



## Annex B STATEMENT OF WORK Plant Biomarker Challenge

### 1. Scope

This Statement of Work (SOW) describes the requirements for the OPCW's Plant Biomarker Challenge. The OPCW is seeking proposals from scientists across its Member States that describe a specific type of vegetation and its potential to act as an indicator of exposure to chemicals that are toxic to humans and animals as part of the Plant Biomarker Challenge.

With a view towards prevention of the re-emergence of chemical weapons and strengthening efforts to keep humans safe and secure from chemical threats, the OPCW Technical Secretariat is interested in learning from the world's scientific community about innovative, yet practical, capabilities that enable the recognition of biochemical signatures of chemical exposure. For example, observable changes in colour, leaf and/or stem morphology and/or any other observable health indicator of vegetation that can be shown to have correlation to indicative chemical exposure biomarkers in the exposed plant. As vegetation (whether natural, introduced or invasive) is always present in areas of human habitation, plants are well suited as potential sentinel species.

Capabilities of interest would include the ability to recognise chemical exposure at the earliest possible occurrence for protection and response purposes, and/or to aid in the retrospective analysis of an incident involving chemical exposure. In the latter case, especially for highly reactive chemicals or chemicals exposed to a decontamination process, effects that arise due to chemicals generated through metabolic pathways, and/or environmental fate and transport processes potentially play an important role.

Fixed price contracts will be awarded for the most innovative proposals, to allow initiation for a proof-of-concept study. Furthermore, the Secretariat intends to take the relevant collective submissions and produce a scientific review article to be published in peer-reviewed literature and authored by all submitting scientists as a means to exchange scientific knowledge across international borders.

Submissions from scientists from all of the five regional groups of OPCW Member States are highly encouraged.

Proposals as described above will be evaluated by a Technical Evaluation Team. Up to 10 submissions (at least one from a State within each regional group that provides submissions) will be invited to "pitch" their proof-of-concept proposals to the Technical Evaluation Team. Based on the presentations, up to five of the submissions will be awarded a fixed price contract of up to €40,000. Should travel be necessary, the OPCW will provide travel, accommodation and entry visa (if needed) support.

Contract awards can only be given to a single institution, where the money can be used by an individual principal investigator or collectively by



collaborating scientists within that institution; if this is the desired outcome, it should be made clear in the submission. Proposals that are intended to be collaborative with multiple institutions represented are also possible (and encouraged); for this situation each institution should draft separate proposals (specific to the work to be done at each institution) and submit the proposals together (as a package) with a lead institution identified for the collaborating groups. The lead institution will receive the award, should the collective proposal be selected by the Technical Evaluation Team.

All submissions, including those not receiving an award, will be considered for inclusion in a scientific review of chemical exposure effects on vegetation. This review would be published in the peer-reviewed scientific literature.

All principal investigators will be asked to give their consent for the information they provide to be included in the publication. In exchange, all consenting principal investigators whose proposals contribute to the review article will be included as authors and given opportunity to review and edit the manuscript. A scientific review committee will facilitate and coordinate the drafting and journal submission of the paper. This review article will be an open access publication to promote international exchange of scientific knowledge.

## 2. Definitions, Acronyms, and Abbreviations

The following definitions, acronyms, and abbreviations shall apply throughout this SOW unless defined otherwise hereinafter:

CWA – chemical warfare agent

TIC – toxic industrial chemical

SAB – Scientific Advisory Board

OMICS - various disciplines in biology whose names end in the suffix -omics, such as genomics, proteomics, etc.

## 3. Requirements

Submissions do not require experimental demonstration. All submissions must provide a proposal for experimentally demonstrating a proof-of-concept. Proposals should describe how a given type of plant might present an “on-site” observable change and link this change to any indicative biomarker(s) that could be confirmed with “off-site” (laboratory-based) molecular detection methods.

Submissions from collaborating scientists and research groups are encouraged. The submission should indicate the corresponding author and the institution to which the contract would be awarded. Please note that each award can only be provided to a single institution.



There are no restrictions on what types of vegetation might be considered. However, preference will be given to proposals describing vegetation that is commonly found (even considered ubiquitous) across multiple geographic regions. A focus on a single type of plant is acceptable, but not required, for the submission.

As there are countless examples of chemicals that can cause harm to vegetation and also can concentrate in plant tissue once released in the environment, preference for an awarded proposal will be given to effects that are induced by a chemical action on a life (metabolic) process. This is intended to be a chemical effect that manifests itself through the interaction of biomarkers and/or adduct formation. The chemicals of interest should be relevant to chemical security concerns due to toxic effects on humans and animals. Proposals that look at commonly used and available herbicides will not be considered.

The underlying biochemistry of exposure for the type of vegetation and the chemicals considered must be described in detail. This would include relevant biomarkers and metabolic processes, as well as environmental fate and transport processes.

The proposal for experimentally demonstrating a proof-of-concept should include a detailed description of how the observable change would be recognised through a non-destructive on-site measurement method. This should include the type of equipment required and a means of creating an alert. Proposals that include the use of mobile devices, computer vision, apps, remote and/or automated data collection tools, and sensors are encouraged.

For the off-site proof-of-concept aspects of the proposal, suitable methods should be identified that could be used to experimentally confirm the presence of indicative markers. Proposals that employ OMICS and systems biology-based approaches are encouraged.

The following should also be considered while developing a proposal:

- The OPCW Designated Laboratory Network has developed sound and robust methods for analysis of CWAs in environmental samples, making traditional CWAs of lesser interest for submitted proposals (CWAs also require specific handling and safety considerations which make them poorly suited to proof-of-concept experiments outside expert laboratories). If a proposal does address an innovative idea involving CWAs, it would be considered on its merits, and a proof-of-concept study using CWA simulants would be acceptable.
- Proposals are encouraged to include consideration of TICs. Easily accessible TIC (many of which are far less toxic than CWAs) pose the risk of being used as chemical threats, and proposals that expand the knowledge of how to recognise environmental exposure are of interest.
- Some types of agricultural chemicals, including pesticides but excluding herbicides, may also be of relevance.
- Another commonly discussed category of chemicals that pose security concerns are the so-called central nervous system (CNS)-acting



chemicals. While these chemicals are thought of for their effect on animal and human nervous systems, there are molecules within vegetation that may be of relevance to biochemical interactions (for example, plant species that express acetylcholinesterase are known).

- The observable effect should be distinct enough to suggest that a certain chemical or type of chemical might have been present (this could be also the result of degradation and/or reaction products that form metabolically after exposure or through environmental fate and transport processes). The observable change of interest is one that is intended to serve as an indicator of need for further characterization. If an observable change in vegetation can be induced by a variety of chemicals, the proposal should be clear on which types of chemicals these might be (noting that from an early warning perspective, the ability to generate a response from a variety of possible toxic chemicals is advantageous).
- For whichever chemicals and/or classes of chemicals are considered in the proposal, the submission should include an explanation of why these chemicals have relevance to chemical security.

The Technical Evaluation Team will determine, inter alia, whether:

- the proposed research meets the objectives of the Plant Biomarker Challenge;
- the project has sufficient scientific merit;
- the existing resources, infrastructures and expertise, as declared, are adequate for implementation of the project; and
- the resources and related funding requested are justified and commensurate with the planned tasks and expenditures.

The Technical Evaluation Team will apply the aforementioned review criteria for both the written proposal submissions as well as the oral presentations by selected applicants.

#### 4. Deliverable Data Items

The Contractor shall deliver the following data items (in English and delivered electronically, unless otherwise specified):

1. Progress report
  - a. To be delivered within 6 months (electronic submission in Microsoft Word and Adobe PDF format) after the award.
2. Presentation
  - a. To be delivered in person or virtually (electronic submission in Microsoft PowerPoint or Adobe PDF) within 12-15 months after award.
3. Final report
  - a. To be delivered within two months after the Presentation (electronic submission in Microsoft Word or Adobe PDF)