PAHs IN AGRICULTURAL SOILS

TDE-P01 Protocol | Assessment of relevance and conditions for initiating investigations · 8 November 2026

TDE criterion: polycyclic aromatic hydrocarbons (PAHs) are not included in the routine TDE soil analytical panel. Soil testing is a targeted investigation, initiated only where objective evidence makes significant historical contamination and a crop-exposure pathway plausible.

1. Purpose of the criterion

TDE is not a general contaminated-site characterisation programme. It selects agricultural areas with low anthropogenic pressure to reduce the likelihood that food products incorporate legacy contaminants or pollutants from present-day deposition. Detectable PAHs in soil do not, in themselves, demonstrate significant transfer to edible plant parts. Any legal obligations applicable to a site or food category remain in force.

2. Scientific rationale

• PAH behaviour varies with molecular weight, hydrophobicity, organic matter and soil properties. Many high-molecular-weight PAHs are strongly retained by soil; root transfer to above-ground plant parts is often limited, but not zero.

• For various crops, particularly those with large leaf surfaces, direct atmospheric deposition and adherence of particles may contribute more to contamination than root uptake. The relative importance of exposure pathways depends on crop and context.

• PAHs may persist in soil after historical fires or combustion; needles, mosses and other bioindicators do not necessarily reconstruct very old events. Therefore, normal current biomonitoring does not prove the absence of historical soil contamination.

• Agricultural exposure may include, in addition to root uptake, direct contact of food products with soil, resuspended dust, contaminated water or deposition from existing sources. This plausible exposure, rather than merely cataloguing PAHs, justifies soil analyses when warranted.

3. Conditions for testing PAHs in soil

A targeted investigation is justified where both conditions occur: (a) independently verifiable evidence of a potentially relevant source or anomaly; and (b) a reasonable exposure pathway from soil to the crop under consideration. Examples include:

• Documented deposits of ash, slag, combustion waste or local historical contamination within a field.

• Maps, site inspections or earlier investigations documenting intense fires, repeated combustion or emission activities with possible accumulation in surface soil.

• Anomalous PAHs in bioindicators, sentinel plants or dust from extraordinary investigations, supported by evidence of potential soil accumulation or transfer to crops.

• Crops particularly exposed to soil splashes, dust or soil contact, where one of the above signs is present.

The following alone are insufficient: the abstract possibility of a fire years earlier; absence of historical information supplied by the farmer; or an isolated, non-anomalous bioindicator result. Company declarations are not a sufficiently reliable sole basis; independently verifiable indications are preferred.

4. Binding rule for PAH testing of food products

PAHs are NOT routinely tested in agricultural products. Within voluntary TDE monitoring, testing is initiated only when an environmental indicator is anomalous or an annual increase exceeds a factor of two, subject to the comparability and validation requirements below. Any food-law testing and compliance obligations remain independent.

TDE trigger: (A) PAH concentrations anomalous relative to available environmental references for the same matrix and area; OR (B) concentration of the selected PAH indicator in year two more than twice that in the preceding year (>100% increase), with the same species, tissue, exposure/sampling period, unit of measurement, analytical method and site design. The >2 rule is a precautionary TDE management criterion, NOT a toxicological or statutory threshold.

A validated trigger initiates targeted PAH testing of edible crop parts and potentially exposed lots, prioritising crops currently growing or nearing harvest. The laboratory uses a method appropriate to the food matrix and applicable limits. A trigger does not automatically revoke TDE status: results, exposure extent and persistence guide decisions to retain, suspend or revoke it. Without a trigger or legal requirement, there is no routine TDE PAH testing of the product.

5. TDE decision scheme

Situation	Decision
Rural area without documented sources or anomalies	No routine PAH testing of soil or products; biomonitoring according to TDE plan.
Recent fire / current deposition	Sample bioindicators; compare with background and previous year; if trigger is validated, analyse exposed products.
Historical event only hypothesised	No soil analysis based on the hypothesis alone.
Documented historical source + plausible exposure pathway	Targeted soil analysis; evaluate indicators and exposure pathways separately to decide on product testing.
Anomalous bioindicator or concentration >2 times the preceding year	Validate comparability; analyse PAHs in potentially exposed crops and lots; decide on suspension/revocation only after assessment.

6. Method and reference note

The laboratory has a panel of 21 PAHs with an LOQ of 2 µg/kg per analyte in soil. This value is retained for potential targeted investigations but is not converted into a routine TDE threshold. Statutory agricultural-soil thresholds (Ministerial Decree 46/2019) serve purposes distinct from voluntary TDE selection; PAH limits in foods (EU Regulation 2023/915) apply to specific matrices and products.

7. Summary of the operational criterion

“PAH determination in soil is not part of the routine TDE-P01 panel because total soil concentration is not generally a reliable predictor of residues in edible plant parts. Routine PAH monitoring relies on plant bioindicators and, where available, deposition or dust. Product testing is initiated only where an indicator is anomalous relative to relevant background or where the year-on-year increase exceeds a factor of two (>2 times), confirmed using comparable, analytically reliable samples. Any statutory testing duties remain applicable. Soil determination is reserved for documented sources with a plausible pathway to crops. Exceeding the biomonitoring trigger alone does not automatically revoke TDE status.”

8. Dynamic rule for PAH monitoring

A comparison indicator is predefined for each station (for example a specified PAH sum or individual priority compounds), and the full analytical profile is retained. The selected analytes, treatment of < LOQ values and reference units must remain unchanged between campaigns.

The “>2 times” criterion applies only where both results are quantifiable and the increase exceeds estimated analytical and sampling variability. If the initial result is < LOQ, the annual ratio cannot be interpreted: assess anomalies against comparable references and, if needed, resample. A change from traces is not automatically evidence of real deterioration.

Following a trigger, the first step is documentary and analytical validation (matrix identity, season, method, QA/QC and possible sampling contamination). If the signal is considered reliable, targeted analysis of potentially exposed food products is initiated without waiting for the next annual monitoring campaign.

9. Operational decision tree

• STEP 1 — Periodic monitoring of mosses/needles or sentinel plants under a standardised protocol.

• STEP 2 — Is the result anomalous relative to relevant background? Or is the comparable indicator >2 times the previous-year value?

• NO → Continue the routine programme; no routine TDE PAH testing of food products.

• YES → Check comparability, LOQ, uncertainty and sample quality; repeat sampling where appropriate.

• ANOMALY NOT CONFIRMED → Record and continue monitoring, potentially at higher frequency.

• VALIDATED ANOMALY → Identify potentially exposed crops/lots and analyse PAHs in the relevant edible parts.

• PRODUCT RESULT + TERRITORIAL ASSESSMENT → Confirm qualification, intensify monitoring, precautionarily suspend or revoke with justification under general TDE criteria. Legal obligations apply independently of the trigger.

10. Experimental proposal: sentinel garden of broad-leaved plants

A pilot experiment is proposed using broad-leaved plants (e.g. lettuce) grown in containers with an initially characterised, uniform substrate, controlled irrigation and no interfering treatments. Establish parallel exposures at TDE and rural reference sites, using the same species/cultivar and synchronised growth cycles.

Collect leaves at the same growth stage and, at least during the experimental phase, distinguish unwashed and washed samples. This comparison may help distinguish surface deposition from tissue-associated residues, without identifying all contamination pathways on its own. Record rainfall, wind, fires, dust and exposure duration.

The sentinel garden is an ADDITIONAL indicator, not automatic proof of the safety of farm crops nor an already validated substitute for mosses/needles. Official adoption would require a multi-season pilot, field blanks, replicates and specific anomaly thresholds. The existing LOQ of 2 µg/kg is declared for SOIL and must not automatically be transferred to leaves or food products.

11. Decision note

Status: operational TDE rule subject to validation within the bioindicator protocol. A factor >2 is an investigation trigger, not a TDE exclusion threshold or food-safety limit. Absolute environmental thresholds and revocation criteria must be defined using measured background data and comparisons between matrices.

Updated regulatory reference: EU Regulation 2023/915, Annex I, Section 5.1, maximum concentrations of benzo(a)pyrene and the sum of four PAHs for specified food categories. https://eur-lex.europa.eu/eli/reg/2023/915/eng

References and verifiable sources

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4. Italian Ministry of the Environment, Ministerial Decree of 1 March 2019, No. 46, Annex 2: contamination thresholds for agricultural soils. https://www.gazzettaufficiale.it/eli/id/2019/06/07/19G00052/SG

5. European Commission, EU Regulation 2023/915, Annex I, Section 5.1: PAHs in selected food categories. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023R0915