	90	19	-0.0318	-0.6126	89	0.5401	-0.1336	0.0699
	Animal reproduction response	795	177	-0.4300	-6.1312	794	8.7220×10^{-10}	-0.5674	-0.2925
	Animal behaviour response	136	30	-0.1013	-1.2867	135	0.1982	-0.2555	0.0530
	Animal biomarker response	180	19	0.3333	4.8015	179	1.5748×10^{-6}	0.1972	0.4693
	Plant growth response	59	9	0.0156	0.1478	58	0.8825	-0.1915	0.2227
	Plant reproduction response	15	6	-0.0273	-0.1647	14	0.8692	-0.3518	0.2972

	Plant biomarker response	15	3	0.1606	0.6733	14	0.5007	-0.3069	0.6281
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	27	5	-0.4590	-1.6337	26	0.1023	-1.0097	0.0917
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Chemical synthetic fungicide	Animal growth response	120	32	-0.0760	-1.8017	119	0.0716	-0.1587	0.0067
	Animal reproduction response	307	53	-0.2453	-1.6371	306	0.1016	-0.5390	0.0484
	Animal behaviour response	119	22	-0.3717	-2.4900	118	0.0128	-0.6643	-0.0791
	Animal biomarker response	579	48	0.4433	6.4565	578	1.0718×10^{-10}	0.3088	0.5779
	Plant growth response	275	38	-0.2543	-2.1874	274	0.0287	-0.4822	-0.0264
	Plant reproduction response	83	17	-0.3449	-0.6919	82	0.4890	-1.3219	0.6321
	Plant biomarker response	260	22	0.3381	4.8833	259	1.0431×10^{-6}	0.2024	0.4738
	Microorganism growth response	42	9	-0.8439	-1.7642	41	0.0777	-1.7814	0.0936
	Microorganism reproduction response	184	30	-0.5520	-2.9674	183	0.0030	-0.9167	-0.1874
	Microorganism biomarker response	19	3	0.2024	0.9385	18	0.3480	-0.2202	0.6250
Mineral-based fungicide	Animal growth response	43	10	-0.1130	-1.2512	42	0.2109	-0.2900	0.0640
	Animal reproduction response	111	22	-0.5072	-1.0018	110	0.3164	-1.4995	0.4851
	Animal behaviour response	37	6	-0.6799	-2.4855	36	0.0129	-1.2160	-0.1438
	Animal biomarker response	105	6	0.4598	4.2831	104	1.8429×10^{-5}	0.2494	0.6703
	Plant growth response	70	10	-0.0644	-1.3450	69	0.1786	-0.1584	0.0295
	Plant reproduction response	35	8	-0.6757	-2.1366	34	0.0326	-1.2955	-0.0559
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	18	1	-0.9655	-1.9700	17	0.0488	-1.9260	-0.0049
	Microorganism reproduction response	52	8	-0.7738	-2.1964	51	0.0281	-1.4642	-0.0833
	Microorganism biomarker response	3	2	1.2927	1.3005	2	0.1934	-0.6556	3.2410
Biogenic fungicide	Animal growth response	9	1	0.0435	0.1491	8	0.8815	-0.5289	0.6159
	Animal reproduction response	31	7	0.0970	0.6986	30	0.4848	-0.1751	0.3690
	Animal behaviour response	9	1	0.1029	0.3511	8	0.7255	-0.4717	0.6775
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	2	1	-0.0328	-0.1310	1	0.8958	-0.5240	0.4583
	Plant reproduction response	2	1	-0.2186	-0.9206	1	0.3572	-0.6841	0.2468
	Plant biomarker response	1	1	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	84	1	0.1618	0.4436	83	0.6574	-0.5530	0.8766
Chemical synthetic herbicide	Animal growth response	539	82	-0.0012	-0.0389	538	0.9689	-0.0605	0.0581
	Animal reproduction response	796	133	-0.2434	-4.3733	795	1.2239×10^{-5}	-0.3525	-0.1343
	Animal behaviour response	229	44	-0.3006	-3.3739	228	7.4101×10^{-4}	-0.4753	-0.1260
	Animal biomarker response	1077	107	0.3300	8.5950	1076	8.3252×10^{-18}	0.2547	0.4052
	Plant growth response	1599	113	-0.4796	-7.7747	1598	7.5620×10^{-15}	-0.6005	-0.3587
	Plant reproduction response	255	41	-0.4305	-4.4773	254	7.5598×10^{-6}	-0.6190	-0.2421
	Plant biomarker response	1128	76	0.4615	9.8149	1127	9.7092×10^{-23}	0.3694	0.5537
	Microorganism growth response	230	30	-0.5102	-5.4528	229	4.9578×10^{-8}	-0.6935	-0.3268
	Microorganism reproduction response	264	40	-1.0194	-3.6290	263	2.8454×10^{-4}	-1.5700	-0.4689
	Microorganism biomarker response	549	34	0.5662	6.8008	548	1.0402×10^{-11}	0.4030	0.7293
Mineral-based herbicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
	Animal reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Biogenic herbicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
	Animal reproduction response	5	1	-0.7848	-3.6948	4	2.2007×10^{-4}	-1.2011	-0.3685
	Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	6	1	-0.5551	-1.4176	5	0.1563	-1.3227	0.2124
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA

Supplementary Table 6 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides in laboratory and field experiments. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Experiment type	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Laboratory experiment	Pesticide	Animal growth response	1382	227	-0.0879	-4.5791	1381	4.6699×10^{-6}	-0.1255	-0.0503
		Animal reproduction response	4518	550	-0.3865	-10.4768	4517	1.1042×10^{-25}	-0.4588	-0.3142
		Animal behaviour response	1219	212	-0.2978	-5.5171	1218	3.4462×10^{-8}	-0.4036	-0.1920
		Animal biomarker response	4439	367	0.3853	16.3516	4438	4.2371×10^{-60}	0.3391	0.4315
		Plant growth response	2220	166	-0.3662	-7.7158	2219	1.2025×10^{-14}	-0.4592	-0.2731
		Plant reproduction response	528	68	-0.5044	-4.1014	527	4.1073×10^{-5}	-0.7454	-0.2633
		Plant biomarker response	1622	108	0.4481	7.3995	1621	1.3669×10^{-13}	0.3294	0.5668
		Microorganism growth response	407	53	-0.5830	-6.2342	406	4.5406×10^{-10}	-0.7662	-0.3997
		Microorganism reproduction response	663	66	-0.7821	-5.5071	662	3.6478×10^{-8}	-1.0605	-0.5038
		Microorganism biomarker response	1159	67	0.5184	9.4959	1158	2.1839×10^{-21}	0.4114	0.6253
	Insecticide	Animal growth response	742	130	-0.1163	-4.1737	741	2.9963×10^{-5}	-0.1709	-0.0617
		Animal reproduction response	3459	423	-0.4427	-10.1305	3458	4.0444×10^{-24}	-0.5284	-0.3571
		Animal behaviour response	863	156	-0.2950	-5.1444	862	2.6844×10^{-7}	-0.4074	-0.1826
		Animal biomarker response	2694	223	0.3829	13.0764	2693	4.4894×10^{-39}	0.3255	0.4402
		Plant growth response	573	52	-0.2165	-4.1400	572	3.4727×10^{-5}	-0.3190	-0.1140
		Plant reproduction response	257	29	-0.4261	-4.6396	256	3.4902×10^{-6}	-0.6061	-0.2461
		Plant biomarker response	390	28	0.4784	2.9014	389	0.0037	0.1552	0.8015
		Microorganism growth response	125	17	-0.5257	-4.1069	124	4.0106×10^{-5}	-0.7766	-0.2748
		Microorganism reproduction response	257	18	-0.5367	-3.9292	256	8.5224×10^{-5}	-0.8044	-0.2690
		Microorganism biomarker response	516	29	0.4536	7.3162	515	2.5515×10^{-13}	0.3321	0.5751
	Fungicide	Animal growth response	159	39	-0.0563	-1.4950	158	0.1349	-0.1300	0.0175
		Animal reproduction response	388	61	-0.3408	-2.2246	387	0.0261	-0.6410	-0.0405
		Animal behaviour response	160	25	-0.4536	-2.9611	159	0.0031	-0.7538	-0.1534
		Animal biomarker response	673	53	0.4525	7.2500	672	4.1690×10^{-13}	0.3302	0.5749
		Plant growth response	275	34	-0.2467	-2.2019	274	0.0277	-0.4664	-0.0271
		Plant reproduction response	80	13	-0.5929	-1.3649	79	0.1723	-1.4443	0.2585
		Plant biomarker response	196	18	0.3638	4.7285	195	2.2621×10^{-6}	0.2130	0.5147
		Microorganism growth response	58	9	-0.9609	-2.1838	57	0.0290	-1.8233	-0.0985
		Microorganism reproduction response	219	24	-0.8566	-4.0801	218	4.5012×10^{-5}	-1.2680	-0.4451
		Microorganism biomarker response	106	5	0.5875	1.4578	105	0.1449	-0.2024	1.3774
	Herbicide	Animal growth response	481	72	-0.0178	-0.5591	480	0.5761	-0.0803	0.0447
		Animal reproduction response	671	109	-0.2987	-5.3730	670	7.7456×10^{-8}	-0.4077	-0.1897
		Animal behaviour response	196	40	-0.2857	-3.0306	195	0.0024	-0.4705	-0.1009
		Animal biomarker response	1072	106	0.3323	8.5640	1071	1.0899×10^{-17}	0.2562	0.4083
		Plant growth response	1372	91	-0.5420	-7.7774	1371	7.4005×10^{-15}	-0.6785	-0.4054
		Plant reproduction response	191	30	-0.5411	-4.5359	190	5.7356×10^{-6}	-0.7749	-0.3073
		Plant biomarker response	1036	66	0.4965	11.1350	1035	8.4781×10^{-29}	0.4091	0.5839
		Microorganism growth response	224	29	-0.5321	-5.5863	223	2.3197×10^{-8}	-0.7187	-0.3454
		Microorganism reproduction response	187	30	-0.8412	-2.5670	186	0.0103	-1.4835	-0.1989
		Microorganism biomarker response	537	33	0.5602	6.5362	536	6.3096×10^{-11}	0.3922	0.7282
Field experiment	Pesticide	Animal growth response	123	26	-0.1391	-1.7980	122	0.0722	-0.2908	0.0125
		Animal reproduction response	958	149	-0.4006	-5.4809	957	4.2316×10^{-8}	-0.5438	-0.2573
		Animal behaviour response	110	21	-0.3749	-3.3472	109	0.0008	-0.5945	-0.1554
		Animal biomarker response	31	4	0.2874	1.5406	30	0.1234	-0.0782	0.6530
		Plant growth response	357	37	-0.1843	-3.6611	356	0.0003	-0.2829	-0.0856
		Plant reproduction response	141	32	-0.0490	-0.8489	140	0.3960	-0.1621	0.0641
		Plant biomarker response	189	21	0.2183	2.8649	188	0.0042	0.0690	0.3677
		Microorganism growth response	16	2	0.0231	0.1063	15	0.9154	-0.4025	0.4486
		Microorganism reproduction response	102	21	-0.2836	-3.9957	101	6.4502×10^{-5}	-0.4226	-0.1445
		Microorganism biomarker response	28	1	0.2723	0.7380	27	0.4605	-0.4509	0.9954
	Insecticide	Animal growth response	52	13	-0.2309	-2.1171	51	0.0342	-0.4446	-0.0171
		Animal reproduction response	767	113	-0.4996	-5.9738	766	2.3178×10^{-9}	-0.6636	-0.3357
		Animal behaviour response	72	15	-0.4499	-2.9876	71	0.0028	-0.7451	-0.1548
		Animal biomarker response	15	2	0.4519	1.2300	14	0.2187	-0.2682	1.1719
		Plant growth response	52	6	-0.1633	-1.2163	51	0.2239	-0.4264	0.0998

	Plant reproduction response	37	11	-0.0630	-0.7852	36	0.4323	-0.2204	0.0943
	Plant biomarker response	32	6	0.0898	0.5358	31	0.5921	-0.2386	0.4182
	Microorganism growth response	8	1	0.0680	0.1767	7	0.8597	-0.6857	0.8216
	Microorganism reproduction response	8	4	-0.1570	-0.6631	7	0.5073	-0.6211	0.3071
	Microorganism biomarker response	16	1	0.1921	0.5141	15	0.6072	-0.5403	0.9245
Fungicide	Animal growth response	13	4	-0.4705	-1.7142	12	0.0865	-1.0085	0.0675
	Animal reproduction response	61	15	-0.2333	-1.3935	60	0.1635	-0.5614	0.0948
	Animal behaviour response	5	2	-0.1049	-0.5996	4	0.5488	-0.4477	0.2380
	Animal biomarker response	11	1	0.0803	0.4574	10	0.6474	-0.2637	0.4242
	Plant growth response	72	8	-0.1405	-1.2142	71	0.2247	-0.3673	0.0863
	Plant reproduction response	40	9	0.0503	0.4286	39	0.6682	-0.1799	0.2805
	Plant biomarker response	65	5	0.1296	0.8016	64	0.4228	-0.1872	0.4463
	Microorganism growth response	2	1	0.0158	0.0594	1	0.9526	-0.5059	0.5375
	Microorganism reproduction response	17	8	-0.2793	-2.6005	16	0.0093	-0.4898	-0.0688
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Herbicide	Animal growth response	58	10	-0.0029	-0.0680	57	0.9457	-0.0853	0.0796
	Animal reproduction response	130	26	0.0333	0.2634	129	0.7923	-0.2144	0.2810
	Animal behaviour response	33	4	-0.1661	-1.0081	32	0.3134	-0.4891	0.1568
	Animal biomarker response	5	1	0.1364	0.5617	4	0.5743	-0.3396	0.6124
	Plant growth response	233	24	-0.2021	-3.3134	232	0.0009	-0.3216	-0.0825
	Plant reproduction response	64	12	-0.1274	-1.0771	63	0.2814	-0.3592	0.1044
	Plant biomarker response	92	10	0.2857	2.4344	91	0.0149	0.0557	0.5157
	Microorganism growth response	6	1	-0.0031	-0.0079	5	0.9937	-0.7706	0.7644
	Microorganism reproduction response	77	10	-0.2919	-2.5161	76	0.0119	-0.5193	-0.0645
	Microorganism biomarker response	12	1	0.3792	0.9933	11	0.3205	-0.3690	1.1273

Supplementary Table 7 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides in temperate and tropical experiments. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Data from laboratory conditions were removed from the models with climatic predictors. Each test is two-sided and the original P value is reported with no multiple comparisons.

Climatic zone of experiments	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Temperate experiment	Pesticide	Animal growth response	121	25	-0.1462	-1.7944	120	0.0727	-0.3059	0.0135
		Animal reproduction response	826	133	-0.3896	-5.0981	825	3.4307×10^{-7}	-0.5394	-0.2398
		Animal behaviour response	78	17	-0.3648	-2.7175	77	0.0066	-0.6279	-0.1017
		Animal biomarker response	31	4	0.2874	1.5406	30	0.1234	-0.0782	0.6530
		Plant growth response	295	34	-0.2019	-3.8902	294	0.0001	-0.3036	-0.1002
		Plant reproduction response	128	29	-0.0547	-0.8951	127	0.3708	-0.1746	0.0651
		Plant biomarker response	142	18	0.2015	2.4526	141	0.0142	0.0405	0.3626
		Microorganism growth response	16	2	0.0231	0.1063	15	0.9154	-0.4025	0.4486
		Microorganism reproduction response	87	18	-0.2792	-3.6753	86	0.0002	-0.4281	-0.1303
		Microorganism biomarker response	28	1	0.2723	0.7380	27	0.4605	-0.4509	0.9954
	Insecticide	Animal growth response	50	12	-0.2521	-2.1662	49	0.0303	-0.4802	-0.0240
		Animal reproduction response	655	100	-0.4833	-5.5334	654	3.1401×10^{-8}	-0.6545	-0.3121
		Animal behaviour response	67	13	-0.4501	-2.6061	66	0.0092	-0.7885	-0.1116
		Animal biomarker response	15	2	0.4519	1.2300	14	0.2187	-0.2682	1.1719
		Plant growth response	52	6	-0.1633	-1.2163	51	0.2239	-0.4264	0.0998
		Plant reproduction response	30	9	-0.0833	-0.9894	29	0.3225	-0.2482	0.0817
		Plant biomarker response	21	5	0.0951	0.5443	20	0.5862	-0.2474	0.4376
		Microorganism growth response	8	1	0.0680	0.1767	7	0.8597	-0.6857	0.8216
		Microorganism reproduction response	5	3	0.0778	0.3604	4	0.7185	-0.3454	0.5011
		Microorganism biomarker response	16	1	0.1921	0.5141	15	0.6072	-0.5403	0.9245
	Fungicide	Animal growth response	13	4	-0.4705	-1.7142	12	0.0865	-1.0085	0.0675
		Animal reproduction response	61	15	-0.2333	-1.3935	60	0.1635	-0.5614	0.0948
		Animal behaviour response	5	2	-0.1049	-0.5996	4	0.5488	-0.4477	0.2380
		Animal biomarker response	11	1	0.0803	0.4574	10	0.6474	-0.2637	0.4242
		Plant growth response	72	8	-0.1405	-1.2142	71	0.2247	-0.3673	0.0863
		Plant reproduction response	40	9	0.0503	0.4286	39	0.6682	-0.1799	0.2805
		Plant biomarker response	65	5	0.1296	0.8016	64	0.4228	-0.1872	0.4463
		Microorganism growth response	2	1	0.0158	0.0594	1	0.9526	-0.5059	0.5375
		Microorganism reproduction response	17	8	-0.2793	-2.6005	16	0.0093	-0.4898	-0.0688
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Herbicide	Animal growth response	58	10	-0.0029	-0.0680	57	0.9457	-0.0853	0.0796
		Animal reproduction response	110	23	0.0204	0.1442	109	0.8853	-0.2572	0.2981
		Animal behaviour response	6	2	-0.0569	-0.4084	5	0.6830	-0.3302	0.2164
		Animal biomarker response	5	1	0.1364	0.5617	4	0.5743	-0.3396	0.6124
		Plant growth response	171	21	-0.2303	-3.6096	170	0.0003	-0.3554	-0.1053
		Plant reproduction response	58	11	-0.1242	-0.9846	57	0.3248	-0.3713	0.1230
		Plant biomarker response	56	8	0.2769	2.2629	55	0.0236	0.0371	0.5167
		Microorganism growth response	6	1	-0.0031	-0.0079	5	0.9937	-0.7706	0.7644
		Microorganism reproduction response	65	8	-0.3271	-2.4566	64	0.0140	-0.5881	-0.0661
		Microorganism biomarker response	12	1	0.3792	0.9933	11	0.3205	-0.3690	1.1273
	Pesticide	Animal growth response	2	1	-0.0078	-0.0254	1	0.9798	-0.6129	0.5972
		Animal reproduction response	132	16	-0.4741	-2.1839	131	0.0290	-0.8995	-0.0486
		Animal behaviour response	32	4	-0.4970	-3.5724	31	0.0004	-0.7696	-0.2243
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	62	3	0.0960	0.4632	61	0.6432	-0.3101	0.5021
		Plant reproduction response	13	3	0.0468	0.2116	12	0.8324	-0.3863	0.4799
		Plant biomarker response	47	3	0.3378	1.2125	46	0.2253	-0.2083	0.8839
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	17	4	-0.3192	-1.3348	14	0.1819	-0.7879	0.1495
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA

Tropical experiment	Insecticide	Animal growth response	2	1	-0.0078	-0.0254	1	0.9798	-0.6129	0.5972
		Animal reproduction response	112	13	-0.5911	-2.3106	111	0.0209	-1.0924	-0.0897
		Animal behaviour response	5	2	-0.5404	-3.9285	4	8.5490×10^{-5}	-0.8100	-0.2708
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	7	2	0.1415	0.5287	6	0.5970	-0.3831	0.6661
		Plant biomarker response	11	1	0.0597	0.1577	10	0.8747	-0.6825	0.8019
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	3	1	-0.7718	-2.1467	2	0.0318	-1.4764	-0.0671
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Fungicide	Animal growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal behaviour response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Herbicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	20	3	0.0381	0.2811	19	0.7786	-0.2276	0.3039
		Animal behaviour response	27	2	-0.4154	-1.5024	26	0.1330	-0.9572	0.1265
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	62	3	0.0960	0.4632	61	0.6432	-0.3101	0.5021
		Plant reproduction response	6	1	-0.1560	-0.3985	5	0.6903	-0.9236	0.6115
		Plant biomarker response	36	2	0.4781	1.1206	35	0.2625	-0.3581	1.3143
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	12	2	-0.0836	-0.3039	11	0.7612	-0.6226	0.4555
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA

Supplementary Table 8 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides in aquatic and terrestrial systems. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Types of organism exposure to pesticides	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb})	CI_{ub}
Terrestrial system	Pesticide	Animal growth response	589	130	-0.1152	-4.1515	588	3.3037×10^{-5}	-0.1696	-0.0608
		Animal reproduction response	4198	504	-0.4129	-10.4323	4197	1.7663×10^{-25}	-0.4905	-0.3354
		Animal behaviour response	942	165	-0.2923	-5.3200	941	1.0378×10-7	-0.4000	-0.1846
		Animal biomarker response	1746	180	0.3689	11.6544	1745	2.1799×10^{-31}	0.3068	0.4309
		Plant growth response	1951	148	-0.2529	-5.7070	1950	1.1499×10^{-8}	-0.3398	-0.1661
		Plant reproduction response	407	63	-0.2858	-2.2121	406	0.0270	-0.5390	-0.0326
		Plant biomarker response	999	79	0.3574	8.9689	998	2.9961×10^{-19}	0.2793	0.4356
		Microorganism growth response	122	11	-0.7794	-2.3730	121	0.0176	-1.4231	-0.1357
		Microorganism reproduction response	562	59	-0.6229	-5.3670	561	8.0048×10^{-8}	-0.8504	-0.3954
		Microorganism biomarker response	5	1	0.2476	0.7258	4	0.4680	-0.4209	0.9160
	Insecticide	Animal growth response	399	91	-0.1240	-3.4206	398	0.0006	-0.1951	-0.0530
		Animal reproduction response	3480	420	-0.4772	-10.5288	3479	6.3670×10^{-26}	-0.5660	-0.3883
		Animal behaviour response	766	137	-0.2826	-5.5039	765	3.7138×10^{-8}	-0.3832	-0.1820
		Animal biomarker response	972	113	0.3697	9.3496	971	8.7939×10^{-21}	0.2922	0.4472
		Plant growth response	487	46	-0.1926	-3.5573	486	0.0004	-0.2988	-0.0865
		Plant reproduction response	145	24	-0.1031	-1.7071	144	0.0878	-0.2215	0.0153
		Plant biomarker response	207	22	0.2681	3.6212	206	0.0003	0.1230	0.4132
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	158	11	-0.2317	-1.9119	157	0.0559	-0.4692	0.0058
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Fungicide	Animal growth response	74	22	-0.0349	-0.6911	73	0.4895	-0.1338	0.0640
		Animal reproduction response	327	59	-0.2221	-1.4432	326	0.1490	-0.5236	0.0795
		Animal behaviour response	63	13	-0.4135	-2.3947	62	0.0166	-0.7520	-0.0751
		Animal biomarker response	436	32	0.4243	5.4855	435	4.1241×10^{-8}	0.2727	0.5760
		Plant growth response	329	38	-0.2470	-2.4208	328	0.0155	-0.4471	-0.0470
		Plant reproduction response	114	19	-0.5149	-1.2451	113	0.2131	-1.3254	0.2956
		Plant biomarker response	187	14	0.3166	3.7855	186	0.0002	0.1527	0.4805
		Microorganism growth response	38	8	-0.8908	-1.6711	37	0.0947	-1.9357	0.1540
		Microorganism reproduction response	209	27	-0.5758	-3.6010	208	0.0003	-0.8892	-0.2624
		Microorganism biomarker response	5	1	0.2476	0.7258	4	0.4679	-0.4209	0.9160
	Herbicide	Animal growth response	116	26	-0.0413	-1.1130	115	0.2657	-0.1141	0.0315
		Animal reproduction response	391	65	-0.2531	-3.5151	390	0.0004	-0.3941	-0.1120
		Animal behaviour response	113	20	-0.4122	-3.4443	112	0.0006	-0.6468	-0.1776
		Animal biomarker response	338	41	0.2828	5.3999	337	6.6664×10^{-8}	0.1802	0.3855
		Plant growth response	1135	73	-0.3759	-4.9657	1134	6.8462×10^{-7}	-0.5243	-0.2275
		Plant reproduction response	148	21	-0.3983	-2.2818	147	0.0225	-0.7404	-0.0562
		Plant biomarker response	605	44	0.4159	7.5794	604	3.4711×10^{-14}	0.3084	0.5234
		Microorganism growth response	84	5	-0.9053	-2.7984	83	0.0051	-1.5394	-0.2712
		Microorganism reproduction response	195	27	-0.9975	-3.6641	194	0.0002	-1.5311	-0.4639
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Pesticide	Animal growth response	916	123	-0.0545	-2.5661	915	0.0103	-0.0962	-0.0129
		Animal reproduction response	1278	189	-0.4006	-7.5913	1277	3.1663×10^{-14}	-0.5040	-0.2972
		Animal behaviour response	387	68	-0.3497	-3.4248	386	0.0006	-0.5498	-0.1495
		Animal biomarker response	2724	191	0.4101	13.9396	2723	3.6379×10^{-44}	0.3524	0.4678
		Plant growth response	626	54	-0.5507	-7.0563	625	1.7105×10^{-12}	-0.7037	-0.3977
		Plant reproduction response	262	35	-0.5586	-7.3457	261	2.0471×10^{-13}	-0.7077	-0.4096
		Plant biomarker response	812	51	0.5442	5.0533	811	4.3424×10^{-7}	0.3331	0.7553

Aquatic system	Insecticide	Microorganism growth response	301	44	-0.4768	-6.3390	300	2.3126×10^{-10}	-0.6242	-0.3294
		Microorganism reproduction response	203	27	-0.8782	-4.5946	202	4.3349×10^{-6}	-1.2529	-0.5036
		Microorganism biomarker response	1182	67	0.5205	9.6558	1181	4.6443×10^{-22}	0.4148	0.6261
		Animal growth response	395	52	-0.0828	-2.7867	394	0.0053	-0.1411	-0.0246
		Animal reproduction response	746	111	-0.4993	-6.2105	745	5.2814×10^{-10}	-0.6569	-0.3417
		Animal behaviour response	169	34	-0.3944	-1.9504	168	0.0511	-0.7907	0.0019
		Animal biomarker response	1737	112	0.3809	13.3657	1736	9.5953×10^{-41}	0.3251	0.4368
		Plant growth response	138	11	-0.3668	-2.3157	137	0.0206	-0.6773	-0.0564
		Plant reproduction response	149	16	-0.6493	-4.3818	148	1.1768×10^{-5}	-0.9397	-0.3589
		Plant biomarker response	215	13	0.6653	2.0181	214	0.0436	0.0192	1.3114
		Microorganism growth response	133	18	-0.4850	-4.1845	132	2.8584×10^{-5}	-0.7122	-0.2578
		Microorganism reproduction response	107	10	-0.7512	-5.0571	106	4.2576×10^{-7}	-1.0424	-0.4601
		Microorganism biomarker response	532	30	0.4443	7.4068	531	1.2937×10^{-13}	0.3267	0.5619
	Fungicide	Animal growth response	98	21	-0.1184	-2.3148	97	0.0206	-0.2187	-0.0182
		Animal reproduction response	122	17	-0.1985	-2.7500	121	0.0060	-0.3399	-0.0570
		Animal behaviour response	102	14	-0.3337	-2.9620	101	0.0031	-0.5544	-0.1129
		Animal biomarker response	248	22	0.4996	4.9620	247	6.9757×10^{-7}	0.3023	0.6969
		Plant growth response	18	3	-0.1504	-0.5002	17	0.6169	-0.7395	0.4388
		Plant reproduction response	6	2	-0.2672	-1.3621	5	0.1732	-0.6517	0.1173
		Plant biomarker response	74	9	0.3456	2.5009	73	0.0124	0.0747	0.6164
		Microorganism growth response	22	2	-0.7852	-2.1350	21	0.0328	-1.5060	-0.0644
		Microorganism reproduction response	27	5	-1.4147	-4.4972	26	6.8841×10^{-6}	-2.0312	-0.7981
		Microorganism biomarker response	101	4	0.6825	1.3171	100	0.1878	-0.3331	1.6981
	Herbicide	Animal growth response	423	56	0.0069	0.2045	422	0.8380	-0.0595	0.0734
		Animal reproduction response	410	69	-0.2784	-3.8240	409	0.0001	-0.4211	-0.1357
		Animal behaviour response	116	24	-0.2928	-2.3392	115	0.0193	-0.5381	-0.0475
		Animal biomarker response	739	66	0.3577	6.9739	738	3.0832×10^{-12}	0.2572	0.4583
		Plant growth response	470	42	-0.6207	-6.7840	469	1.1686×10^{-11}	-0.8000	-0.4414
		Plant reproduction response	107	20	-0.5447	-5.8729	106	4.2820×10^{-9}	-0.7265	-0.3629
		Plant biomarker response	523	32	0.5402	7.6651	522	1.7870×10^{-14}	0.4021	0.6784
		Microorganism growth response	146	25	-0.4260	-4.3953	145	1.1062×10^{-5}	-0.6159	-0.2360
		Microorganism reproduction response	69	13	-0.8166	-1.8401	68	0.0658	-1.6864	0.0532
		Microorganism biomarker response	549	34	0.5662	6.8008	548	1.0402×10^{-11}	0.4030	0.7293

Supplementary Table 9 Sensitivity analysis for taxonomic groups of animals, invertebrates, vertebrates, plants, seed plants, spore-producing plants, microorganisms, bacteria and fungus. Absolute values of 'biomarker' values were taken. Each test is two-sided and the original P value is reported with no multiple comparisons.

Taxonomic group	Indicator	Number of missing studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Animal	Growth	0	-0.0994	-11.7917	1504	4.3097×10^{-32}	-0.1159	-0.0829
	Reproduction	0	-0.4481	-45.9640	5475	0.0000	-0.4672	-0.4290
	Behaviour	0	-0.2589	-17.2811	1328	6.5296×10^{-67}	-0.2883	-0.2295
	Biomarker	0	0.3887	55.1021	4469	0.0000	0.3749	0.4025
Invertebrate	Growth	0	-0.1213	-9.4314	673	4.0464×10^{-21}	-0.1465	-0.0961
	Reproduction	0	-0.4681	-43.3822	4710	0.0000	-0.4892	-0.4469
	Behaviour	0	-0.2520	-15.5565	986	1.4383×10^{-54}	-0.2837	-0.2202
	Biomarker	272	0.4178	37.5439	1186	0.0000	0.3959	0.4396
Vertebrate	Growth	0	-0.0829	-7.4350	830	1.0455×10^{-13}	-0.1048	-0.0611
	Reproduction	167	-0.4391	-23.3361	764	1.9084×10^{-120}	-0.4760	-0.4022
	Behaviour	0	-0.2810	-7.8369	341	4.6168×10^{-15}	-0.3512	-0.2107
	Biomarker	0	0.4101	48.0170	3282	0.0000	0.3933	0.4268
Plant	Growth	582	-0.5192	-43.8745	2576	0.0000	-0.5424	-0.4960
	Reproduction	0	-0.4238	-14.0065	668	1.4229×10^{-44}	-0.4831	-0.3645
	Biomarker	0	0.4730	30.8010	1810	2.5374×10^{-208}	0.4429	0.5031
Seed plant	Growth	517	-0.5263	-41.6607	2272	0.0000	-0.5510	-0.5015
	Reproduction	123	-0.4821	-14.5755	420	4.0191×10^{-48}	-0.5470	-0.4173
	Biomarker	261	0.5146	38.2528	1207	0.0000	0.4882	0.5409
Spore-producing plant	Growth	0	-0.3192	-9.1828	303	4.2001×10^{-20}	-0.3874	-0.2511
	Reproduction	0	-0.6700	-14.3069	247	1.9823×10^{-46}	-0.7618	-0.5782
	Biomarker	0	0.6120	16.4756	602	5.4967×10^{-61}	0.5392	0.6848
Microorganism	Growth	0	-0.5777	-15.6592	422	2.8738×10^{-55}	-0.6500	-0.5054
	Reproduction	0	-0.5024	-15.5626	764	1.3067×10^{-54}	-0.5657	-0.4392
	Biomarker	301	0.6363	38.5786	1186	0.0000	0.6040	0.6687
Bacteria	Growth	0	-0.4876	-12.1083	294	9.5459×10^{-34}	-0.5665	-0.4087
	Reproduction	38	-0.9010	-13.2285	201	6.0055×10^{-40}	-1.0344	-0.7675
	Biomarker	296	0.6389	38.2702	1162	0.0000	0.6062	0.6716
Fungus	Growth	0	-0.7640	-10.2696	127	9.6560×10^{-25}	-0.9098	-0.6182
	Reproduction	0	-0.4386	-12.1830	562	3.8296×10^{-34}	-0.5092	-0.3680
	Biomarker	0	0.3819	3.5796	23	3.4409×10^{-4}	0.1728	0.5909

Supplementary Table 10 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides within the range of recommended field application rates. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Pesticide	Animal growth	24	7	-0.1355	-0.6792	23	0.4970	-0.5265	0.2555
Pesticide	Animal reproduction	471	73	-0.3894	-4.7837	470	1.7208×10^{-6}	-0.5490	-0.2299
Pesticide	Animal behavior	54	10	-0.5713	-3.2252	53	0.0013	-0.9185	-0.2241
Pesticide	Animal biomarker	0	0	NA	NA	NA	NA	NA	NA
Pesticide	Plant growth	177	17	-0.1455	-1.0467	176	0.2952	-0.4179	0.1269
Pesticide	Plant reproduction	61	14	-0.1421	-1.0469	60	0.2951	-0.4081	0.1239
Pesticide	Plant biomarker	94	12	0.1624	0.8217	93	0.4112	-0.2249	0.5496
Pesticide	Microorganism growth	15	2	0.0736	0.1893	14	0.8498	-0.6879	0.8351
Pesticide	Microorganism reproduction	69	12	-0.2396	-1.4590	68	0.1446	-0.5616	0.0823
Pesticide	Microorganism biomarker	28	1	0.2787	0.3797	27	0.7041	-1.1599	1.7174
insecticide	Animal growth	13	4	-0.2608	-0.9465	12	0.3439	-0.8009	0.2793
insecticide	Animal reproduction	423	60	-0.4570	-5.0797	422	3.7800×10^{-7}	-0.6334	-0.2807
insecticide	Animal behavior	28	9	-0.5822	-2.9982	27	0.0027	-0.9628	-0.2016
insecticide	Animal biomarker	0	0	NA	NA	NA	NA	NA	NA
insecticide	Plant growth	29	4	-0.1512	-0.4164	28	0.6771	-0.8629	0.5605
insecticide	Plant reproduction	24	8	-0.0667	-0.4606	23	0.6451	-0.3503	0.2170
insecticide	Plant biomarker	24	4	0.1046	0.3373	23	0.7359	-0.5034	0.7127
insecticide	Microorganism growth	8	1	0.0860	0.1125	7	0.9105	-1.4134	1.5854
insecticide	Microorganism reproduction	4	2	0.1592	0.3573	3	0.7209	-0.7139	1.0322
insecticide	Microorganism biomarker	16	1	0.2079	0.2797	15	0.7797	-1.2492	1.6651
fungicide	Animal growth	9	2	-0.0753	-0.2002	8	0.8413	-0.8123	0.6617
fungicide	Animal reproduction	21	8	0.1113	0.4489	20	0.6535	-0.3747	0.5974
fungicide	Animal behavior	0	0	NA	NA	NA	NA	NA	NA
fungicide	Animal biomarker	0	0	NA	NA	NA	NA	NA	NA
fungicide	Plant growth	40	5	-0.1728	-0.5472	39	0.5842	-0.7915	0.4460
fungicide	Plant reproduction	7	3	0.0502	0.1213	6	0.9034	-0.7606	0.8610
fungicide	Plant biomarker	20	2	0.2955	0.5205	19	0.6027	-0.8172	1.4082
fungicide	Microorganism growth	1	1	NA	NA	NA	NA	NA	NA
fungicide	Microorganism reproduction	5	3	-0.1215	-0.3863	4	0.6993	-0.7379	0.4950
fungicide	Microorganism biomarker	0	0	NA	NA	NA	NA	NA	NA
herbicide	Animal growth	2	1	0.1151	0.2545	1	0.7991	-0.7716	1.0019
herbicide	Animal reproduction	27	7	-0.2151	-0.9507	26	0.3417	-0.6586	0.2284
herbicide	Animal behavior	26	1	-0.4404	-0.5991	25	0.5491	-1.8809	1.0002
herbicide	Animal biomarker	0	0	NA	NA	NA	NA	NA	NA
herbicide	Plant growth	108	9	-0.1411	-0.8433	107	0.3990	-0.4691	0.1869
herbicide	Plant reproduction	30	3	-0.4248	-1.3203	29	0.1867	-1.0553	0.2058
herbicide	Plant biomarker	50	6	0.1560	0.6302	49	0.5286	-0.3292	0.6412
herbicide	Microorganism growth	6	1	0.0150	0.0193	5	0.9846	-1.5119	1.5419
herbicide	Microorganism reproduction	60	8	-0.3213	-1.5927	59	0.1112	-0.7166	0.0741
herbicide	Microorganism biomarker	12	1	0.3732	0.4971	11	0.6191	-1.0982	1.8445

Supplementary Table 11 Results of the meta-regression analysis for the responses of taxonomic groups (invertebrates, vertebrates, seed plants, spore-producing plants, bacteria and fungus) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides within the range of recommended field application rates. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented.

Pesticide category	Non-target organism	Non-target organism response category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Pesticide	Invertebrate	Animal reproduction	453	70	-0.3936	-4.7362	452	2.1781×10^{-6}	-0.5565	-0.2307
Pesticide	Invertebrate	Animal growth	14	5	-0.1764	-0.7185	13	0.4725	-0.6578	0.3049
Pesticide	Invertebrate	Animal behavior	52	9	-0.6019	-3.0264	51	0.0025	-0.9917	-0.2121
Pesticide	Seed plant	Plant biomarker	94	12	0.1624	0.8217	93	0.4112	-0.2249	0.5496
Pesticide	Seed plant	Plant reproduction	61	14	-0.1421	-1.0469	60	0.2951	-0.4081	0.1239
Pesticide	Seed plant	Plant growth	177	17	-0.1455	-1.0467	176	0.2952	-0.4179	0.1269
Pesticide	Fungus	Microorganism reproduction	65	11	-0.2062	-1.1677	64	0.2429	-0.5522	0.1399
Pesticide	Fungus	Microorganism growth	1	1	NA	NA	NA	NA	NA	NA
Pesticide	Vertebrate	Animal reproduction	18	3	-0.2551	-0.6274	17	0.5304	-1.0521	0.5419
Pesticide	Vertebrate	Animal growth	10	2	-0.0561	-0.1639	9	0.8698	-0.7265	0.6144
Pesticide	Vertebrate	Animal behavior	2	1	-0.2681	-0.4499	1	0.6528	-1.4361	0.8999
Pesticide	Bacteria	Microorganism growth	14	1	0.0556	0.0745	13	0.9406	-1.4077	1.5189
Pesticide	Bacteria	Microorganism biomarker	28	1	0.2787	0.3797	27	0.7041	-1.1599	1.7174
Pesticide	Bacteria	Microorganism reproduction	4	2	-1.0735	-1.1683	3	0.2427	-2.8743	0.7274
Insecticide	Invertebrate	Animal reproduction	412	59	-0.4553	-5.0033	411	5.6347×10^{-7}	-0.6337	-0.2770
Insecticide	Invertebrate	Animal growth	11	3	-0.3321	-1.0685	10	0.2853	-0.9412	0.2770
Insecticide	Invertebrate	Animal behavior	26	8	-0.6177	-2.8037	25	0.0051	-1.0495	-0.1859
Insecticide	Seed plant	Plant biomarker	24	4	0.1046	0.3373	23	0.7359	-0.5034	0.7127
Insecticide	Seed plant	Plant reproduction	24	8	-0.0667	-0.4606	23	0.6451	-0.3503	0.2170
Insecticide	Seed plant	Plant growth	29	4	-0.1512	-0.4164	28	0.6771	-0.8629	0.5605
Insecticide	Fungus	Microorganism reproduction	4	2	0.1592	0.3573	3	0.7209	-0.7139	1.0322
Insecticide	Fungus	Microorganism growth	0	0	NA	NA	NA	NA	NA	NA
Insecticide	Vertebrate	Animal reproduction	11	1	-0.5757	-0.9028	10	0.3666	-1.8253	0.6740
Insecticide	Vertebrate	Animal growth	2	1	0.0012	0.0020	1	0.9984	-1.1668	1.1692
Insecticide	Vertebrate	Animal behavior	2	1	-0.2681	-0.4499	1	0.6528	-1.4361	0.8999
Insecticide	Bacteria	Microorganism growth	8	1	0.0860	0.1125	7	0.9105	-1.4134	1.5854
Insecticide	Bacteria	Microorganism biomarker	16	1	0.2079	0.2797	15	0.7797	-1.2492	1.6651
Insecticide	Bacteria	Microorganism reproduction	0	0	NA	NA	NA	NA	NA	NA
Fungicide	Invertebrate	Animal reproduction	18	7	0.0976	0.3756	17	0.7072	-0.4116	0.6067
Fungicide	Invertebrate	Animal growth	1	1	NA	NA	NA	NA	NA	NA
Fungicide	Invertebrate	Animal behavior	0	0	NA	NA	NA	NA	NA	NA
Fungicide	Seed plant	Plant biomarker	20	2	0.2955	0.5205	19	0.6027	-0.8172	1.4082
Fungicide	Seed plant	Plant reproduction	7	3	0.0502	0.1213	6	0.9034	-0.7606	0.8610
Fungicide	Seed plant	Plant growth	40	5	-0.1728	-0.5472	39	0.5842	-0.7915	0.4460
Fungicide	Fungus	Microorganism reproduction	5	3	-0.1215	-0.3863	4	0.6993	-0.7379	0.4950
Fungicide	Fungus	Microorganism growth	1	1	NA	NA	NA	NA	NA	NA
Fungicide	Vertebrate	Animal reproduction	3	1	0.2528	0.3035	2	0.7615	-1.3796	1.8851
Fungicide	Vertebrate	Animal growth	8	1	-0.0842	-0.2016	7	0.8402	-0.9030	0.7345
Fungicide	Vertebrate	Animal behavior	0	0	NA	NA	NA	NA	NA	NA
Fungicide	Bacteria	Microorganism growth	0	0	NA	NA	NA	NA	NA	NA
Fungicide	Bacteria	Microorganism biomarker	0	0	NA	NA	NA	NA	NA	NA
Fungicide	Bacteria	Microorganism reproduction	0	0	NA	NA	NA	NA	NA	NA
Herbicide	Invertebrate	Animal reproduction	23	6	-0.2109	-0.8409	22	0.4004	-0.7025	0.2807
Herbicide	Invertebrate	Animal growth	2	1	0.1151	0.2545	1	0.7991	-0.7716	1.0019
Herbicide	Invertebrate	Animal behavior	26	1	-0.4404	-0.5991	25	0.5491	-1.8809	1.0002
Herbicide	Seed plant	Plant biomarker	50	6	0.1560	0.6302	49	0.5286	-0.3292	0.6412
Herbicide	Seed plant	Plant reproduction	30	3	-0.4248	-1.3203	29	0.1867	-1.0553	0.2058
Herbicide	Seed plant	Plant growth	108	9	-0.1411	-0.8433	107	0.3990	-0.4691	0.1869
Herbicide	Fungus	Microorganism reproduction	56	7	-0.2872	-1.2713	55	0.2036	-0.7300	0.1556
Herbicide	Fungus	Microorganism growth	0	0	NA	NA	NA	NA	NA	NA
Herbicide	Vertebrate	Animal reproduction	4	1	-0.2289	-0.3353	3	0.7374	-1.5666	1.1088
Herbicide	Vertebrate	Animal growth	0	0	NA	NA	NA	NA	NA	NA
Herbicide	Vertebrate	Animal behavior	0	0	NA	NA	NA	NA	NA	NA
Herbicide	Bacteria	Microorganism growth	6	1	0.0150	0.0193	5	0.9846	-1.5119	1.5419
Herbicide	Bacteria	Microorganism biomarker	12	1	0.3732	0.4971	11	0.6191	-1.0982	1.8445
Herbicide	Bacteria	Microorganism reproduction	4	2	-1.0735	-1.1683	3	0.2427	-2.8743	0.7274

Supplementary Table 12 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to chemical synthetic, mineral-based and biogenic pesticides, insecticides, fungicides or herbicides within the range of recommended field application rates. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Chemical synthetic pesticides	Animal growth response	15	5	-0.1591	-0.6760	14	0.4991	-0.6204	0.3022
	Animal reproduction response	420	66	-0.4394	-5.0352	419	4.7724×10^{-7}	-0.6105	-0.2684
	Animal behaviour response	54	10	-0.5713	-3.2252	53	0.0013	-0.9185	-0.2241
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	173	17	-0.1472	-1.0473	172	0.2950	-0.4226	0.1283
	Plant reproduction response	60	14	-0.1423	-1.0471	59	0.2950	-0.4085	0.1240
	Plant biomarker response	91	12	0.1620	0.8191	90	0.4127	-0.2257	0.5497
	Microorganism growth response	15	2	0.0736	0.1893	14	0.8498	-0.6879	0.8351
	Microorganism reproduction response	66	12	-0.2572	-1.5438	65	0.1226	-0.5837	0.0693
	Microorganism biomarker response	28	1	0.2787	0.3797	27	0.7041	-1.1599	1.7174
Mineral-based pesticides	Animal growth response	9	2	-0.0753	-0.2002	8	0.8413	-0.8123	0.6617
	Animal reproduction response	11	5	-0.0966	-0.3063	10	0.7594	-0.7149	0.5217
	Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Biogenic pesticides	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
	Animal reproduction response	40	17	-0.1393	-0.7429	39	0.4576	-0.5070	0.2283
	Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	4	2	-0.1280	-0.2764	3	0.7823	-1.0360	0.7800
	Plant reproduction response	1	1	NA	NA	NA	NA	NA	NA
	Plant biomarker response	3	1	0.0988	0.1186	2	0.9056	-1.5335	1.7312
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	3	1	0.2555	0.4111	2	0.6810	-0.9627	1.4737
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Chemical synthetic insecticides	Animal growth response	13	4	-0.2608	-0.9465	12	0.3439	-0.8009	0.2793
	Animal reproduction response	390	59	-0.4756	-5.1225	389	3.0148×10^{-7}	-0.6576	-0.2936
	Animal behaviour response	28	9	-0.5822	-2.9982	27	0.0027	-0.9628	-0.2016
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	25	3	-0.1593	-0.4722	24	0.6368	-0.8205	0.5019
	Plant reproduction response	23	8	-0.0706	-0.4267	22	0.6696	-0.3948	0.2536
	Plant biomarker response	21	4	0.1030	0.3268	20	0.7438	-0.5147	0.7207
	Microorganism growth response	8	1	0.0860	0.1125	7	0.9105	-1.4134	1.5854
	Microorganism reproduction response	1	1	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	16	1	0.2079	0.2797	15	0.7797	-1.2492	1.6651
Mineral-based insecticides	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
	Animal reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Biogenic insecticides	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
	Animal reproduction response	33	14	-0.2761	-1.3247	32	0.1853	-0.6847	0.1324
	Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	4	2	-0.1280	-0.2764	3	0.7823	-1.0360	0.7800

	Plant reproduction response	1	1	NA	NA	NA	NA	NA	NA
	Plant biomarker response	3	1	0.0988	0.1186	2	0.9056	-1.5335	1.7312
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	3	1	0.2555	0.4111	2	0.6810	-0.9627	1.4737
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Chemical synthetic fungicides	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
	Animal reproduction response	3	1	0.2528	0.3035	2	0.7615	-1.3796	1.8851
	Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	40	5	-0.1728	-0.5472	39	0.5842	-0.7915	0.4460
	Plant reproduction response	7	3	0.0502	0.1213	6	0.9034	-0.7606	0.8610
	Plant biomarker response	20	2	0.2955	0.5205	19	0.6027	-0.8172	1.4082
	Microorganism growth response	1	1	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	5	3	-0.1215	-0.3863	4	0.6993	-0.7379	0.4950
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Mineral-based fungicides	Animal growth response	9	2	-0.0753	-0.2002	8	0.8413	-0.8123	0.6617
	Animal reproduction response	11	5	-0.0966	-0.3063	10	0.7594	-0.7149	0.5217
	Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Biogenic fungicides	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
	Animal reproduction response	7	3	0.4427	1.0296	6	0.3032	-0.4000	1.2855
	Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Chemical synthetic herbicides	Animal growth response	2	1	0.1151	0.2545	1	0.7991	-0.7716	1.0019
	Animal reproduction response	27	7	-0.2151	-0.9507	26	0.3417	-0.6586	0.2284
	Animal behaviour response	26	1	-0.4404	-0.5991	25	0.5491	-1.8809	1.0002
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	108	9	-0.1411	-0.8433	107	0.3990	-0.4691	0.1869
	Plant reproduction response	30	3	-0.4248	-1.3203	29	0.1867	-1.0553	0.2058
	Plant biomarker response	50	6	0.1560	0.6302	49	0.5286	-0.3292	0.6412
	Microorganism growth response	6	1	0.0150	0.0193	5	0.9846	-1.5119	1.5419
	Microorganism reproduction response	60	8	-0.3213	-1.5927	59	0.1112	-0.7166	0.0741
	Microorganism biomarker response	12	1	0.3732	0.4971	11	0.6191	-1.0982	1.8445
Mineral-based herbicides	Animal growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal behaviour response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Biogenic herbicides	Animal growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal behaviour response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A

Supplementary Table 13 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides within the range of recommended field application rates in temperate and tropical experiments. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Data from laboratory conditions were removed from the models with climatic predictors. Each test is two-sided and the original P value is reported with no multiple comparisons.

Climatic zone of experiments	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Temperate experiment	Pesticide	Animal growth response	22	6	-0.1528	-0.7215	21	0.4706	-0.5677	0.2622
		Animal reproduction response	378	64	-0.3803	-4.4920	377	7.0566×10^{-6}	-0.5463	-0.2144
		Animal behaviour response	23	7	-0.6318	-2.1751	22	0.0296	-1.2012	-0.0625
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	129	16	-0.1569	-1.0956	128	0.2733	-0.4375	0.1238
		Plant reproduction response	58	13	-0.1512	-1.0992	57	0.2717	-0.4208	0.1184
		Plant biomarker response	60	10	0.1799	0.8285	59	0.4074	-0.2457	0.6056
		Microorganism growth response	15	2	0.0736	0.1893	14	0.8498	-0.6879	0.8351
		Microorganism reproduction response	67	11	-0.2434	-1.4562	66	0.1453	-0.5711	0.0842
		Microorganism biomarker response	28	1	0.2787	0.3797	27	0.7041	-1.1599	1.7174
	Insecticide	Animal growth response	11	3	-0.3321	-1.0685	10	0.2853	-0.9412	0.2770
		Animal reproduction response	339	52	-0.4369	-4.7074	338	2.5093×10^{-6}	-0.6188	-0.2550
		Animal behaviour response	23	7	-0.6318	-2.1751	22	0.0296	-1.2012	-0.0625
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	29	4	-0.1512	-0.4164	28	0.6771	-0.8629	0.5605
		Plant reproduction response	21	7	-0.0813	-0.4823	20	0.6296	-0.4117	0.2491
		Plant biomarker response	13	3	0.1262	0.2657	12	0.7905	-0.8048	1.0572
		Microorganism growth response	8	1	0.0860	0.1125	7	0.9105	-1.4134	1.5854
		Microorganism reproduction response	4	2	0.1592	0.3573	3	0.7209	-0.7139	1.0322
		Microorganism biomarker response	16	1	0.2079	0.2797	15	0.7797	-1.2492	1.6651
	Fungicide	Animal growth response	9	2	-0.0753	-0.2002	8	0.8413	-0.8123	0.6617
		Animal reproduction response	21	8	0.1113	0.4489	20	0.6535	-0.3747	0.5974
		Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	40	5	-0.1728	-0.5472	39	0.5842	-0.7915	0.4460
		Plant reproduction response	7	3	0.0502	0.1213	6	0.9034	-0.7606	0.8610
		Plant biomarker response	20	2	0.2955	0.5205	19	0.6027	-0.8172	1.4082
		Microorganism growth response	1	1	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	5	3	-0.1215	-0.3863	4	0.6993	-0.7379	0.4950
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Herbicide	Animal growth response	2	1	0.1151	0.2545	1	0.7991	-0.7716	1.0019
		Animal reproduction response	18	6	-0.2781	-1.0368	17	0.2998	-0.8037	0.2476
		Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	60	8	-0.1873	-1.3745	59	0.1693	-0.4544	0.0798
		Plant reproduction response	30	3	-0.4248	-1.3203	29	0.1867	-1.0553	0.2058
		Plant biomarker response	27	5	0.1711	0.6326	26	0.5270	-0.3590	0.7013
		Microorganism growth response	6	1	0.0150	0.0193	5	0.9846	-1.5119	1.5419
		Microorganism reproduction response	58	7	-0.3316	-1.6004	57	0.1095	-0.7376	0.0745
		Microorganism biomarker response	12	1	0.3732	0.4971	11	0.6191	-1.0982	1.8445
	Pesticide	Animal growth response	2	1	0.0012	0.0020	1	0.9984	-1.1668	1.1692
		Animal reproduction response	93	9	-0.5570	-1.5719	92	0.1160	-1.2514	0.1375
		Animal behaviour response	31	3	-0.5279	-2.6249	30	0.0087	-0.9221	-0.1337
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	48	1	0.0399	0.0691	47	0.9449	-1.0916	1.1714
		Plant reproduction response	3	1	0.1920	0.2305	2	0.8177	-1.4404	1.8243
		Plant biomarker response	34	2	0.0776	0.2330	33	0.8158	-0.5751	0.7302

		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	2	1	-0.1338	-0.1515	1	0.8796	-1.8652	1.5975
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Insecticide	Animal growth response	2	1	0.0012	0.0020	1	0.9984	-1.1668	1.1692
		Animal reproduction response	84	8	-0.6785	-1.6928	83	0.0905	-1.4641	0.1071
		Animal behaviour response	5	2	-0.5390	-2.0696	4	0.0385	-1.0495	-0.0286
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	3	1	0.1920	0.2305	2	0.8177	-1.4404	1.8243
		Plant biomarker response	11	1	0.0778	0.1033	10	0.9177	-1.3987	1.5543
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Fungicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Tropical experiment	Herbicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	9	1	0.0610	0.1567	8	0.8755	-0.7022	0.8242
		Animal behaviour response	26	1	-0.4404	-0.5991	25	0.5491	-1.8809	1.0002
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	48	1	0.0399	0.0691	47	0.9449	-1.0916	1.1714
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	23	1	0.0780	0.1271	22	0.8989	-1.1258	1.2819
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	2	1	-0.1338	-0.1515	1	0.8796	-1.8652	1.5975
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA

Supplementary Table 14 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides within the range of recommended field application rates in old and new pesticides. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Types of organism exposure to pesticides	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
New pesticides	Pesticide	Animal growth response	15	6	-0.0099	-0.0451	14	0.9640	-0.4423	0.4224
		Animal reproduction response	147	40	-0.2870	-2.9603	146	0.0031	-0.4770	-0.0970
		Animal behaviour response	20	4	-0.1608	-0.4879	19	0.6256	-0.8066	0.4850
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	154	14	-0.1869	-1.6159	153	0.1061	-0.4136	0.0398
		Plant reproduction response	26	7	0.0578	0.1912	25	0.8484	-0.5343	0.6498
		Plant biomarker response	79	10	0.1581	0.7429	78	0.4575	-0.2589	0.5751
		Microorganism growth response	2	1	0.2976	0.3369	1	0.7362	-1.4338	2.0289
		Microorganism reproduction response	55	8	-0.2374	-1.1621	54	0.2452	-0.6378	0.1630
		Microorganism biomarker response	4	1	0.5017	0.6222	3	0.5338	-1.0788	2.0822
	Insecticide	Animal growth response	4	3	-0.0273	-0.0800	3	0.9362	-0.6960	0.6414
		Animal reproduction response	102	27	-0.4264	-3.3840	101	0.0007	-0.6733	-0.1794
		Animal behaviour response	12	3	-0.1038	-0.2844	11	0.7761	-0.8194	0.6117
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	23	4	-0.1779	-0.4651	22	0.6418	-0.9277	0.5718
		Plant reproduction response	8	4	0.0698	0.1580	7	0.8744	-0.7962	0.9358
		Plant biomarker response	15	3	0.0643	0.1336	14	0.8937	-0.8789	1.0076
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	2	1	0.2318	0.3516	1	0.7252	-1.0603	1.5238
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Fungicide	Animal growth response	9	2	-0.0753	-0.2002	8	0.8413	-0.8123	0.6617
		Animal reproduction response	19	7	0.2402	0.8933	18	0.3717	-0.2869	0.7673
		Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	29	3	-0.1929	-0.4480	28	0.6542	-1.0371	0.6512
		Plant reproduction response	3	2	0.0486	0.0885	2	0.9295	-1.0269	1.1240
		Plant biomarker response	20	2	0.2955	0.5205	19	0.6027	-0.8172	1.4082
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Herbicide	Animal growth response	2	1	0.1151	0.2545	1	0.7991	-0.7716	1.0019
		Animal reproduction response	26	6	-0.2280	-0.9791	25	0.3275	-0.6845	0.2285
		Animal behaviour response	8	1	-0.4108	-0.5369	7	0.5913	-1.9102	1.0886
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	102	7	-0.1533	-0.8712	101	0.3836	-0.4983	0.1916
		Plant reproduction response	15	1	0.0453	0.0719	14	0.9427	-1.1904	1.2810
		Plant biomarker response	44	5	0.1566	0.5998	43	0.5487	-0.3551	0.6683
		Microorganism growth response	2	1	0.2976	0.3369	1	0.7362	-1.4338	2.0289
		Microorganism reproduction response	53	7	-0.2872	-1.3369	52	0.1813	-0.7084	0.1339
		Microorganism biomarker response	4	1	0.5017	0.6222	3	0.5338	-1.0788	2.0822
	Pesticide	Animal growth response	9	3	-0.4645	-1.5552	8	0.1199	-1.0499	0.1209
		Animal reproduction response	324	54	-0.5038	-5.0161	323	5.27×10^{-7}	-0.7006	-0.3069
		Animal behaviour response	34	8	-0.7201	-3.2038	33	0.0014	-1.1607	-0.2796
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	23	7	-0.1277	-0.4734	22	0.6359	-0.6561	0.4008

		Plant reproduction response	35	11	-0.1605	-1.1094	34	0.2672	-0.4440	0.1230
		Plant biomarker response	15	4	0.1446	0.3438	14	0.7310	-0.6798	0.9690
		Microorganism growth response	13	2	0.0434	0.1255	12	0.9001	-0.6337	0.7205
		Microorganism reproduction response	14	5	-0.1858	-0.7182	13	0.4726	-0.6929	0.3212
		Microorganism biomarker response	24	1	0.2416	0.3282	23	0.7428	-1.2012	1.6844
Old pesticides	Insecticide	Animal growth response	9	3	-0.4538	-1.6280	8	0.1035	-1.0001	0.0925
		Animal reproduction response	321	52	-0.5075	-4.9505	320	7.40×10^{-7}	-0.7085	-0.3066
		Animal behaviour response	16	7	-0.8103	-2.8120	15	0.0049	-1.3751	-0.2455
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	6	3	-0.0688	-0.1451	5	0.8846	-0.9980	0.8604
		Plant reproduction response	16	7	-0.0673	-0.3948	15	0.6930	-0.4015	0.2669
		Plant biomarker response	9	3	0.1421	0.2844	8	0.7761	-0.8373	1.1215
		Microorganism growth response	8	1	0.0860	0.1125	7	0.9105	-1.4134	1.5854
		Microorganism reproduction response	2	2	0.1239	0.2170	1	0.8282	-0.9952	1.2430
		Microorganism biomarker response	16	1	0.2079	0.2797	15	0.7797	-1.2492	1.6651
	Fungicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	2	2	-0.4990	-0.8748	1	0.3817	-1.6171	0.6190
		Animal behaviour response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	11	3	-0.2212	-0.5864	10	0.5576	-0.9605	0.5181
		Plant reproduction response	4	2	0.0439	0.0891	3	0.9290	-0.9212	1.0090
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	1	1	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	5	3	-0.1215	-0.3863	4	0.6993	-0.7379	0.4950
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Herbicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	1	1	NA	NA	NA	NA	NA	NA
		Animal behaviour response	18	1	-0.4535	-0.6120	17	0.5405	-1.9059	0.9989
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	6	2	-0.0261	-0.0484	5	0.9614	-1.0847	1.0324
		Plant reproduction response	15	2	-0.5823	-1.6752	14	0.0939	-1.2636	0.0990
		Plant biomarker response	6	1	0.1507	0.1934	5	0.8466	-1.3762	1.6776
		Microorganism growth response	4	1	-0.1263	-0.1566	3	0.8756	-1.7068	1.4542
		Microorganism reproduction response	7	1	-0.5740	-0.9801	6	0.3270	-1.7218	0.5739
		Microorganism biomarker response	8	1	0.3089	0.4037	7	0.6864	-1.1905	1.8083

Supplementary Table 15 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to old or new pesticides, insecticides, fungicides and herbicides in all the 1705 studies. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Pesticide use history	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
New pesticides	Pesticide	Animal growth response	597	122	-0.0690	-3.1208	596	0.0018	-0.1123	-0.0257
		Animal reproduction response	2133	394	-0.3764	-5.2502	2132	1.5192×10^{-7}	-0.5169	-0.2359
		Animal behaviour response	441	102	-0.2069	-3.4314	440	0.0006	-0.3251	-0.0887
		Animal biomarker response	1524	142	0.3640	10.4381	1523	1.6608×10^{-25}	0.2957	0.4324
		Plant growth response	1046	108	-0.3851	-5.5023	1045	3.7485×10^{-8}	-0.5222	-0.2479
		Plant reproduction response	255	48	-0.4006	-1.5927	254	0.1112	-0.8935	0.0924
		Plant biomarker response	932	72	0.4014	7.9997	931	1.2475×10^{-15}	0.3030	0.4997
		Microorganism growth response	155	21	-0.6245	-2.8992	154	0.0037	-1.0468	-0.2023
		Microorganism reproduction response	350	49	-0.8284	-4.1206	349	3.7784×10^{-5}	-1.2224	-0.4344
		Microorganism biomarker response	335	26	0.5058	5.3743	334	7.6871×10^{-8}	0.3213	0.6902
	Insecticide	Animal growth response	209	49	-0.0900	-2.3420	208	0.0192	-0.1652	-0.0147
		Animal reproduction response	1403	272	-0.5541	-4.2082	1402	2.5746×10^{-5}	-0.8122	-0.2960
		Animal behaviour response	284	65	-0.1552	-1.9137	283	0.0557	-0.3142	0.0038
		Animal biomarker response	626	60	0.3667	9.3366	625	9.9458×10^{-21}	0.2897	0.4436
		Plant growth response	141	23	-0.2658	-3.1634	140	0.0016	-0.4304	-0.1011
		Plant reproduction response	63	16	-0.2607	-2.6673	62	0.0076	-0.4523	-0.0691
		Plant biomarker response	71	13	0.2981	2.7183	70	0.0066	0.0832	0.5130
		Microorganism growth response	59	6	-0.4001	-1.5784	58	0.1145	-0.8970	0.0967
		Microorganism reproduction response	65	5	-0.4748	-1.5159	64	0.1295	-1.0887	0.1391
		Microorganism biomarker response	144	9	0.3753	4.5303	143	5.8887×10^{-6}	0.2130	0.5377
	Fungicide	Animal growth response	74	22	-0.0759	-1.4198	73	0.1557	-0.1807	0.0289
		Animal reproduction response	205	46	-0.2488	-2.3276	204	0.0199	-0.4584	-0.0393
		Animal behaviour response	36	8	-0.1761	-1.4292	35	0.1529	-0.4176	0.0654
		Animal biomarker response	264	24	0.4199	3.7518	263	0.0002	0.2005	0.6392
		Plant growth response	125	20	-0.2398	-2.0928	124	0.0364	-0.4644	-0.0152
		Plant reproduction response	43	12	-0.4923	-0.6207	42	0.5348	-2.0469	1.0622
		Plant biomarker response	178	14	0.3761	4.4014	177	0.0000	0.2086	0.5436
		Microorganism growth response	21	6	-1.0192	-1.6555	20	0.0978	-2.2259	0.1875
		Microorganism reproduction response	86	16	-0.6131	-2.7452	85	0.0060	-1.0508	-0.1754
		Microorganism biomarker response	17	4	0.7161	1.3874	16	0.1653	-0.2956	1.7278
	Herbicide	Animal growth response	525	94	-0.2213	-4.8566	524	1.1944×10^{-6}	-0.3107	-0.1320
		Animal reproduction response	121	31	-0.3767	-3.1565	120	0.0016	-0.6106	-0.1428
		Animal behaviour response	634	60	0.2817	6.9694	633	3.1820×10^{-12}	0.2025	0.3610
		Animal biomarker response	780	67	-0.5025	-4.6250	779	3.7455×10^{-6}	-0.7154	-0.2895
		Plant growth response	149	20	-0.5394	-2.4671	148	0.0136	-0.9678	-0.1109
		Plant reproduction response	683	46	0.4500	6.2591	682	3.8719×10^{-10}	0.3091	0.5909
		Plant biomarker response	75	11	-0.6788	-2.2750	74	0.0229	-1.2637	-0.0940
		Microorganism growth response	199	32	-1.0543	-2.6507	198	0.0080	-1.8339	-0.2748
		Microorganism reproduction response	174	13	0.5472	3.6082	173	0.0003	0.2500	0.8445
		Microorganism biomarker response	525	94	-0.2213	-4.8566	524	1.1944×10^{-6}	-0.3107	-0.1320
Old pesticides	Pesticide	Animal growth response	908	167	-0.0880	-3.5277	907	0.0004	-0.1369	-0.0391
		Animal reproduction response	3343	508	-0.4373	-10.1761	3342	2.5347×10^{-24}	-0.5216	-0.3531
		Animal behaviour response	888	167	-0.3417	-4.6218	887	3.8043×10^{-6}	-0.4867	-0.1968
		Animal biomarker response	2946	261	0.3786	13.0727	2945	4.7188×10^{-39}	0.3219	0.4354
		Plant growth response	1531	129	-0.3154	-7.6635	1530	1.8089×10^{-14}	-0.3961	-0.2348
		Plant reproduction response	414	67	-0.3342	-3.4307	413	0.0006	-0.5251	-0.1433
		Plant biomarker response	879	69	0.4041	4.9275	878	8.3273×10^{-7}	0.2434	0.5649
		Microorganism growth response	268	42	-0.5315	-6.0907	267	1.1244×10^{-9}	-0.7025	-0.3605
		Microorganism reproduction response	415	56	-0.7047	-4.8008	414	1.5807×10^{-6}	-0.9924	-0.4170
		Microorganism biomarker response	852	48	0.5005	8.0227	851	1.0346×10^{-15}	0.3782	0.6228
	Insecticide	Animal growth response	585	117	-0.1280	-3.6927	584	0.0002	-0.1959	-0.0600
		Animal reproduction response	2823	428	-0.4658	-10.0161	2822	1.2946×10^{-23}	-0.5570	-0.3747
		Animal behaviour response	651	134	-0.3476	-5.4533	650	4.9450×10^{-8}	-0.4725	-0.2227
		Animal biomarker response	2083	182	0.3847	10.9654	2082	5.6076×10^{-28}	0.3160	0.4535
		Plant growth response	484	46	-0.2141	-3.9314	483	8.4435×10^{-5}	-0.3208	-0.1074

	Plant reproduction response	231	33	-0.3162	-3.7016	230	0.0002	-0.4836	-0.1488
	Plant biomarker response	351	28	0.3965	2.3338	350	0.0196	0.0635	0.7294
	Microorganism growth response	74	12	-0.5293	-3.8724	73	1.0777×10^{-4}	-0.7972	-0.2614
	Microorganism reproduction response	200	21	-0.4884	-3.9498	199	7.8233×10^{-5}	-0.7308	-0.2460
	Microorganism biomarker response	388	22	0.4868	5.7608	387	8.3720×10^{-9}	0.3212	0.6525
Fungicide	Animal growth response	98	22	-0.0829	-1.5391	97	0.1238	-0.1884	0.0227
	Animal reproduction response	244	43	-0.3325	-1.7028	243	0.0886	-0.7153	0.0502
	Animal behaviour response	129	21	-0.4944	-2.7290	128	0.0064	-0.8495	-0.1393
	Animal biomarker response	420	30	0.4983	8.2810	419	1.2212×10^{-16}	0.3804	0.6162
	Plant growth response	222	31	-0.2877	-4.0211	221	5.7931×10^{-5}	-0.4279	-0.1474
	Plant reproduction response	77	16	-0.2769	-0.6156	76	0.5382	-1.1584	0.6047
	Plant biomarker response	83	13	0.2815	3.3405	82	0.0008	0.1163	0.4467
	Microorganism growth response	39	9	-0.6560	-2.5422	38	0.0110	-1.1618	-0.1503
	Microorganism reproduction response	150	27	-0.8811	-4.1154	149	3.8656×10^{-5}	-1.3007	-0.4614
	Microorganism biomarker response	89	3	0.1664	0.7208	88	0.4710	-0.2861	0.6189
Herbicide	Animal growth response	225	37	0.0180	0.4700	224	0.6384	-0.0570	0.0930
	Animal reproduction response	276	53	-0.3179	-3.8276	275	0.0001	-0.4807	-0.1551
	Animal behaviour response	108	17	-0.2261	-2.1477	107	0.0317	-0.4324	-0.0198
	Animal biomarker response	443	53	0.3625	6.1375	442	8.3841×10^{-10}	0.2467	0.4783
	Plant growth response	825	60	-0.4184	-5.8097	824	6.2590×10^{-9}	-0.5596	-0.2773
	Plant reproduction response	106	22	-0.4349	-4.2308	105	2.3288×10^{-5}	-0.6364	-0.2334
	Plant biomarker response	445	31	0.4565	7.0143	444	2.3105×10^{-12}	0.3290	0.5841
	Microorganism growth response	155	24	-0.4766	-4.5004	154	6.7824×10^{-6}	-0.6842	-0.2690
	Microorganism reproduction response	65	15	-0.6873	-1.9030	64	0.0570	-1.3951	0.0206
	Microorganism biomarker response	375	24	0.5596	6.0033	374	1.9340×10^{-9}	0.3769	0.7422

Supplementary Table 16 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides for model species and non-model species in all the 1705 studies. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Non-target organism type	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Model species	Pesticide	Animal growth response	660	131	-0.1071	-3.7703	659	1.6307×10^{-4}	-0.1628	-0.0514
		Animal reproduction response	1534	239	-0.4078	-7.8722	1533	3.4833×10^{-15}	-0.5094	-0.3063
		Animal behaviour response	675	119	-0.3097	-4.4722	674	7.7423×10^{-6}	-0.4455	-0.1740
		Animal biomarker response	2270	206	0.3852	12.3949	2269	2.7863×10^{-35}	0.3242	0.4461
		Plant growth response	996	110	-0.2499	-4.0863	995	4.3826×10^{-5}	-0.3698	-0.1300
		Plant reproduction response	248	43	-0.0798	-1.4273	247	0.1535	-0.1895	0.0298
		Plant biomarker response	641	53	0.3266	7.3132	640	2.6086×10^{-13}	0.2391	0.4141
		Microorganism growth response	52	9	-0.4903	-2.1971	51	0.0280	-0.9278	-0.0529
		Microorganism reproduction response	88	15	-0.8111	-2.6339	87	0.0084	-1.4147	-0.2075
		Microorganism biomarker response	36	7	0.6076	2.1317	35	0.0330	0.0489	1.1663
	Insecticide	Animal growth response	408	81	-0.1381	-3.4613	407	0.0005	-0.2163	-0.0599
		Animal reproduction response	1102	175	-0.4523	-7.1626	1101	7.9187×10^{-13}	-0.5760	-0.3285
		Animal behaviour response	478	86	-0.3778	-4.1397	477	3.4778×10^{-5}	-0.5567	-0.1989
		Animal biomarker response	1242	122	0.3748	10.3600	1241	3.7693×10^{-25}	0.3039	0.4457
		Plant growth response	377	37	-0.1831	-2.7430	376	0.0061	-0.3138	-0.0523
		Plant reproduction response	129	19	-0.0796	-1.0146	128	0.3103	-0.2333	0.0741
		Plant biomarker response	146	15	0.2595	2.9650	145	0.0030	0.0880	0.4311
		Microorganism growth response	5	1	0.0188	0.0473	4	0.9623	-0.7596	0.7972
		Microorganism reproduction response	14	2	-0.4617	-0.8595	13	0.3901	-1.5145	0.5911
		Microorganism biomarker response	3	1	0.0692	0.3743	2	0.7082	-0.2933	0.4318
	Fungicide	Animal growth response	94	26	-0.0893	-1.6808	93	0.0928	-0.1934	0.0148
		Animal reproduction response	251	40	-0.3293	-1.5930	250	0.1112	-0.7344	0.0759
		Animal behaviour response	104	18	-0.2949	-3.1954	103	0.0014	-0.4758	-0.1140
		Animal biomarker response	501	39	0.4383	6.5760	500	4.8318×10^{-11}	0.3077	0.5689
		Plant growth response	198	22	-0.2639	-3.0697	197	0.0021	-0.4323	-0.0954
		Plant reproduction response	41	10	0.0020	0.0225	40	0.9820	-0.1692	0.1732
		Plant biomarker response	111	9	0.2094	1.7767	110	0.0756	-0.0216	0.4405
		Microorganism growth response	11	2	-0.6972	-1.0989	10	0.2718	-1.9406	0.5463
		Microorganism reproduction response	53	8	-0.8234	-3.0963	52	0.0020	-1.3446	-0.3022
		Microorganism biomarker response	7	2	1.1657	1.0474	6	0.2949	-1.0157	3.3471
	Herbicide	Animal growth response	158	29	-0.0093	-0.2435	157	0.8076	-0.0846	0.0659
		Animal reproduction response	181	44	-0.2564	-4.3073	180	1.6525×10^{-5}	-0.3730	-0.1397
		Animal behaviour response	93	20	-0.3051	-2.5834	92	0.0098	-0.5366	-0.0736
		Animal biomarker response	527	56	0.3471	5.9409	526	2.8349×10^{-9}	0.2326	0.4616
		Plant growth response	421	57	-0.3691	-3.1472	420	0.0016	-0.5989	-0.1392
		Plant reproduction response	78	16	-0.2102	-1.2629	77	0.2066	-0.5365	0.1160
		Plant biomarker response	384	30	0.3878	6.3779	383	1.7948×10^{-10}	0.2687	0.5070
		Microorganism growth response	36	6	-0.4668	-2.2285	35	0.0258	-0.8774	-0.0563
		Microorganism reproduction response	21	5	-1.0603	-1.1484	20	0.2508	-2.8698	0.7492
		Microorganism biomarker response	26	4	0.4968	2.6447	25	0.0082	0.1286	0.8650
Non-model species	Pesticide	Animal growth response	845	127	-0.0633	-3.0388	844	0.0024	-0.1041	-0.0225
		Animal reproduction response	3942	480	-0.4188	-10.5428	3941	5.4837×10^{-26}	-0.4967	-0.3409
		Animal behaviour response	654	118	-0.3203	-4.3711	653	1.2360×10^{-5}	-0.4639	-0.1767
		Animal biomarker response	2200	174	0.4045	12.6202	2199	1.6337×10^{-36}	0.3417	0.4673
		Plant growth response	1581	100	-0.3890	-8.7366	1580	2.4028×10^{-18}	-0.4763	-0.3018
		Plant reproduction response	421	60	-0.4850	-2.9930	420	0.0028	-0.8027	-0.1674
		Plant biomarker response	1170	79	0.4741	6.1313	1169	8.7185×10^{-10}	0.3225	0.6256
		Microorganism growth response	371	46	-0.5851	-6.4962	370	8.2356×10^{-11}	-0.7616	-0.4086
		Microorganism reproduction response	677	72	-0.6414	-5.3752	676	7.6482×10^{-8}	-0.8753	-0.4075
		Microorganism biomarker response	1151	62	0.5186	9.8131	1150	9.8885×10^{-23}	0.4151	0.6222
	Insecticide	Animal growth response	386	65	-0.0944	-3.6154	385	0.0003	-0.1456	-0.0432
		Animal reproduction response	3124	375	-0.5026	-10.5301	3123	6.2797×10^{-26}	-0.5962	-0.4091
		Animal behaviour response	457	88	-0.3044	-3.6273	456	0.0003	-0.4689	-0.1399
		Animal biomarker response	1467	110	0.4174	10.4018	1466	2.4338×10^{-25}	0.3387	0.4960

	Plant growth response	248	24	-0.2726	-5.3548	247	8.5675×10^{-8}	-0.3724	-0.1729
	Plant reproduction response	165	22	-0.5151	-4.2973	164	1.7290×10^{-5}	-0.7500	-0.2802
	Plant biomarker response	276	21	0.5030	2.3399	275	0.0193	0.0817	0.9243
	Microorganism growth response	128	17	-0.5186	-4.3494	127	1.3649×10^{-5}	-0.7524	-0.2849
	Microorganism reproduction response	251	19	-0.4909	-3.7570	250	0.0002	-0.7470	-0.2348
	Microorganism biomarker response	529	29	0.4756	7.9590	528	1.7348×10^{-15}	0.3585	0.5928
Fungicide	Animal growth response	78	17	-0.0872	-1.4317	77	0.1522	-0.2066	0.0322
	Animal reproduction response	198	38	-0.1348	-1.1814	197	0.2374	-0.3584	0.0888
	Animal behaviour response	61	9	-0.4571	-2.2280	60	0.0259	-0.8592	-0.0550
	Animal biomarker response	183	16	0.4846	3.6085	182	0.0003	0.2214	0.7479
	Plant growth response	149	22	-0.2393	-1.8574	148	0.0633	-0.4917	0.0132
	Plant reproduction response	79	13	-0.4528	-0.7738	78	0.4391	-1.5997	0.6941
	Plant biomarker response	150	15	0.3947	4.7136	149	2.4342×10^{-6}	0.2306	0.5588
	Microorganism growth response	49	8	-1.0297	-2.7448	48	0.0061	-1.7649	-0.2944
	Microorganism reproduction response	183	25	-0.4718	-2.7227	182	0.0065	-0.8115	-0.1322
	Microorganism biomarker response	99	3	0.2332	1.1192	98	0.2631	-0.1752	0.6416
Herbicide	Animal growth response	381	56	-0.0046	-0.1310	380	0.8958	-0.0735	0.0643
	Animal reproduction response	620	95	-0.2383	-3.6187	619	0.0003	-0.3673	-0.1092
	Animal behaviour response	136	25	-0.2760	-2.6092	135	0.0091	-0.4832	-0.0687
	Animal biomarker response	550	55	0.3015	6.8994	549	5.2233×10^{-12}	0.2158	0.3871
	Plant growth response	1184	61	-0.5290	-8.6509	1183	5.1114×10^{-18}	-0.6488	-0.4091
	Plant reproduction response	177	28	-0.5511	-4.8723	176	1.1032×10^{-6}	-0.7728	-0.3294
	Plant biomarker response	744	46	0.5111	7.7775	743	7.3958×10^{-15}	0.3823	0.6399
	Microorganism growth response	194	24	-0.5144	-4.8444	193	1.2702×10^{-6}	-0.7226	-0.3063
	Microorganism reproduction response	243	35	-0.9357	-3.7024	242	0.0002	-1.4310	-0.4404
	Microorganism biomarker response	523	31	0.5715	6.2267	522	4.7635×10^{-10}	0.3916	0.7514

Supplementary Table 17 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behavior and biomarker) to pesticides, insecticides, fungicides and herbicides within the range of environmentally relevant concentrations in aquatic ecosystems. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Pesticide	Animal growth response	350	61	-0.0446	-3.5380	349	4.0312×10^{-4}	-0.0693	-0.0199
	Animal reproduction response	397	75	-0.3155	-16.2475	396	2.3254×10^{-59}	-0.3535	-0.2774
	Animal behavior response	162	37	-0.1807	-9.5678	161	1.0918×10^{-21}	-0.2177	-0.1437
	Animal biomarker response	895	86	0.3978	25.2234	894	2.2169×10^{-140}	0.3669	0.4288
	Plant growth response	164	28	-0.2783	-7.5924	163	3.1412×10^{-14}	-0.3502	-0.2065
	Plant reproduction response	61	14	-0.4711	-8.5243	60	1.5379×10^{-17}	-0.5795	-0.3628
	Plant biomarker response	104	22	0.2454	6.0461	103	1.4842×10^{-9}	0.1658	0.3249
	Microorganism growth response	42	12	-0.1153	-1.6678	41	0.0954	-0.2509	0.0202
	Microorganism reproduction response	20	4	-0.5350	-4.7406	19	2.1307×10^{-6}	-0.7562	-0.3138
	Microorganism biomarker response	98	11	0.2355	4.8809	97	1.0558×10^{-6}	0.1409	0.3301
Insecticide	Animal growth response	202	31	-0.0654	-3.1328	201	0.0017	-0.1063	-0.0245
	Animal reproduction response	295	50	-0.3693	-15.7358	294	8.5898×10^{-56}	-0.4153	-0.3233
	Animal behavior response	82	19	-0.3189	-10.0210	81	1.2331×10^{-23}	-0.3813	-0.2566
	Animal biomarker response	582	49	0.3183	15.2783	581	1.0670×10^{-52}	0.2774	0.3591
	Plant growth response	15	7	-0.4146	-4.4174	14	9.9894×10^{-6}	-0.5986	-0.2306
	Plant reproduction response	24	4	-0.6795	-6.2131	23	5.1948×10^{-10}	-0.8938	-0.4651
	Plant biomarker response	15	5	0.2023	2.4697	14	0.0135	0.0418	0.3628
	Microorganism growth response	13	4	-0.0786	-0.6224	12	0.5337	-0.3261	0.1689
	Microorganism reproduction response	10	1	-1.2031	-6.3732	9	1.8512×10^{-10}	-1.5731	-0.8331
	Microorganism biomarker response	48	6	0.2325	4.2726	47	1.9325×10^{-5}	0.1258	0.3391
Fungicide	Animal growth response	38	9	-0.0388	-0.8211	37	0.4116	-0.1313	0.0538
	Animal reproduction response	32	9	-0.2056	-3.3051	31	0.0009	-0.3276	-0.0837
	Animal behavior response	32	9	-0.3099	-7.7351	31	1.0331×10^{-14}	-0.3884	-0.2314
	Animal biomarker response	90	12	0.6429	14.2085	89	8.1130×10^{-46}	0.5542	0.7316
	Plant growth response	4	2	-0.0944	-0.6431	3	0.5202	-0.3820	0.1933
	Plant reproduction response	2	1	-0.2335	-1.6828	1	0.0924	-0.5055	0.0385
	Plant biomarker response	13	3	0.2382	2.2727	12	0.0230	0.0328	0.4436
	Microorganism growth response	6	1	-0.5115	-2.2728	5	0.0230	-0.9527	-0.0704
	Microorganism reproduction response	6	1	-0.5038	-2.2386	5	0.0252	-0.9450	-0.0627
	Microorganism biomarker response	42	2	0.1336	0.8215	41	0.4113	-0.1851	0.4523
Herbicide	Animal growth response	110	23	-0.0321	-1.9193	109	0.0550	-0.0648	0.0007
	Animal reproduction response	70	19	-0.1893	-4.7787	69	1.7642×10^{-6}	-0.2670	-0.1117
	Animal behavior response	48	11	-0.0053	-0.1870	47	0.8517	-0.0613	0.0506
	Animal biomarker response	223	27	0.4451	16.3021	222	9.5415×10^{-60}	0.3915	0.4986
	Plant growth response	145	19	-0.2665	-6.4403	144	1.1921×10^{-10}	-0.3476	-0.1854
	Plant reproduction response	35	11	-0.5025	-7.9969	34	1.2761×10^{-15}	-0.6257	-0.3793
	Plant biomarker response	76	15	0.2635	5.2245	75	1.7458×10^{-7}	0.1647	0.3624
	Microorganism growth response	23	7	-0.0718	-0.8077	22	0.4193	-0.2459	0.1024
	Microorganism reproduction response	4	2	0.0554	0.3073	3	0.7586	-0.2982	0.4091
	Microorganism biomarker response	8	3	0.3261	2.3943	7	0.0167	0.0592	0.5931

Supplementary Table 18 Results of the meta-regression analysis for the responses of taxonomic groups (invertebrates, vertebrates, seed plants, spore-producing plants, bacteria and fungus) and their response categories (growth, reproduction, behavior and biomarker) to pesticides, insecticides, fungicides and herbicides within the range of environmentally relevant concentrations in aquatic ecosystems. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Pesticide category	Non-target organism	Non-target organism response category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Pesticide	Animal	Vertebrate growth response	197	39	-0.0269	-1.7817	196	0.0748	-0.0565	0.0027
	Animal	Vertebrate reproduction response	107	35	-0.3295	-9.6344	106	5.7232×10^{-22}	-0.3965	-0.2625
	Animal	Vertebrate behavior response	79	21	-0.1598	-6.6184	78	3.6305×10^{-11}	-0.2071	-0.1125
	Animal	Vertebrate biomarker response	623	57	0.4384	23.0512	622	1.4293×10^{-117}	0.4011	0.4756
	Animal	Invertebrate growth response	153	22	-0.0849	-3.7188	152	0.0002	-0.1297	-0.0402
	Animal	Invertebrate reproduction response	290	40	-0.3088	-13.0923	289	3.6427×10^{-39}	-0.3550	-0.2626
	Animal	Invertebrate behavior response	83	16	-0.2137	-7.0477	82	1.8184×10^{-12}	-0.2731	-0.1543
	Animal	Invertebrate biomarker response	272	29	0.3085	10.9272	271	8.5448×10^{-28}	0.2532	0.3639
	Plant	Spore-producing plant growth response	48	16	-0.4937	-7.6895	47	1.4767×10^{-14}	-0.6195	-0.3679
	Plant	Spore-producing plant reproduction response	59	14	-0.5013	-8.9253	58	4.4456×10^{-19}	-0.6114	-0.3912
	Plant	Spore-producing plant biomarker response	86	17	0.2823	5.8960	85	3.7240×10^{-9}	0.1885	0.3762
	Plant	Seed plant growth response	116	12	-0.1742	-3.8999	115	9.6223×10^{-5}	-0.2617	-0.0866
	Plant	Seed plant reproduction response	2	1	-0.0736	-0.5307	1	0.5956	-0.3456	0.1983
	Plant	Seed plant biomarker response	18	5	0.1511	1.9770	17	0.0480	0.0013	0.3009
	Microorganism	Bacteria growth response	41	11	-0.1126	-1.5512	40	0.1208	-0.2549	0.0297
	Microorganism	Bacteria reproduction response	20	4	-0.5350	-4.7406	19	2.1307×10^{-6}	-0.7562	-0.3138
	Microorganism	Bacteria biomarker response	95	9	0.2282	4.5347	94	5.7675×10^{-6}	0.1296	0.3269
	Microorganism	Fungus growth response	1	1	NA	NA	NA	NA	NA	NA
	Microorganism	Fungus reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism	Fungus biomarker response	3	2	0.3184	1.8760	2	0.0607	-0.0143	0.6511
Insecticide	Animal	Vertebrate growth response	86	14	-0.0341	-1.0361	85	0.3001	-0.0987	0.0304
	Animal	Vertebrate reproduction response	64	19	-0.3313	-6.6587	63	2.7634×10^{-11}	-0.4289	-0.2338
	Animal	Vertebrate behavior response	29	8	-0.1275	-2.7637	28	0.0057	-0.2180	-0.0371
	Animal	Vertebrate biomarker response	398	30	0.3126	11.9708	397	5.0523×10^{-33}	0.2614	0.3638
	Animal	Invertebrate growth response	116	17	-0.0863	-3.2001	115	0.0014	-0.1391	-0.0334
	Animal	Invertebrate reproduction response	231	31	-0.3802	-14.2838	230	2.7605×10^{-46}	-0.4323	-0.3280
	Animal	Invertebrate behavior response	53	11	-0.4926	-11.2074	52	3.7516×10^{-29}	-0.5788	-0.4065
	Animal	Invertebrate biomarker response	184	19	0.3281	9.5002	183	2.0956×10^{-21}	0.2604	0.3958
	Plant	Spore-producing plant growth response	12	6	-0.5542	-4.9140	11	8.9226×10^{-7}	-0.7753	-0.3332
	Plant	Spore-producing plant reproduction response	24	4	-0.6795	-6.2131	23	5.1948×10^{-10}	-0.8938	-0.4651
	Plant	Spore-producing plant biomarker response	12	4	0.2045	2.1845	11	0.0289	0.0210	0.3879
	Plant	Seed plant growth response	3	1	-0.1002	-0.5918	2	0.5540	-0.4319	0.2316
	Plant	Seed plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant	Seed plant biomarker response	3	1	0.1952	1.1532	2	0.2488	-0.1365	0.5269
	Microorganism	Bacteria growth response	13	4	-0.0786	-0.6224	12	0.5337	-0.3261	0.1689
	Microorganism	Bacteria reproduction response	10	1	-1.2031	-6.3732	9	1.8512×10^{-10}	-1.5731	-0.8331
	Microorganism	Bacteria biomarker response	48	6	0.2325	4.2726	47	1.9325×10^{-5}	0.1258	0.3391
	Microorganism	Fungus growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism	Fungus reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism	Fungus biomarker response	0	0	NA	NA	NA	NA	NA	NA
Fungicide	Animal	Vertebrate growth response	33	7	-0.0321	-0.6498	32	0.5158	-0.1287	0.0646
	Animal	Vertebrate reproduction response	23	6	-0.2713	-3.5225	22	0.0004	-0.4222	-0.1203
	Animal	Vertebrate behavior response	24	6	-0.3582	-8.0347	23	9.3791×10^{-16}	-0.4455	-0.2708
	Animal	Vertebrate biomarker response	90	12	0.6429	14.2085	89	8.1130×10^{-46}	0.5542	0.7316
	Animal	Invertebrate growth response	5	2	-0.1117	-0.6867	4	0.4923	-0.4306	0.2072
	Animal	Invertebrate reproduction response	9	3	-0.0823	-0.7794	8	0.4357	-0.2892	0.1246
	Animal	Invertebrate behavior response	8	3	-0.1071	-1.1716	7	0.2414	-0.2862	0.0720
	Animal	Invertebrate biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant	Spore-producing plant growth response	1	1	NA	NA	NA	NA	NA	NA
	Plant	Spore-producing plant reproduction response	1	1	NA	NA	NA	NA	NA	NA
	Plant	Spore-producing plant biomarker response	13	3	0.2382	2.2727	12	0.0230	0.0328	0.4436
	Plant	Seed plant growth response	3	1	-0.1121	-0.6623	2	0.5078	-0.4438	0.2196
	Plant	Seed plant reproduction response	1	1	NA	NA	NA	NA	NA	NA
	Plant	Seed plant biomarker response	0	0	NA	NA	NA	NA	NA	NA

	Microorganism	Bacteria growth response	6	1	-0.5115	-2.2728	5	0.0230	-0.9527	-0.0704
	Microorganism	Bacteria reproduction response	6	1	-0.5038	-2.2386	5	0.0252	-0.9450	-0.0627
	Microorganism	Bacteria biomarker response	40	1	0.2135	1.0121	39	0.3115	-0.2000	0.6270
	Microorganism	Fungus growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism	Fungus reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism	Fungus biomarker response	2	1	0.0166	0.0651	1	0.9481	-0.4836	0.5168
Herbicide	Animal	Vertebrate growth response	78	19	-0.0238	-1.3165	77	0.1880	-0.0592	0.0116
	Animal	Vertebrate reproduction response	20	11	-0.3541	-6.0869	19	1.1515×10^{-9}	-0.4682	-0.2401
	Animal	Vertebrate behavior response	26	7	-0.0457	-1.2461	25	0.2127	-0.1177	0.0262
	Animal	Vertebrate biomarker response	135	17	0.5241	15.9468	134	2.9999×10^{-57}	0.4597	0.5885
	Animal	Invertebrate growth response	32	4	-0.0806	-1.8403	31	0.0657	-0.1664	0.0052
	Animal	Invertebrate reproduction response	50	8	-0.0468	-0.8651	49	0.3870	-0.1529	0.0592
	Animal	Invertebrate behavior response	22	4	0.0565	1.2439	21	0.2135	-0.0325	0.1455
	Animal	Invertebrate biomarker response	88	10	0.2691	5.4880	87	4.0655×10^{-8}	0.1730	0.3652
	Plant	Spore-producing plant growth response	35	9	-0.4967	-6.1331	34	8.6174×10^{-10}	-0.6554	-0.3380
	Plant	Spore-producing plant reproduction response	34	11	-0.5379	-8.3385	33	7.5269×10^{-17}	-0.6644	-0.4115
	Plant	Spore-producing plant biomarker response	61	11	0.3291	5.2746	60	1.3302×10^{-7}	0.2068	0.4514
	Plant	Seed plant growth response	110	10	-0.1852	-3.8469	109	0.0001	-0.2795	-0.0908
	Plant	Seed plant reproduction response	1	1	NA	NA	NA	NA	NA	NA
	Plant	Seed plant biomarker response	15	4	0.1398	1.6322	14	0.1026	-0.0281	0.3077
	Microorganism	Bacteria growth response	22	6	-0.0591	-0.6121	21	0.5405	-0.2483	0.1301
	Microorganism	Bacteria reproduction response	4	2	0.0554	0.3073	3	0.7586	-0.2982	0.4091
	Microorganism	Bacteria biomarker response	7	2	0.1963	1.1537	6	0.2486	-0.1372	0.5298
	Microorganism	Fungus growth response	1	1	NA	NA	NA	NA	NA	NA
	Microorganism	Fungus reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism	Fungus biomarker response	1	1	NA	NA	NA	NA	NA	NA

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Supplementary Table 19 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behavior and biomarker) to chemical synthetic, mineral-based and biogenic pesticides, insecticides, fungicides or herbicides within the range of environmentally relevant concentrations in aquatic ecosystems. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Chemical synthetic pesticides	Animal growth response	318	58	-0.0435	-3.4174	317	0.0006	-0.0685	-0.0186
	Animal reproduction response	374	70	-0.3003	-14.9137	373	2.6826×10^{-50}	-0.3397	-0.2608
	Animal behavior response	153	35	-0.1279	-6.5356	152	6.3369×10^{-11}	-0.1662	-0.0895
	Animal biomarker response	870	85	0.3993	25.2534	869	1.0392×10^{-140}	0.3683	0.4303
	Plant growth response	164	28	-0.2783	-7.5924	163	3.1412×10^{-14}	-0.3502	-0.2065
	Plant reproduction response	59	14	-0.4751	-8.4590	58	2.6978×10^{-17}	-0.5852	-0.3650
	Plant biomarker response	103	22	0.2580	6.2902	102	3.1701×10^{-10}	0.1776	0.3384
	Microorganism growth response	36	11	-0.0740	-1.0187	35	0.3083	-0.2165	0.0684
	Microorganism reproduction response	14	3	-0.5455	-4.1818	13	2.8917×10^{-5}	-0.8012	-0.2898
	Microorganism biomarker response	58	10	0.2367	4.7761	57	1.7876×10^{-6}	0.1396	0.3339
Mineral-based pesticides	Animal growth response	20	3	-0.1222	-1.3480	19	0.1777	-0.2999	0.0555
	Animal reproduction response	5	2	-0.1460	-0.9517	4	0.3412	-0.4467	0.1547
	Animal behavior response	9	2	-0.9082	-12.5153	8	6.1583×10^{-36}	-1.0505	-0.7660
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	6	1	-0.5115	-2.2728	5	0.0230	-0.9527	-0.0704
	Microorganism reproduction response	6	1	-0.5038	-2.2386	5	0.0252	-0.9450	-0.0627
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Biogenic pesticides	Animal growth response	12	1	0.0236	0.1780	11	0.8587	-0.2359	0.2831
	Animal reproduction response	18	5	-0.4724	-6.8675	17	6.5315×10^{-12}	-0.6073	-0.3376
	Animal behavior response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	25	2	0.1596	1.3502	24	0.1770	-0.0721	0.3913
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	2	1	-0.2335	-1.6828	1	0.0924	-0.5055	0.0385
	Plant biomarker response	1	1	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	40	1	0.2135	1.0121	39	0.3115	-0.2000	0.6270
Chemical synthetic insecticides	Animal growth response	190	31	-0.0667	-3.1907	189	0.0014	-0.1077	-0.0257
	Animal reproduction response	278	47	-0.3420	-14.0395	277	8.9399×10^{-45}	-0.3897	-0.2942
	Animal behavior response	82	19	-0.3189	-10.0210	81	1.2331×10^{-23}	-0.3813	-0.2566
	Animal biomarker response	557	48	0.3202	15.3008	556	7.5509×10^{-53}	0.2792	0.3612
	Plant growth response	15	7	-0.4146	-4.4174	14	9.9894×10^{-6}	-0.5986	-0.2306
	Plant reproduction response	24	4	-0.6795	-6.2131	23	5.1948×10^{-10}	-0.8938	-0.4651
	Plant biomarker response	15	5	0.2023	2.4697	14	0.0135	0.0418	0.3628
	Microorganism growth response	13	4	-0.0786	-0.6224	12	0.5337	-0.3261	0.1689
	Microorganism reproduction response	10	1	-1.2031	-6.3732	9	1.8512×10^{-10}	-1.5731	-0.8331
	Microorganism biomarker response	48	6	0.2325	4.2726	47	1.9325×10^{-5}	0.1258	0.3391
Mineral-based insecticides	Animal growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal behavior response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Biogenic insecticides	Animal growth response	12	1	0.0236	0.1780	11	0.8587	-0.2359	0.2831
	Animal reproduction response	17	4	-0.5723	-7.5131	16	5.7755E-14	-0.7216	-0.4230
	Animal behavior response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	25	2	0.1596	1.3502	24	0.1770	-0.0721	0.3913
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA

	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Chemical synthetic fungicides	Animal growth response	18	6	-0.0077	-0.1395	17	0.8891	-0.1161	0.1007
	Animal reproduction response	26	6	-0.2585	-3.4378	25	0.0006	-0.4058	-0.1111
	Animal behavior response	23	7	-0.0476	-0.9902	22	0.3221	-0.1418	0.0466
	Animal biomarker response	90	12	0.6429	14.2085	89	8.1130×10^{-46}	0.5542	0.7316
	Plant growth response	4	2	-0.0944	-0.6431	3	0.5202	-0.3820	0.1933
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	12	2	0.3762	2.7155	11	0.0066	0.1047	0.6477
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	2	1	0.0166	0.0651	1	0.9481	-0.4836	0.5168
Mineral-based fungicides	Animal growth response	20	3	-0.1222	-1.3480	19	0.1777	-0.2999	0.0555
	Animal reproduction response	5	2	-0.1460	-0.9517	4	0.3412	-0.4467	0.1547
	Animal behavior response	9	2	-0.9082	-12.5153	8	6.1583×10^{-36}	-1.0505	-0.7660
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	6	1	-0.5115	-2.2728	5	0.0230	-0.9527	-0.0704
	Microorganism reproduction response	6	1	-0.5038	-2.2386	5	0.0252	-0.9450	-0.0627
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Biogenic fungicides	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
	Animal reproduction response	1	1	NA	NA	NA	NA	NA	NA
	Animal behavior response	0	0	NA	NA	NA	NA	NA	NA
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	0	0	NA	NA	NA	NA	NA	NA
	Plant reproduction response	2	1	-0.2335	-1.6828	1	0.0924	-0.5055	0.0385
	Plant biomarker response	1	1	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	40	1	0.2135	1.0121	39	0.3115	-0.2000	0.6270
Chemical synthetic herbicides	Animal growth response	110	23	-0.0321	-1.9193	109	0.0550	-0.0648	0.0007
	Animal reproduction response	70	19	-0.1893	-4.7787	69	1.7642×10^{-6}	-0.2670	-0.1117
	Animal behavior response	48	11	-0.0053	-0.1870	47	0.8517	-0.0613	0.0506
	Animal biomarker response	223	27	0.4451	16.3021	222	9.5415×10^{-60}	0.3915	0.4986
	Plant growth response	145	19	-0.2665	-6.4403	144	1.1921×10^{-10}	-0.3476	-0.1854
	Plant reproduction response	35	11	-0.5025	-7.9969	34	1.2761×10^{-15}	-0.6257	-0.3793
	Plant biomarker response	76	15	0.2635	5.2245	75	1.7458×10^{-7}	0.1647	0.3624
	Microorganism growth response	23	7	-0.0718	-0.8077	22	0.4193	-0.2459	0.1024
	Microorganism reproduction response	4	2	0.0554	0.3073	3	0.7586	-0.2982	0.4091
	Microorganism biomarker response	8	3	0.3261	2.3943	7	0.0167	0.0592	0.5931
Mineral-based herbicides	Animal growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal behavior response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Biogenic herbicides	Animal growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal behavior response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Animal biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Plant biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Microorganism biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A

Supplementary Table 20 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behavior and biomarker) to pesticides, insecticides, fungicides and herbicides within the range of environmentally relevant concentrations in aquatic ecosystems in temperate and tropical experiments. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Data from laboratory conditions were removed from the models with climatic predictors. Each test is two-sided and the original P value is reported with no multiple comparisons.

Climatic zone of experiments	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Temperate experiment	Pesticide	Animal growth response	22	4	-0.0529	-1.5002	21	0.1336	-0.1220	0.0162
		Animal reproduction response	55	13	-0.2684	-4.7369	54	2.1706×10^{-6}	-0.3795	-0.1573
		Animal behavior response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	7	2	0.1141	1.5613	6	0.1185	-0.0291	0.2574
		Plant growth response	43	4	-0.1333	-1.3204	42	0.1867	-0.3312	0.0646
		Plant reproduction response	1	1	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Insecticide	Animal growth response	18	3	-0.2387	-2.4341	17	0.0149	-0.4308	-0.0465
		Animal reproduction response	49	10	-0.3349	-5.1793	48	2.2271×10^{-7}	-0.4616	-0.2081
		Animal behavior response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	4	1	0.0806	0.9656	3	0.3343	-0.0830	0.2441
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Fungicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	2	1	0.0002	0.0013	1	0.9990	-0.3516	0.3521
		Animal behavior response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Herbicide	Animal growth response	4	1	-0.0253	-0.6696	3	0.5031	-0.0994	0.0488
		Animal reproduction response	4	3	-0.0492	-0.3831	3	0.7017	-0.3010	0.2026
		Animal behavior response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	3	1	0.2249	1.4835	2	0.1380	-0.0722	0.5219
		Plant growth response	43	4	-0.1333	-1.3204	42	0.1867	-0.3312	0.0646
		Plant reproduction response	1	1	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Pesticide	Animal growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal behavior response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A

		Microorganism growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Insecticide	Animal growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal behavior response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Fungicide	Animal growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal behavior response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Herbicide	Animal growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal behavior response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Animal biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Plant biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism growth response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism reproduction response	0	0	N/A	N/A	N/A	N/A	N/A	N/A
		Microorganism biomarker response	0	0	N/A	N/A	N/A	N/A	N/A	N/A

Tropical experiment

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86 **Supplementary Table 21 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behavior and biomarker) to pesticides, insecticides, fungicides and herbicides within the**
88 **range of environmentally relevant concentrations of old and new pesticides in aquatic ecosystems.** Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations
90 available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Status of pesticides	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	Lower Bound of Confidence Interval (CI_{lb})	Upper Bound of Confidence Interval (CI_{ub})
Old pesticides	Pesticide	Animal growth response	288	52	-0.0573	-4.0514	287	5.0903×10^{-5}	-0.0851	-0.0296
		Animal reproduction response	311	57	-0.2353	-10.4956	310	9.0458×10^{-26}	-0.2792	-0.1914
		Animal behavior response	105	26	-0.2017	-9.0472	104	1.4674×10^{-19}	-0.2454	-0.1580
		Animal biomarker response	577	61	0.3962	22.1307	576	1.5996×10^{-108}	0.3611	0.4313
		Plant growth response	133	20	-0.2361	-5.7401	132	9.4646×10^{-9}	-0.3168	-0.1555
		Plant reproduction response	48	11	-0.5389	-8.6827	47	3.8661×10^{-18}	-0.6605	-0.4172
		Plant biomarker response	84	18	0.2097	4.6922	83	2.7033×10^{-6}	0.1221	0.2973
		Microorganism growth response	24	8	-0.0680	-0.7995	23	0.4240	-0.2348	0.0987
		Microorganism reproduction response	12	2	-0.8067	-5.3156	11	1.0629×10^{-7}	-1.1042	-0.5093
		Microorganism biomarker response	47	4	0.2929	2.4943	46	0.0126	0.0627	0.5230
	Insecticide	Animal growth response	171	27	-0.0693	-3.2161	170	0.0013	-0.1116	-0.0271
		Animal reproduction response	225	37	-0.2697	-9.5344	224	1.5077×10^{-21}	-0.3251	-0.2143
		Animal behavior response	56	13	-0.2962	-7.7207	55	1.1566×10^{-14}	-0.3714	-0.2210
		Animal biomarker response	382	38	0.3108	13.6022	381	3.8854×10^{-42}	0.2660	0.3556
		Plant growth response	8	4	-0.0324	-0.2732	7	0.7847	-0.2645	0.1998
		Plant reproduction response	13	2	-1.2817	-7.1640	12	7.8329×10^{-13}	-1.6324	-0.9311
		Plant biomarker response	15	5	0.2023	2.4697	14	0.0135	0.0418	0.3628
		Microorganism growth response	1	1	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	10	1	-1.2031	-6.3732	9	1.8512×10^{-10}	-1.5731	-0.8331
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Fungicide	Animal growth response	26	6	-0.0810	-1.2539	25	0.2099	-0.2076	0.0456
		Animal reproduction response	26	7	-0.1753	-2.5906	25	0.0096	-0.3080	-0.0427
		Animal behavior response	19	6	-0.3345	-7.7828	18	7.0941×10^{-15}	-0.4187	-0.2503
		Animal biomarker response	67	7	0.5617	10.1291	66	4.1043×10^{-24}	0.4530	0.6704
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	2	1	-0.2335	-1.6828	1	0.0924	-0.5055	0.0385
		Plant biomarker response	4	2	0.0848	0.6361	3	0.5247	-0.1766	0.3462
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	41	2	0.1454	0.8476	40	0.3967	-0.1908	0.4816
	Herbicide	Animal growth response	91	20	-0.0448	-2.2929	90	0.0219	-0.0831	-0.0065
		Animal reproduction response	60	15	-0.1798	-4.2560	59	2.0814×10^{-5}	-0.2626	-0.0970
		Animal behavior response	30	8	-0.0299	-0.8509	29	0.3948	-0.0989	0.0390
		Animal biomarker response	128	17	0.5133	15.6923	127	1.7070×10^{-55}	0.4492	0.5774
		Plant growth response	125	16	-0.2641	-6.0200	124	1.7441×10^{-9}	-0.3501	-0.1781
		Plant reproduction response	33	10	-0.5452	-8.4094	32	4.1218×10^{-17}	-0.6723	-0.4181
		Plant biomarker response	65	12	0.2381	4.2677	64	1.9750×10^{-5}	0.1287	0.3474
		Microorganism growth response	23	7	-0.0718	-0.8077	22	0.4193	-0.2459	0.1024
		Microorganism reproduction response	2	1	-0.0823	-0.3225	1	0.7470	-0.5825	0.4179
		Microorganism biomarker response	6	2	0.4229	2.6257	5	0.0086	0.1072	0.7386
	Pesticide	Animal growth response	62	13	0.0051	0.1964	61	0.8443	-0.0455	0.0556
		Animal reproduction response	86	22	-0.4909	-13.6638	85	1.6701×10^{-42}	-0.5613	-0.4204
		Animal behavior response	57	14	-0.1197	-3.5902	56	3.3037×10^{-4}	-0.1851	-0.0544
		Animal biomarker response	318	30	0.3872	12.7681	317	2.4699×10^{-37}	0.3277	0.4466
		Plant growth response	31	9	-0.4386	-5.6233	30	1.8735×10^{-8}	-0.5915	-0.2857
		Plant reproduction response	13	3	-0.2115	-1.7407	12	0.0817	-0.4497	0.0266
		Plant biomarker response	20	4	0.4127	4.2616	19	2.0300×10^{-5}	0.2229	0.6025
		Microorganism growth response	18	4	-0.2075	-1.7477	17	0.0805	-0.4403	0.0252
		Microorganism reproduction response	8	2	-0.1989	-1.1782	7	0.2387	-0.5297	0.1320

		Microorganism biomarker response	51	8	0.2195	4.1915	50	2.7717×10^{-5}	0.1169	0.3221
New pesticides	Insecticide	Animal growth response	31	7	0.0044	0.0807	30	0.9357	-0.1036	0.1125
		Animal reproduction response	70	16	-0.5251	-13.4724	69	2.2730×10^{-41}	-0.6015	-0.4487
		Animal behavior response	26	8	-0.3018	-6.0361	25	1.5791×10^{-9}	-0.3998	-0.2038
		Animal biomarker response	200	14	0.3427	7.5955	199	3.0658×10^{-14}	0.2543	0.4311
		Plant growth response	7	3	-1.0600	-6.8881	6	5.6550×10^{-12}	-1.3617	-0.7584
		Plant reproduction response	11	2	-0.3202	-2.3172	10	0.0205	-0.5910	-0.0494
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	12	3	-0.0903	-0.6458	11	0.5184	-0.3642	0.1837
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	48	6	0.2325	4.2726	47	1.9325×10^{-5}	0.1258	0.3391
	Fungicide	Animal growth response	12	3	0.0097	0.1396	11	0.8890	-0.1259	0.1452
		Animal reproduction response	6	2	-0.3707	-2.3461	5	0.0190	-0.6804	-0.0610
		Animal behavior response	13	3	-0.1468	-1.3265	12	0.1847	-0.3637	0.0701
		Animal biomarker response	23	5	0.8046	10.2809	22	8.5948×10^{-25}	0.6512	0.9580
		Plant growth response	4	2	-0.0944	-0.6431	3	0.5202	-0.3820	0.1933
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	9	1	0.4856	2.8663	8	0.0042	0.1536	0.8177
		Microorganism growth response	6	1	-0.5115	-2.2728	5	0.0230	-0.9527	-0.0704
		Microorganism reproduction response	6	1	-0.5038	-2.2386	5	0.0252	-0.9450	-0.0627
		Microorganism biomarker response	1	1	NA	NA	NA	NA	NA	NA
	Herbicide	Animal growth response	19	4	0.0021	0.0646	18	0.9485	-0.0605	0.0646
		Animal reproduction response	10	4	-0.2593	-2.2690	9	0.0233	-0.4832	-0.0353
		Animal behavior response	18	4	0.0381	0.7941	17	0.4272	-0.0559	0.1320
		Animal biomarker response	95	11	0.2803	5.8319	94	5.4795×10^{-9}	0.1861	0.3744
		Plant growth response	20	4	-0.3032	-2.6378	19	0.0083	-0.5284	-0.0779
		Plant reproduction response	2	1	0.1592	0.6238	1	0.5327	-0.3410	0.6594
		Plant biomarker response	11	3	0.3773	3.1969	10	0.0014	0.1460	0.6087
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	2	1	0.1932	0.7571	1	0.4490	-0.3070	0.6934
		Microorganism biomarker response	2	1	0.0831	0.3257	1	0.7446	-0.4171	0.5833

Supplementary Table 22 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behavior and biomarker) to pesticides, insecticides, fungicides and herbicides within the range of environmentally relevant concentrations for model and non-model species in aquatic ecosystems. Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Types of organism exposure to pesticides	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Model species	Pesticide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	137	30	-0.3637	-12.8454	136	9.1228×10^{-38}	-0.4192	-0.3082
		Animal behavior response	79	18	-0.2403	-9.1884	78	3.9856×10^{-20}	-0.2916	-0.1890
		Animal biomarker response	383	42	0.4528	18.9732	382	2.8382×10^{-80}	0.4061	0.4996
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Insecticide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	113	18	-0.3743	-10.9399	112	7.4262×10^{-28}	-0.4413	-0.3072
		Animal behavior response	43	8	-0.3528	-8.2718	42	1.3191×10^{-16}	-0.4364	-0.2692
		Animal biomarker response	212	20	0.3734	10.7061	211	9.5339×10^{-27}	0.3051	0.4418
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Fungicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	11	6	-0.2557	-3.3281	10	8.7442×10^{-4}	-0.4063	-0.1051
		Animal behavior response	20	5	-0.4032	-8.4664	19	2.5318×10^{-17}	-0.4965	-0.3099
		Animal biomarker response	47	8	0.3652	5.6448	46	1.6540×10^{-8}	0.2384	0.4920
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Herbicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	13	7	-0.3850	-6.0805	12	1.1978×10^{-9}	-0.5091	-0.2609
		Animal behavior response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	124	16	0.5510	15.6797	123	2.0822×10^{-55}	0.4821	0.6199
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Pesticide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	260	47	-0.2666	-10.2799	259	8.6815×10^{-25}	-0.3174	-0.2158
		Animal behavior response	83	19	-0.1158	-4.2386	82	2.2487×10^{-5}	-0.1693	-0.0622
		Animal biomarker response	512	47	0.3468	16.9206	511	3.1726×10^{-64}	0.3066	0.3869
		Plant growth response	110	25	-0.2994	-6.9114	109	4.7998×10^{-12}	-0.3843	-0.2145
		Plant reproduction response	59	14	-0.5013	-8.9253	58	4.4456×10^{-19}	-0.6114	-0.3912
		Plant biomarker response	97	20	0.2699	6.0714	96	1.2684×10^{-9}	0.1828	0.3570
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA

		Microorganism reproduction response	18	3	-0.6451	-5.1265	17	2.9518×10^{-7}	-0.8917	-0.3985
		Microorganism biomarker response	95	9	0.2282	4.5347	94	5.7675×10^{-6}	0.1296	0.3269
Non-model species	Insecticide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	182	33	-0.3435	-10.9109	181	1.0219×10^{-27}	-0.4052	-0.2818
		Animal behavior response	39	11	-0.2764	-5.7810	38	7.4252×10^{-9}	-0.3701	-0.1827
		Animal biomarker response	370	32	0.2800	11.2002	369	4.0691×10^{-29}	0.2310	0.3291
		Plant growth response	15	7	-0.4146	-4.4174	14	9.9894×10^{-6}	-0.5986	-0.2306
		Plant reproduction response	24	4	-0.6795	-6.2131	23	5.1948×10^{-10}	-0.8938	-0.4651
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	10	1	-1.2031	-6.3732	9	1.8512×10^{-10}	-1.5731	-0.8331
		Microorganism biomarker response	48	6	0.2325	4.2726	47	1.9325×10^{-5}	0.1258	0.3391
	Fungicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Animal behavior response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	43	4	0.9088	14.3552	42	9.8860×10^{-47}	0.7847	1.0328
		Plant growth response	0	0	NA	NA	NA	NA	NA	NA
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Herbicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
		Animal reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Animal behavior response	0	0	NA	NA	NA	NA	NA	NA
		Animal biomarker response	99	11	0.2838	6.5446	98	5.9661×10^{-11}	0.1988	0.3687
		Plant growth response	91	16	-0.2898	-5.5975	90	2.1743×10^{-8}	-0.3913	-0.1883
		Plant reproduction response	34	11	-0.5379	-8.3385	33	7.5269×10^{-17}	-0.6644	-0.4115
		Plant biomarker response	69	13	0.3123	5.3364	68	9.4793×10^{-8}	0.1976	0.4270
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA

Supplementary Table 23 Results of the meta-regression analysis for the responses of taxonomic groups (animals, plants and microorganisms) and their response categories (growth, reproduction, behaviour and biomarker) to pesticides, insecticides, fungicides and herbicides in conflict of interest status (i.e., no conflict of interest and having conflict of interest). Absolute values of 'biomarker' values were taken. In addition to the estimated mean effect sizes, test-statistics (t-value), and the associated P-values, the number of studies and observations available for each predictor category are also presented. Each test is two-sided and the original P value is reported with no multiple comparisons.

Conflict of interest status	Pesticide category	Non-target organism category	Number of observations	Number of studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
No conflict of interest	Pesticide	Animal growth response	1426	231	-0.0972	-4.9817	1425	6.3035×10^{-7}	-0.1354	-0.0589
		Animal reproduction response	4464	575	-0.3932	-10.2335	4463	1.4033×10^{-24}	-0.4686	-0.3179
		Animal behaviour response	1256	218	-0.2875	-6.1588	1255	7.3283×10^{-10}	-0.3790	-0.1960
		Animal biomarker response	3817	330	0.3925	16.4990	3816	3.7300×10^{-61}	0.3459	0.4392
		Plant growth response	1936	153	-0.3525	-6.8215	1935	9.0101×10^{-12}	-0.4538	-0.2512
		Plant reproduction response	437	68	-0.3284	-5.5411	436	3.0058×10^{-8}	-0.4446	-0.2123
		Plant biomarker response	1577	103	0.4244	6.7733	1576	1.2589×10^{-11}	0.3016	0.5472
		Microorganism growth response	336	41	-0.5515	-5.2346	335	1.6538×10^{-7}	-0.7581	-0.3450
		Microorganism reproduction response	557	74	-0.6892	-6.1423	556	8.1320×10^{-10}	-0.9091	-0.4693
		Microorganism biomarker response	1015	54	0.5640	8.8368	1014	9.8484×10^{-19}	0.4389	0.6891
	Insecticide	Animal growth response	757	130	-0.1344	-4.6115	756	3.9968×10^{-6}	-0.1916	-0.0773
		Animal reproduction response	3360	435	-0.4340	-9.2938	3359	1.4881×10^{-20}	-0.5255	-0.3425
		Animal behaviour response	888	161	-0.3109	-5.3950	887	6.8540×10^{-8}	-0.4239	-0.1980
		Animal biomarker response	2290	194	0.4032	12.3547	2289	4.5925×10^{-35}	0.3393	0.4672
		Plant growth response	410	42	-0.1920	-3.6466	409	0.0003	-0.2952	-0.0888
		Plant reproduction response	178	28	-0.2419	-3.2645	177	0.0011	-0.3871	-0.0967
		Plant biomarker response	372	28	0.4227	2.5079	371	0.0121	0.0924	0.7530
		Microorganism growth response	98	13	-0.4034	-3.3141	97	0.0009	-0.6420	-0.1648
		Microorganism reproduction response	143	16	-0.5664	-3.7305	142	0.0002	-0.8640	-0.2688
		Microorganism biomarker response	429	22	0.5308	6.8035	428	1.0214×10^{-11}	0.3779	0.6837
	Fungicide	Animal growth response	165	40	-0.0657	-1.7540	164	0.0794	-0.1392	0.0077
		Animal reproduction response	398	61	-0.2735	-2.4083	397	0.0160	-0.4961	-0.0509
		Animal behaviour response	153	24	-0.2976	-3.2864	152	0.0010	-0.4751	-0.1201
		Animal biomarker response	684	54	0.4426	7.1489	683	8.7445×10^{-13}	0.3213	0.5640
		Plant growth response	300	33	-0.2772	-2.5581	299	0.0105	-0.4895	-0.0648
		Plant reproduction response	41	10	-0.1895	-1.8342	40	0.0666	-0.3920	0.0130
		Plant biomarker response	220	20	0.3490	4.5854	219	4.5320×10^{-6}	0.1998	0.4982
		Microorganism growth response	60	10	-0.8592	-2.1065	59	0.0352	-1.6586	-0.0598
		Microorganism reproduction response	196	29	-0.7790	-4.2099	195	2.5546×10^{-5}	-1.1416	-0.4163
		Microorganism biomarker response	106	5	0.5875	1.4578	105	0.1449	-0.2024	1.3774
	Herbicide	Animal growth response	504	76	-0.0087	-0.2837	503	0.7767	-0.0692	0.0517
		Animal reproduction response	706	120	-0.2413	-4.0965	705	4.1939×10^{-5}	-0.3568	-0.1259
		Animal behaviour response	215	40	-0.2578	-2.9264	214	0.0034	-0.4305	-0.0852
		Animal biomarker response	843	95	0.3148	9.5816	842	9.5568×10^{-22}	0.2504	0.3791
		Plant growth response	1226	87	-0.4863	-6.6658	1225	2.6317×10^{-11}	-0.6293	-0.3433
		Plant reproduction response	218	34	-0.4883	-4.5296	217	5.9103×10^{-6}	-0.6996	-0.2770
		Plant biomarker response	985	59	0.4756	10.5205	984	6.9529×10^{-26}	0.3870	0.5643
		Microorganism growth response	178	21	-0.5186	-4.4354	177	9.1902×10^{-6}	-0.7477	-0.2894
		Microorganism reproduction response	218	35	-0.6739	-3.1013	217	0.0019	-1.0998	-0.2480
		Microorganism biomarker response	480	28	0.6085	6.4410	479	1.1868×10^{-10}	0.4233	0.7936
Having conflict of interest	Pesticide	Animal growth response	17	3	-0.0346	-0.2442	16	0.8071	-0.3124	0.2432
		Animal reproduction response	114	13	-0.4176	-3.1060	113	0.0019	-0.6811	-0.1541
		Animal behaviour response	36	5	-0.1056	-1.0378	35	0.2993	-0.3050	0.0938
		Animal biomarker response	26	3	0.7212	1.2378	25	0.2158	-0.4208	1.8632
		Plant growth response	36	4	-0.1563	-0.5399	35	0.5893	-0.7237	0.4111
		Plant reproduction response	9	2	0.2510	0.5140	8	0.6073	-0.7060	1.2080
		Plant biomarker response	4	1	0.2563	0.6323	3	0.5272	-0.5381	1.0508
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Insecticide	Animal growth response	4	1	-0.0289	-0.1334	3	0.8939	-0.4538	0.3960
		Animal reproduction response	100	10	-0.4893	-3.2164	99	0.0013	-0.7874	-0.1911
		Animal behaviour response	26	2	-0.1825	-1.0947	25	0.2736	-0.5092	0.1442
		Animal biomarker response	15	1	0.1207	0.4637	14	0.6429	-0.3895	0.6309
		Plant growth response	7	1	-0.3155	-4.5856	6	4.5273×10^{-6}	-0.4503	-0.1806
		Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
		Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA

Fungicide	Animal growth response	0	0	NA	NA	NA	NA	NA	NA
	Animal reproduction response	4	2	-0.1736	-1.4087	3	0.1589	-0.4151	0.0679
	Animal behaviour response	4	1	-0.1121	-0.3977	3	0.6908	-0.6644	0.4402
	Animal biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Plant growth response	1	1	NA	NA	NA	NA	NA	NA
	Plant reproduction response	9	2	0.2510	0.5140	8	0.6073	-0.7060	1.2080
	Plant biomarker response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA
Herbicide	Animal growth response	13	2	-0.0389	-0.2075	12	0.8357	-0.4061	0.3284
	Animal reproduction response	10	2	0.0129	0.0369	9	0.9706	-0.6723	0.6981
	Animal behaviour response	6	2	-0.0463	-0.3208	5	0.7484	-0.3290	0.2365
	Animal biomarker response	11	2	1.0088	1.1826	10	0.2370	-0.6631	2.6808
	Plant growth response	28	2	-0.4827	-1.3033	27	0.1925	-1.2085	0.2432
	Plant reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Plant biomarker response	4	1	0.2563	0.6323	3	0.5272	-0.5381	1.0508
	Microorganism growth response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism reproduction response	0	0	NA	NA	NA	NA	NA	NA
	Microorganism biomarker response	0	0	NA	NA	NA	NA	NA	NA

Supplementary Table 24. Sensitivity analysis for the use of absolute values of biomarkers on overall pesticide responses. Biomarkers include metrics that may potentially be both be up and down regulated as a response to exposure to pesticides. For example, protein synthesis may be hypothesized to be increased or decreased in response to different pesticides active ingredients. In both cases this would represent biologically meaningful responses that may have longer term fitness consequences for individual populations. To account for the potential of both up- and down-regulation of biomarkers we have treated these as absolute values within the main analyses, i.e. removed the directionality of the effect. This was done to avoid both positive and negative biomarker responses cancelling each other out and so resulting in a questionable presentation of no net effect of pesticides. However, our decision to use absolute values of biomarkers to infer effect sizes has implications for the underlying distribution of the data, although checks of model assumptions indicate that the analysis was robust (see Supplementary Fig. 25). To support broader interpretation of the data we provide a comparative sensitivity analysis below for the response of biomarkers to overall pesticide exposure for the animals, plants, and microorganisms using absolute values of 'biomarker' (as described in the methods) and the original raw values of 'biomarker', i.e. with directionality of the effect. As can be seen even when biomarkers are not treated as absolute values, they are still on average characterized by negative effects in response to pesticide exposure and the results remain qualitatively equivalent to those presented in the main paper. This would suggest that while biomarkers may in principal be both up and down regulated following pesticide exposure, across the studies considered this effect remains overwhelmingly down regulation. Each test is two-sided and the original P value is reported with no multiple comparisons.

Taxonomic group	Indicator	Number of missing studies	Effect size	t-value	df	P-value	CI_{lb}	CI_{ub}
Animal	Absolute values of 'biomarker'	0	0.3887	55.1021	4469	0.0000	0.3749	0.4025
	Original values of 'biomarker'	0	-0.0262	-2.8815	4469	0.0040	-0.0441	-0.0084
Plant	Absolute values of 'biomarker'	0	0.4730	30.8010	1810	2.5374×10^{-208}	0.4429	0.5031
	Original values of 'biomarker'	0	-0.1288	-6.9293	1810	4.2301×10^{-12}	-0.1652	-0.0923
Microorganism	Absolute values of 'biomarker'	301	0.6363	38.5786	1186	0.0000	0.6040	0.6687
	Original values of 'biomarker'	331	-0.4724	-21.6379	1186	7.9075×10^{-104}	-0.5152	-0.4296

Supplementary Note 1 Responses of animals, plants and microorganisms to pesticides

Supplementary Note 1.1 Sub-sets of the data on the responses of animals, plants and microorganisms to pesticides

These include sub-sets of the data by experimental study, climatic zones, types of pesticide, types of organism (taxonomic classes and whether it is a model ecotoxicological system), pesticide history (old or new pesticides), conflict of interest status and publication year.

Laboratory and field studies showed significant differences in response to pesticides among the three taxonomic groups (i.e., animals, plants, and microorganisms) (X^2=12.661, df=8, P<0.001), and among the taxonomic group response categories (growth, reproduction, behaviours and biomarkers) (X^2=432.775, df =15, P<0.001; Supplementary Table 1.1). In laboratory experiments, for animals, pesticides overall (i.e. all insecticides, fungicides and herbicides together) decreased growth (CI=−1.126 to −0.050, df=1381, ES=−0.088, P<0.001) and reproduction (CI=−0.459 to −0.314, df=4517, ES=−0.387, P<0.001) and suppressed behavioural responses (CI=−0.404 to −0.192, df=1218, ES=−0.298, P<0.001); pesticides overall decreased the growth (CI=−0.459 to −0.273, df=2219, ES=−0.366, P<0.001) and reproduction (CI=−0.745 to −0.263, df=527, ES=−0.504, P<0.001) of plants, and also decreased the growth (CI=−0.766 to −0.400, df=406, ES=−0.583, P<0.001) and reproduction (CI=−1.061 to −0.504, df=662, ES=−0.782, P<0.001) of microorganisms. Pesticides overall perturbed the absolute values of biomarkers of animals (CI=0.339 to 0.432, df=4438, ES=0.385, P<0.001), plants (CI=0.329 to 0.567, df=1621, ES=0.448, P<0.001) and microorganisms (CI=0.411 to 0.625, df=1158, ES=0.518, P<0.001) (Supplementary Table 6). In field experiments, pesticides decreased the behaviour (CI=−0.595 to −0.155, df=109, ES=−0.375, P=0.001) and reproduction (CI=−0.544 to −0.257, df=957, ES=−0.401, P<0.001) of animals, but there was no evidence of effects on measures of animal growth (CI=−0.291 to 0.013, df=122, ES=0.139, P=0.072); pesticides decreased plant growth (CI=−0.283 to −0.086, df=356, ES=−0.184, P<0.001) and microorganism reproduction (CI=−0.423 to −0.145, df=101, ES=−0.284, P<0.001), but there was no evidence of effects on plant reproduction (CI=−0.162 to 0.064, df=140, ES=0.049, P=0.396) or microorganism growth (CI=−0.403 to 0.449, df=15, ES=−0.023, P=0.915). Pesticides did not have significant effect on the biomarkers of animals (CI=−0.078 to 0.653, df=30, ES=0.287, P=0.123) and microorganisms (CI=−0.451 to 0.995, df=27, ES=0.272, P=0.461), but significantly perturbed the biomarkers of plants (CI=0.069 to 0.368, df=188, ES=0.218, P=0.004) (Supplementary Table 6; Fig. 5).

For climatic zone types, there were not significant difference in the response to pesticides among the three taxonomic groups (i.e., animals, plants and microorganisms) (X^2=0.288, df=8, P=0.591) and response categories (growth, reproduction, behaviours and biomarkers) between the taxonomic

group (X^2=37.586, df=15, P<0.001; Supplementary Table 1.1). In temperate zones, the response of animal reproduction (CI=−0.539 to −0.240, df=825, ES=−0.390, P<0.001), animal behaviour (CI=−0.628 to −0.102, df=77, ES=0.365, P=0.007), plant growth (CI=−0.304 to −0.100, df=294, ES=−0.202, P<0.001) and microorganism reproduction (CI=−0.428 to −0.130, df=86, ES=−0.279, P<0.001) to pesticides was negative and significant. The responses of animal growth (CI=−0.306 to −0.014, df=120, ES=−0.146, P=0.073), plant reproduction (CI=−0.175 to 0.065, df=127, ES=−0.055, P=0.371), microorganism growth (CI=−0.403 to 0.449, df=15, ES=−0.023, P=0.915), animal biomarkers (CI= − 0.078 to 0.653, df=30, ES=0.287, P=0.123), and microorganism biomarkers (CI=−0.451 to 0.995, df=27, ES=0.272, P=0.461) were not significant. However, the responses of the absolute value of the plant biomarkers (CI=0.041 to 0.363, df=141, ES=0.202, P=0.014) to pesticides were all significant. That is to say pesticides elicited a deviation from that seen under control conditions. In tropical zones, pesticides decreased animal reproduction (CI=−0.900 to −0.049, df=131, ES=−0.474, P=0.029) and animal behaviour (CI=−0.770 to −0.224, df=31, ES=−0.497, P<0.001), but the effect was not evident for animal growth (CI=−0.613 to 0.597, df=1, ES=−0.008, P=0.980), plant growth (CI=−0.310 to 0.502, df=61, ES=−0.096, P=0.643), plant biomarkers (CI=−0.208 to 0.884, df=46, ES=0.338, P=0.225), plant reproduction (CI=−0.386 to 0.480, df=12, ES=0.047, P=0.832) or microorganism reproduction (CI=−0.788 to 1.500, df=14, ES=−0.312, P=0.182). There were no response data (N=0) for animal biomarkers, microorganism growth or microorganism biomarkers,(Supplementary Table 7; Fig. 6).

There were not significant responses of taxonomic groups (i.e., animals, plants, and microorganisms) to the type of pesticides (fungicides, herbicides or insecticides) (X^2=4.777, df=9, P=0.092). The taxonomic group response categories (growth, reproduction, behaviours and biomarkers) differed significantly in response to these three classes of pesticides (X^2=422.399, df=16, P<0.001) (Supplementary Table 1.1). Looking at the impact of pesticides formulated for one taxonomic group (e.g. insecticides to control insects) on other taxonomic groups (e.g. insecticide impacts on plants) we found that insecticides impacted the growth (CI=−0.176 to −0.070, df=793, ES=−0.123, P<0.001), reproduction (CI=−0.550 to −0.382, df=4225, ES=−0.466, P<0.001) and behaviour of animals (CI=−0.421 to −0.202, df=934, ES=−0.311, P<0.001) (Fig. 2b). Fungicides also reduced animal growth (CI=−0.153 to −0.005, df=171, ES=−0.079, P=0.037), reproduction (CI=−0.521 to 0.001, df=448, ES=−0.260, P=0.051) and measures of behaviour (CI=−0.693 to −0.145, df=164, ES=−0.419, P=0.003) (Fig. 2c). Our analysis also detected impacts of herbicides on animal reproduction (CI=−0.362 to −0.145, df=800, ES=−0.253, P<0.001) and behaviour (CI=−0.475 to −0.126, df=228, ES=−0.301, P<0.001) (Fig. 2d) but not on animal growth (CI=−0.061 to 0.058, df=538, ES=−0.001, P=0.969). Insecticides (CI=0.325 to 0.440, df=2708, ES=0.382, P<0.001), fungicides (CI=0.321 to 0.564, df=683, ES=0.443, P<0.001) and herbicides

(CI=0.255 to 0.405, df=1076, ES=0.330, P<0.001) perturbed animal biomarkers. Three types of pesticides decreased plant growth (insecticides, CI=−0.307 to −0.113, df=624, ES=−0.210, P<0.001; fungicides, CI=−0.433 to −0.045, df=346, ES=−0.239, P=0.016; herbicides, CI=−0.602 to −0.362, df=1604, ES=−0.482, P<0.001) and reproduction (insecticides, CI=−0.448 to −0.167, df=293, ES=−0.308, P<0.001; fungicides, CI=−1.173 to 0.430, df=119, ES=−0.372, P=0.364; herbicides, CI=−0.619 to −0.242, df=254, ES=−0.431, P<0.001). Considered separately (insecticides, CI=0.133 to 0.686, df=421, ES=0.410, P=0.004; fungicides, CI=0.190 to 0.454, df=260, ES=0.322, P<0.001; herbicides, CI=0.369 to 0.554, df=1127, ES=0.462, P<0.001), plant biomarkers were all significantly affected. For microorganisms, three types of pesticide exposure decreased growth (insecticides, CI=−0.712 to −0.258, df=132, ES=−0.485, P<0.001; fungicides, CI=−1.659 to −0.060, df=59, ES=−0.859, P=0.035; herbicides, CI=−0.694 to −0.327, df=229, ES=−0.510, P<0.001) and reproduction (insecticides, CI=−0.741 to −0.252, df=264, ES=−0.496, P<0.001; fungicides, CI=−1.079 to −0.418, df=235, ES=−0.748, P<0.001; herbicides, CI=−0.694 to −0.327, df=229, ES=−0.510, P<0.001) (Fig. 2). Microorganism biomarkers (i.e., indicators of enzymatic reaction system) were significantly affected by exposure to insecticides (CI=0.327 to 0.562, df=531, ES=0.444, P<0.001) and herbicides (CI=0.403 to 0.729, df=548, ES=0.566, P<0.001) but not fungicides (CI=−0.202 to 1.377, df=105, ES=0.588, P=0.145) (Supplementary Table 3; Fig. 2).

Types of pesticide based on their chemical makeup (distinguishing between mineral-based, biogenic and chemical synthetic pesticides) also caused significant difference in response to pesticides among the three taxonomic groups (i.e., animals, plants and microorganisms) (X^2=13.772, df=9, P=0.001) and among the taxonomic group response categories (growth, reproduction, behaviours and biomarkers) (X^2=430.943, df=16, P<0.001) (Supplementary Table 1). The responses of animals (growth: CI=−0.133 to −0.054, df=1360, ES=−0.093, P<0.001; reproduction: CI=−0.494 to −0.345, df=4523, ES=−0.419, P<0.001; behaviour: CI=−0.444 to −0.205, df=1146, ES=−0.324, P<0.001; biomarkers: CI=0.341 to 0.435, df=4184, ES=0.388, P<0.001), plants (growth: CI=−0.448 to −0.267, df=2439, ES=−0.357, P<0.001; reproduction: CI=−0.575 to −0.148, df=616, ES=−0.362, P<0.001; biomarkers: CI=0.299 to 0.513, df=1794, ES=0.406, P<0.001) and microorganisms (growth: CI=−0.715 to −0.364, df=404, ES=−0.540, P<0.001; reproduction: CI=−0.985 to −0.471, df=685, ES=−0.728, P<0.001; biomarkers: CI=0.398 to 0.598, df=1099, ES=0.498, P<0.001) to chemical synthetic pesticides were all significant. Likewise, the responses of animal behaviour (CI=−1.216 to −0.144, df=36, ES=−0.680, P=0.013) and animal biomarker (CI=0.249 to 0.670, df=104, ES=0.460, P<0.001), plant reproduction (CI=−1.296 to −0.056, df=34, ES=−0.676, P=0.033), microorganism growth (CI=−1.926 to −0.005, df=17, ES=−0.966, P=0.049) and microorganism reproduction (CI=−1.464 to −0.083, df=51, ES=−0.774, P=0.028) to mineral-based pesticides were all significant. For biogenic pesticides, the responses of animal reproduction

(CI=−0.531 to −0.270, df=830, ES=−0.401, P<0.001) and animal biomarker (CI=0.197 to 0.469, df=179, ES=0.333, P<0.001) were all significant, but there was no significant response for animal growth (CI=−0.130 to 0.071, df=98, ES=−0.030, P=0.564), animal behaviour (CI=−0.245 to 0.054, df=144, ES=−0.096, P=0.210), plant growth (CI=−0.210 to 0.161, df=66, ES=−0.025, P=0.795), plant reproduction (CI=−0.356 to 0.176, df=16, ES=0.090, P=0.508) or plant biomarker (CI=−0.228 to 0.456, df=15, ES=0.114, P=0.513). For the microorganisms, the responses of biomarkers (CI=−0.553 to 0.877, df=83, ES= 0.162, P=0.657) and reproduction (CI=−1.010 to 0.092, df=26, ES=−0.459, P=0.102) were not significant (see Supplementary Table 5; Fig. 4).

The medium in which exposure to pesticides occurred (aquatic or terrestrial) resulted in marginally significant differences in the response to pesticides between the three taxonomic groups (i.e., animals, plants, and microorganisms) (X^2=3.707, df=8, P=0.054), and caused significant difference in the response to pesticides between the taxonomic group response categories (growth, reproduction, behaviours and biomarkers) (X^2=419.477, df=15, P<0.001) (Supplementary Table 1). In aquatic systems, the responses of animals to overall pesticides were all significant (growth: CI=−0.096 to −0.013, df=915, ES=−0.055, P=0.010; reproduction: CI=−0.504 to −0.297, df=1277, ES=−0.401, P<0.001; behaviour: CI=−0.550 to −0.150, df=386, ES=−0.350, P=0.001; biomarkers: CI=0.352 to 0.468, df=2723, ES=0.410, P<0.001). The same effects occurred on the responses of plants (growth: CI=−0.704 to −0.398, df=625, ES=−0.551, P<0.001; reproduction: CI=−0.708 to −0.410, df=261, ES=−0.559, P<0.001; biomarkers: CI=0.333 to 0.755, df=811, ES=0.544, P<0.001) and microorganisms (growth: CI=−0.624 to −0.329, df=300, ES=−0.477, P<0.001; reproduction: CI=−1.253 to −0.504, df=202, ES=−0.878, P<0.001; biomarkers: CI=0.415 to 0.626, df=1181, ES=0.521, P<0.001). In terrestrial systems, pesticides significantly negatively affected the responses of animal growth (CI=−0.170 to −0.061, df=588, ES=−0.115, P<0.001), reproduction (CI=−0.491 to −0.335, df=4197, ES=−0.413, P<0.001) and behaviour (CI=−0.400 to −0.185, df=941, ES=−0.292, P<0.001). The response of plant growth (CI=−0.340 to −0.166, df=1950, ES=−0.253, P<0.001) and reproduction (CI=−0.539 to −0.033, df=406, ES=−0.286, P=0.027) to pesticides was significant and negative. The response of microorganism growth (CI=−1.423 to −0.136, df=121, ES=−0.779, P=0.018), and reproduction (CI=−0.850 to −0.395, df=561, ES=−0.623, P<0.001) to pesticides was significant and negative. Finally, pesticides significantly perturbed the biomarkers of animals (CI=0.307 to 0.431, df=1745, ES=0.369, P<0.001) and plants (CI=0.279 to 0.436, df=998, ES=0.357, P<0.001), although there was no significant effect for microorganism biomarkers (CI=−0.421 to 0.916, df=4, ES=0.248, P=0.468) (Supplementary Table 8; Fig. 7).

Studies on old (currently not licensed in the European Union) and new (licensed for use in the EU) pesticides did not show significant differences in response to pesticides among the three

taxonomic groups (i.e., animals, plants, and microorganisms) (X^2=0.149, df=8, P=0.700), but showed significant differences among the taxonomic group response categories (growth, reproduction, behaviours and biomarkers) (X^2=418.138, df =15, P<0.001; Supplementary Table 1.1). For exposure to old pesticide active ingredients, pesticides overall (i.e. all old insecticides, fungicides and herbicides together) decreased growth (CI=−0.137 to −0.039, df=907, ES=−0.088, P<0.001), reproduction (CI=−0.522 to −0.351, df=3342, ES=−0.437, P<0.001) and measures of behavioural responses of animals (CI=−0.487 to −0.197, df=887, ES=−0.342, P<0.001). They did, however, result in deviation of the absolute values of animal biomarkers from zero (CI=0.322 to 0.435, df=2945, ES=0.379, P<0.001). Overall, old pesticides decreased the growth (CI=−0.396 to −0.235, df=1530, ES=−0.315, P<0.001) and reproduction (CI=−0.525 to −0.143, df=413, ES=−0.334, P=0.001) of plants but increased plant biomarkers (CI=0.243 to 0.565, df=878, ES=0.404, P<0.001). Likewise, old pesticides decreased the growth (CI=−0.703 to −0.361, df=267, ES=−0.532, P<0.001) and reproduction (CI=−0.992 to −0.417, df=414, ES=−0.705, P<0.001) of microorganisms but increased microorganism biomarkers (CI=0.378 to 0.623, df=851, ES=0.501, P<0.001) (Supplementary Table 15). In new pesticide experiments, pesticides decreased growth (CI=−0.112 to −0.026, df=596, ES=−0.069, P=0.002), reproduction (CI=−0.517 to −0.236, df=2132, ES=−0.376, P<0.001) and behaviours of animals (CI=−0.325 to −0.089, df=440, ES=−0.207, P=0.001), but increased animal biomarkers (CI=0.296 to 0.432, df=1523, ES=0.364, P<0.001). Likewise, new pesticides decreased plant growth (CI=−0.522 to −0.248, df=1045, ES=−0.385, P<0.001) and reproduction (CI=−0.894 to 0.092, df=254, ES=−0.401, P=0.112) but increased plant biomarkers (CI=0.303 to 0.500, df=931, ES=0.401, P<0.001). New pesticides decreased microorganism growth (CI=−1.047 to −0.202, df=154, ES=−0.625, P=0.004) and reproduction (CI=−1.222 to −0.434, df=349, ES=−0.828, P<0.001) but increased microorganism biomarkers (CI=0.321 to 0.690, df=334, ES=0.506, P<0.001) (Supplementary Table 15).

Types of experimental organisms (non-model and model species based principally on OECD and US EPA recommended regulatory study species) did not significantly affect the response to pesticides among the three taxonomic groups (i.e., animals, plants and microorganisms) (X^2=1.210, df=8, P=0.271) but not among the taxonomic group response categories (growth, reproduction, behaviours and biomarkers) (X^2=419.477, df=15, P<0.001) (Supplementary Table 1.1). For model species, pesticides decreased animal growth (CI=−0.163 to −0.051, df=659, ES=−0.107, P<0.001), reproduction (CI=−0.509 to −0.306, df=1533, ES=−0.408, P<0.001) and behaviours (CI=−0.446 to −0.174, df=674, ES=−0.310, P<0.001), but increased animal biomarkers (CI=0.324 to 0.446, df=2269, ES=0.385, P<0.001). Pesticides decreased plant growth (CI=−0.370 to −0.130, df=995, ES=−0.250, P<0.001), increased plant biomarkers (CI=0.239 to 0.414, df=640, ES=0.327, P<0.001), but had no significant effect on plant reproduction (CI=−0.190 to 0.030, df=247, ES=−0.080,

P=0.154). Pesticides decreased model microorganism growth (CI=−0.928 to −0.053, df=51, ES=−0.490, P=0.028), model microorganism reproduction (CI=−1.415 to −0.208, df=87, ES=−0.811, P=0.008), and increased model microorganism biomarkers (CI=0.049 to 1.166, df=35, ES=0.608, P=0.033) (Supplementary Table 16). For non-model species, pesticides decreased animal growth (CI=−0.104 to −0.023, df=844, ES=−0.063, P=0.002), reproduction (CI=−0.497 to −0.341, df=3941, ES=−0.419, P<0.001) and measured behaviours (CI=−0.464 to −0.177, df=653, ES=−0.320, P<0.001), but increased animal biomarkers (CI=0.342 to 0.467, df=2199, ES=0.405, P<0.001). Pesticides decreased non-model plant growth (CI=−0.476 to −0.302, df=1580, ES=−0.389, P<0.001) and non-model plant reproduction (CI=−0.803 to −0.167, df=420, ES=−0.485, P=0.003) and increased non-model plant biomarkers (CI=0.323 to 0.626, df=1169, ES=0.474, P<0.001). Pesticides decreased non-model microorganism growth (CI=−0.762 to −0.409, df=370, ES=−0.585, P<0.001) and reproduction (CI=−0.875 to −0.408, df=676, ES=−0.641, P<0.001), but increased non-model microorganism biomarkers (CI=0.415 to 0.622, df=1150, ES=0.519, P<0.001) (Supplementary Table 16).

Conflict of interest status did not show significant differences in response to pesticides among the three taxonomic groups (i.e., animals, plants, and microorganisms) (X^2=4.983, df=9, P=0.083), but showed significant differences among the taxonomic group response categories (growth, reproduction, behaviours and biomarkers) (X^2=421.889, df=16, P<0.001; Supplementary Table 1.1). For the pesticide articles without conflict of interest, pesticides overall (i.e. all insecticides, fungicides and herbicides together) decreased growth (CI=−0.135 to −0.059, df=1425, ES=−0.097, P<0.001), reproduction (CI=−0.469 to −0.318, df=4463, ES=−0.393, P<0.001) and measures of behavioural responses of animals (CI=−0.379 to −0.196, df=1255, ES=−0.288, P<0.001). They did, however, result in deviation of the absolute values of animal biomarkers from zero (CI=0.346 to 0.439, df=3816, ES=0.393, P<0.001). Likewise, pesticides without conflict of interest decreased the growth (CI=−0.454 to −0.251, df=1935, ES=−0.353, P<0.001) and reproduction (CI=−0.445 to −0.212, df=436, ES=−0.328, P<0.001) of plants but increased plant biomarkers (CI=0.302 to 0.547, df=1576, ES=0.424, P<0.001), and pesticides decreased the growth (CI=−0.758 to −0.345, df=335, ES=−0.552, P<0.001) and reproduction (CI=−0.909 to −0.469, df=556, ES=−0.689, P<0.001) of microorganisms but increased microorganism biomarkers (CI=0.439 to 0.689, df=1014, ES=0.564, P<0.001) (Supplementary Table 23). For the pesticide articles with conflict of interest, pesticides overall (i.e. all insecticides, fungicides and herbicides together) had no significant effects on animal growth (CI=−0.312 to 0.243, df=16, ES=−0.035, P=0.807), animal behaviour (CI=−0.305 to 0.094, df=35, ES=−0.106, P=0.299) or animal biomarkers (CI=−0.421 to 1.863, df=25, ES=0.721, P=0.216), but had significant effects on animal reproduction (CI=−0.681 to −0.154, df=113, ES=−0.418, P=0.002). Pesticides (with conflict of interest) had no significant effects on the growth

(CI=−0.724 to 0.411, df=35, ES=−0.156, P=0.589), reproduction (CI=−0.706 to 1.208, df=8, ES=0.251, P=0.607) or biomarkers (CI= − 0.538 to 1.051, df=3, ES=0.251, P=0.607) of microorganisms (Supplementary Table 23). The responses of animal behaviours, microorganism reproduction to pesticides (with conflict of interest) were not found due to lack of sample size. In addition, an assessment of the effects of insecticides, fungicides and herbicides on animals, plants and microorganisms was not possible due to low sample size (Supplementary Tables 23).

Publication year did not show significant differences in response to pesticides among the three taxonomic groups (i.e., animals, plants, and microorganisms) (X^2=1.519, df=8, P=0.218), but had significant differences in response to pesticides among the taxonomic group response categories (growth, reproduction, behaviours and biomarkers) (X^2=419.180, df=15, P<0.001; Supplementary Table 1.1).

In this analysis we refined the taxonomic resolution of animals, plants, and microorganisms into six taxonomic groups (i.e., invertebrates, vertebrates, seed plants, spore-producing plants, bacteria and fungi) (Fig. 3). For these, there existed overall significant difference between them to the type of experimental study (laboratory or field: X^2=12.040, df=11, P=0.001), and pesticide type by chemical makeup (mineral-based, biogenic and chemical synthetic pesticides: X^2=14.075, df=12, P=0.001) but the difference was not significant for climatic zones (temperate or tropical: X^2=0.681, df=11, P=0.409), pesticide classification (fungicides, herbicides or insecticides: X^2=5.301, df=12, P=0.071), medium of exposure (terrestrial or aquatic: X^2=0.366, df=11, P=0.545), types of experimental organisms (model or non-model species: X^2=0.698, df=11, P=0.404), types of pesticide use history (old or new pesticides: X^2=0.134, df=11, P=0.715), conflict of interest status (with or without conflict of interest: X^2=4.677, df=12, P=0.097), or for publication year (X^2=1.230, df=11, P=0.267) (Supplementary Table 1.2).

When the six taxonomic groups were split into 20 response categories (i.e., invertebrate growth, invertebrate reproduction, invertebrate behaviour, invertebrate biomarkers, vertebrate growth, vertebrate reproduction, vertebrate behaviour, vertebrate biomarkers, seed plant growth, seed plant reproduction, seed plant biomarkers, spore-producing plant growth, spore-producing plant reproduction, spore-producing plant biomarkers, bacteria growth, bacteria reproduction, bacteria biomarkers, fungus growth, fungus reproduction and fungus biomarkers), we found that there existed significant difference in their response to the types of experimental study (X^2=556.127, df=25, P<0.001), climatic zones (X^2=41.044, df=23, P<0.001), pesticide type (X^2=545.887, df=26, P<0.001), pesticide chemical makeup (X^2=554.361, df=26, P<0.001), medium though which chemical exposure occurred (X^2=542.433, df=25, P<0.001), types of experimental organisms (X^2=542.041, df=25, P<0.001) and types of pesticide use history (X^2=541.382, df=25, P<0.001) (Supplementary Table 1.2). Likewise, the difference was not significant for conflict of interest

status (X^2=544.973, df=26, P<0.001), or for publication year (X^2=542.340, df=25, P<0.001) (Supplementary Table 1.2).

Supplementary Note 1.2 Responses of different taxonomic groups to pesticides

For these the responses of animals (including amphibian, annelid, arthropods, birds, coelenterata, echinoderm, fish, mammals, mollusks, nemathelminth, platyhelminth, protozoa, reptiles, rotifera), plants (including algae, dicotyledonous and monocotyledonous plants) and microorganisms (including ascomycotina, bacillus, basidiomycotina, cocci, deuteromycotina, glomeromycota, spirillum and zygomycotina) in terms of their growth, reproduction, behaviour, and biomarkers were variable or non-significant (Supplementary Data 5−7).

We also show that pesticides not formulated with the goal of controlling particular taxonomic groups still elicited negative effects. Insecticides (e.g., neonicotinoids, organophosphorus and pyrethroids) had: a) negative effects on the growth, reproduction or behaviour of animals and their subgroups (e.g., annelid, arthropods, amphibians and fish) (Supplementary Table 9); b) had a negative effects on the growth and reproduction of plants and their subgroups (e.g., algae, dicotyledonous and monocotyledonous plants), negative effects on the growth and reproduction of microorganisms and their subgroups (e.g., ascomycotina, bacillus and glomeromycota); and c) also perturbed the the biomarkers of animals, plants, microorganisms and their subgroups. Fungicides (e.g., amide) and herbicides (e.g., organophosphorus) had negative effects on: d) the growth, reproduction or behaviour of animals; and e) perturbed the the biomarkers of animals (Supplementary Data 6 and 7). Similarly, these suppressive effects occurred in the responses of plants and microorganism to chemical herbicides (e.g., organophosphorus) (Supplementary Data 7). An assessment of the effects of insecticides and fungicides on plants and microorganisms was not possible due to low sample size (Supplementary Data 5 and 6).

Supplementary Note 1.3 Application rate-dependent effects of pesticides on non-target organisms

To establish the application rate-dependent relationships of the different pesticide impacts we used generalized least-squares models to correlate the different effect sizes with the application rate (log_2-transformed number of application rates relative to a control; see Methods and Supplementary Data 8). We found significantly negative relationships between increased application rate of pesticides and the growth (t_{1141}=−2.619, P=0.009, R^2=0.026), reproduction (t_{3811}= −14.949, P<0.001, R^2=0.274) and behaviour (t_{955}=−4.335, P<0.001, R^2=0.154) of animals (Fig. 9a). Likewise,

significantly negative relationships were also seen between increased application rate of pesticides and the growth (t_{2211}=−4.170, P<0.001, R^2=0.128) and reproduction (t_{476}=−0.804, P<0.001, R^2=0.392) of plants, as well as between increased pesticide application rates and the growth (t_{334}=−9.120, P<0.001, R^2=0.231) and reproduction (t_{587}=−3.794, P<0.001, R^2=0.341) of microorganisms (Fig. 9c). However, we found positive relationships between increased application rate of pesticides and absolute value of the responses of animal biomarkers (t_{4009}=1.942, P=0.052, R^2=0.067), plant biomarkers (t_{1623}=6.733, P<0.001, R^2=0.185) and microorganism biomarkers (t_{1083}=5.246, P<0.001, R^2=0.113) (Fig. 9). This indicated that there were clear application rate dependent effects of increased pesticide application rates on non-target organisms.

We found application rate dependent negative effects of insecticides on the growth (t_{585}=−3.164, P=0.002, R^2=0.038), reproduction (t_{2881}=−13.841, P<0.001, R^2=0.284) and behaviour (t_{661}=−4.127, P<0.001, R^2=0.164) of animals (Fig. 9d), but not application rate dependent negative effects of insecticides on the growth (t_{514}=−1.593, P=0.112, R^2=0.052) and reproduction (t_{211}=0.214, P=0.831, R^2=0.153) of plants (Fig. 3e). Increasing application rates of insecticides decreased the growth (t_{108}=−7.458, P<0.001, R^2=0.179) and reproduction (t_{224}=−3.903, P<0.001, R^2=0.211) of microorganisms (Fig. 9f). We found application rate dependent positive effects of insecticides on the absolute value of the biomarker responses of animals (t_{2431}=1.098, P=0.273, R^2=0.053) (Fig. 9d), plants (t_{357}=7.857, P<0.001, R^2=0.473) and microorganisms (t_{491}=6.529, P<0.001, R^2=0.122) (Fig. 9f).

Increasing application rates of fungicides had negative effects on the growth (t_{123}=−1.861, P=0.065, R^2=0.012), reproduction (t_{304}=−5.604, P<0.001, R^2=0.306) and behaviour (t_{120}=−3.360, P=0.001, R^2=0.195) of animals. Significantly negative effects were seen on plant growth (t_{276}=−2.344, P=0.020, R^2=0.119), as well as negative effects on the reproduction (t_{153}=−2.427, P=0.016, R^2=0.297) of microorganisms. Increasing application rates of fungicides had significant effects on the absolute value of the biomarker response of animals (t_{621}=2.264, P=0.024, R^2=0.117) and microorganisms (t_{92}=5.768, P<0.001, R^2=0.077), but had no significant effects on the absolute value of the biomarker response of plants (t_{229}=0.721, P=0.472, R^2=0.053) (Figs. 9g–i; see Supplementary Data 8).

Increasing application rates of herbicides did not significantly decrease the growth, reproduction or behaviour of animals (growth, t_{431}=−0.243, P=0.808, R^2=0.010; reproduction, t_{624}=−0.476, P=0.634, R^2=0.126; behaviour, t_{172}=−1.301, P=0.195, R^2=0.105), or microorganism reproduction (t_{208}=−0.995, P=0.321, R^2=0.505), but significantly decrease the growth and reproduction of plants (growth, t_{1419}=−5.053, P<0.001, R^2=0.164; reproduction, t_{199}=−3.772, P<0.001, R^2=0.269), and microorganism growth (t_{183}=−6.325, P<0.001, R^2=0.196). Increased application rates of herbicides had no significant effect on animal biomarker (t_{955}=0.699, P=0.485, R^2=0.070). However, there was

significant evidence that plant (t_{1035}=3.493, P<0.001, R^2=0.077) and microorganism (t_{498}=3.460, P<0.001, R^2=0.140) biomarkers increasingly deviated from the controls with further herbicide applications (Figs. 9k−l; see Supplementary Data 8).

Overall, there was variation in the application rate dependent effects of insecticides, fungicides or herbicides on animals, plants and microorganisms in response to the types of experiments (lab vs. field; Supplementary Figs. 1, 2), climatic zones (Supplementary Figs. 3, 4), pesticide chemical makeup (Supplementary Figs. 5, 8) and pesticide types (Supplementary Figs. 7–9). A similar pattern occurred for invertebrate and vertebrate animals (Supplementary Figs. 10–13), seed and spore-producing plants (Supplementary Figs. 14–17), and bacteria and fungi (Supplementary Figs. 18–21). In addition, there was variation in the application rate dependent effects of 243 insecticides, 104 fungicides and 124 herbicides on 560 animal species, 192 plant species or 78 microorganism species. There was also variation in threshold application rates of each pesticide species to the growth, reproduction, behaviour, or biomarker of each organism species (Supplementary Data 24–26).

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