Pesticide contamination in ambient air

A Germany-wide study to determine the occurrence of pesticides in ambient air, honeybee bread, filters from ventilation systems and air quality bark monitoring were analysed for the presence of over 500 pesticides and their related active substances including glyphosate.

Dr. Maren Kruse-Plaß
Dr. Werner Wosniok
Dipl.-Forstwirt Ulrich Schlechtriemen

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Abstract

For the Federal Republic of Germany, the present study is the most comprehensive collection of data on the occurrence and distribution of pesticides in the air. The results show that the existence of uncontaminated sites within a year of measuring is very unlikely. The number and composition of the pesticides found as well as the level of exposure depend on the sampling site, the sampling media and on the characteristics of the pesticides. The contamination tends to be higher in areas where an intensive use of pesticides can be assumed. The distance to the next potential source had little impact. Even in areas where pesticides are not applied one can expect to find a cocktail of pesticides in the air. The effect of these airborne substances on humans is still unknown. The results gathered through non-biological collection media indicate that in the air, glyphosate is more widespread than any of the other active substances studied. It is the first time that the presence of this pesticide in ambient air has been documented to this extent.

Tree bark measurements taken between 2014 and 2018 provided a first indication that pesticides used in conventional agriculture can be widely distributed through the air (Hofmann, Schlechtriemen et al. 2019). The purpose of this study was to expand on these results by using a number of additional methods to measure the pesticide contamination in the air.

For this purpose, in 2019, 116 sites across the Federal Republic of Germany were examined as part of a Citizen Science project. The following collection methods were employed: technical passive samplers (49 samples), filter mats from ventilation systems (20 samples), honeybee bread (41 samples) and tree bark samples (6 samples). The samples were analysed by using multi-analysis for over 500 pesticide active substances including glyphosate, glufosinate and AMPA (aminomethylphosphonic acid, degradation

product of glyphosate). The results were compared with data from earlier bark analyses from the years 2014 to 2018 (47 samples).

- In 163 samples, a total of 152 active substances were detected,
- 138 were attributable to agricultural sources.
- Out of these, 41 active substances (30 percent) are no longer licensed for use in the Federal Republic of Germany.

Results of different collection methods

In general, passive samplers provided the most meaningful results. A total of 80 active substances were detected. The results are based on the government guideline for the detection of pesticide residues in food stuff (ASU L 00.00 – 115, compiled by the BVL (Bundesamt für Verbraucherschutz und Lebensmittelsicherheit; BVL 2018).

In a second step these detected active substances were reduced to contain only agents with a primarily agricultural origin. After excluding PCB (5) and other substances of non-agricultural origin (4) from the original list 71 active substances remain. After active substance reduction 5 to 31 pesticides active substances were detected per sampling site. The median number of active substances in the passive samplers is 17.

In this study, the active substances most commonly found include glyphosate, chlorothalonil, metolachlor, pendimethalin, terbuthylazine, prothioconazole-desthio (degradation product of prothioconazole), dimethenamide, prosulfocarb, AMPA, flufenacet, tebuconazole, aclonifene, chlorflurenol, HCH-gamma (lindane), MCPA (2-methyl-4-chlorphenoxyacetic acid), epoxiconazole and folpet. The active substances listed were detected at least on one third (16 locations) of the 49 passive sampling sites.

Glyphosate was detected in all samples of non-biological origin (100 percent of all sites with passive samplers and filter mats).

The lowest contamination was found in the Bavarian Forest National Park (sample no. 747/1007). Here, in addition to glyphosate, 4 other active substances from pesticides were identified. In addition to the ubiquitous substance lindane, there are pesticides detected which are currently in use: dimethenamide, chlorothalonil and chlorpropham (in Germany the approval for both substances was withdrawn in 2019, their grace period ends in 2020 (BVL 2019a, BVL 2019b)).

A site in eastern Germany (sample no. 723/869) in a wine-growing region recorded the highest number of detected active substances (31). High levels of contamination are also found in other fruit and wine growing areas (sample no. 736/948 (28)). A larger number of active substances per test site was found in northern Germany (sample no. 746/778 (29), sample no. 726/879 (27), sample no 742/1002 (26)), but also in eastern Germany (sample no. 703/709 (26)).

A high number of detected pesticides per test site is not linked to high on-site pesticide application. Sites P-No. 742/1002 and 744/1004 are among the most contaminated sites with 26 and 24 pesticides detected, respectively. Both sampling sites were located on large organically managed farms. With 3916 ng/sample, the highest value for pendimethalin was measured at site 744/1004. Previously, organic produce from the area had been found to exceed the threshold for pesticide contamination.

The Harz National Park (Brockengarten, sample no. 740/1000) is a particularly striking example for pesticide contamination in northern Germany: 12 pesticide active substances were found, several in highly significant quantities, e.g. glyphosate (99.2 ng/sample), chlorothalonil (1494.7 ng/sample), terbuthylazine (49.3 ng/sample), prothioconazole-desthio (58.7 ng/sample). Folpet, a pesticide used in wine growing, was also measured with 23.5 ng/sample (for all measures see table 32 in the main report).

While the PUF matrix in passive samplers absorbs volatile pesticide active substances, filter mats in ventilation systems are designed to filter dust particles from the air. It can therefore be assumed that the detected pesticides initially adhered to soil particles which, transported by wind, were caught in the filter of the ventilation system. This may cause them to accumulate in the collection medium. In 20 samples 62 pesticide active substances with a primarily agricultural origin were detected. Sites were contaminated with between one and 34 active substances.

For bees the collection spectrum is different again. Unlike passive samplers and filter mats, bee bread reflects the bees' exposure to insecticides such as thiacloprid. In 41 samples, 48 pesticide active substances were found, with 0 to 12 active substances per site.

The samples from tree bark monitoring show the widest range of pesticide active substances. In 53 samples 94 active substances were found in total and at each site 1 to 26 pesticides were present.

The statistical analysis

The statistical analysis examines six locational factors for their effect on the measured values. It identifies the natural area of the site and the intensity of agriculture as important influencing factors in the passive samplers. The distance to the nearest potential source and the location in a nature reserve has little impact on the values detected. Also, the orientation of a site towards organic management, wind erosion classification of the underlying soil and the biogeographical area have no effect on the number of observed active substances. Only for metolachlor significantly lower values can be found in organic farming. The data are complexly linked and must be considered separately for each active

substance investigated. The composition of the active substances detected varies for the different media tested.

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