SLOVENSKI STANDARD
SIST EN ISO 16198:2015

01-marec-2015

Kakovost tal - Rastlinski biološki preskus za ocenjevanje okoljske biološke razpoložljivosti elementov v sledovih za rastline (ISO 16198:2015)

Soil quality - A plant based-based biotest to assess the environmental bioavailability of trace elements to plants (ISO 16198:2015)

Bodenbeschaffenheit - Pflanzenbasierter Biotest zur Beurteilung der umweltrelevanten Bioverfügbarkeit von Spurenelementen für Pflanzen (ISO 16198:2015)

Qualité du sol - Biotest végétal pour l'évaluation de la biodisponibilité environnementale des éléments traces pour les végétaux (ISO 16198:2015)

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Soil quality - Plant-based test to assess the environmental bioavailability of trace elements to plants (ISO 16198:2015)

Qualité du sol - Test végétal pour l'évaluation de la biodisponibilité environnementale des éléments traces pour les végétaux (ISO 16198:2015)

Bodenbeschaffenheit - Pflanzenbasierter Test zur Beurteilung der umweltrelevanten Bioverfügbarkeit von Spurenelementen für Pflanzen (ISO 16198:2015)

This European Standard was approved by CEN on 24 October 2014.

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Foreword

This document (EN ISO 16198:2015) has been prepared by Technical Committee ISO/TC 190 “Soil quality” in collaboration with Technical Committee CEN/TC 345 “Characterization of soils” the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2015, and conflicting national standards shall be withdrawn at the latest by July 2015.

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INTERNATIONAL STANDARD

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Soil quality — Plant-based test to assess the environmental bioavailability of trace elements to plants

Qualité du sol — Test végétal pour l'évaluation de la biodisponibilité environnementale des éléments traces pour les végétaux

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 190, *Soil quality*, Subcommittee SC 7, *Soil and site assessment*.

Introduction

One of the main objectives of ISO 17402 is to define a conceptual framework of the bioavailability of contaminants in soils and soil materials, and to provide a guidance for the selection of methods able to be standardized for the measurement of bioavailability. Bioavailability was thus defined according to three successive steps:

a) "environmental availability";

b) "environmental bioavailability";

c) "toxicological bioavailability".

The environmental bioavailability is consequently a prerequisite to the assessment of the toxicological bioavailability and is directly related to the impact of pollutants on major functions of soil in the ecosystem and more particularly to habitat and retention functions.

Environmental bioavailability can be estimated with either chemical or biological methods. In the case of trace elements, chemical methods are usually the cheapest, easy to perform, and some of them are already standardized at national or international level (e.g. ISO 19730). However, chemical methods which, strictly speaking, measure the environmental availability in soils have to be correlated with biological measurements before being used as indicators of environmental bioavailability. Whatever chemical methods are employed, none are designed per se to address the diversity of responses observed among different plant species or cultivars which can be attributed to a) the uptake behaviour of plants (i.e. sensitive, tolerant, accumulator, or hyper-accumulator of trace elements) and/or b) the ability of plants to alter the biological, physical and physical-chemical properties of their "bio-influenced zone" at the soil-root interface, i.e. the so-called rhizosphere. It could alternatively, be suggested to apply chemical methods directly to the rhizosphere but the sampling of the rhizosphere is definitely too tedious to be applied routinely.

For biological methods, four standardized biotests account for rhizosphere processes as they are based on soil-grown plants (ISO 11269-1, ISO 11269-2, ISO 17126, and ISO 22030). However, these were only designed to predict trace element phytotoxicity, i.e. the toxicological bioavailability. In these biotests, roots grow directly in the soil, therefore requiring a tedious washing procedure to reliably measure trace elements accumulated in the roots. Indeed, the amount of trace elements accumulated in shoots of non-accumulator plant species is not sufficiently sensitive to be used for assessing the environmental bioavailability of trace elements compared to the amount accumulated in the whole plant, roots included. Thus, there is still a need to develop biological methods accounting for rhizosphere processes and enabling to include the root compartment in order to properly estimate the environmental bioavailability of trace elements to plants.

Consequently, the present International Standard introduces a biotest based on the growing of roots in contact with the soil but without penetrating it. Although this experimental design is partly artificial, it enables a fair comparison of the bioavailability of trace elements between tested soils. In addition, the end point measured can be more directly related to the measurement of the environmental availability than any end point based on the measurement of toxicity.

Soil quality — Plant-based test to assess the environmental bioavailability of trace elements to plants

1 Scope

This International Standard specifies the plant-based test, hereafter called the biotest. It enables estimation of the environmental bioavailability of trace elements to plants either basically as the concentration in shoots and roots or in a more integrative way as the net uptake flux in plants. The biotest procedure includes two successive steps: (i) a pre-growth of plants in hydroponics and (ii) a growth of plants in contact with soil samples. The concentration in shoots and roots as well as the net uptake flux of trace elements in plants are determined at the end of the second step of the biotest procedure.

This biotest is applicable to the assessment of environmental bioavailability of trace elements to plants, more particularly to agricultural plants, in soils or soil materials under oxic conditions, considering that

— three plant species (cabbage, *Brassica oleracea*; tall fescue, *Festuca arundinacea*; tomato, *Lycopersicon esculentum*; 7.1) are suggested in the standardized biotest procedure, but additional target-plant species can also be used (see 7.1, Annex A), and

— the standardized biotest procedure is validated for a range of trace elements including arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), nickel (Ni), and zinc (Zn), but additional trace elements can also be accounted for (see Annex A).

The biotest can be applied to soils and soil materials, including soils amended before or after field sampling with composts, sludges, wastewaters, and other (waste) materials.

NOTE 1 This biotest is not designed to assess the environmental bioavailability of trace elements that are prone to volatilisation or resulting from uptake occurring in plant leaves following, e.g. atmospheric fallout.

NOTE 2 This biotest is not designed to assess the environmental bioavailability to plants of organic contaminants. A similar experimental procedure could be used but the physical separation between plant roots and soil using a polyamide mesh needs to be adapted to avoid organic contaminant sorption on the mesh.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 10390, *Soil quality — Determination of pH*

ISO 10694, *Soil quality — Determination of organic and total carbon after dry combustion (elementary analysis)*

ISO 11269-2, *Soil quality — Determination of the effects of pollutants on soil flora — Part 2: Effects of contaminated soil on the emergence and early growth of higher plants*

ISO 11277, *Soil quality — Determination of particle size distribution in mineral soil material — Method by sieving and sedimentation*

ISO 11465, *Soil quality — Determination of dry matter and water content on a mass basis — Gravimetric method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
contaminant
substance or agent present in the soil as a result of human activity

[SOURCE: ISO 11074:2005, 3.5.1]

Note 1 to entry: There is no assumption in this definition that harm results from the presence of the contaminant

3.2
environmental availability
fraction of contaminant physico-chemically driven by desorption processes potentially available to organisms

[SOURCE: ISO 17402:2008, 3.4]

3.3
environmental bioavailability
fraction of the environmentally available compound which an organism takes up through physiologically driven processes

[SOURCE: ISO 17402:2008, 3.5]

3.4
habitat function
ability of soil/soil materials to serve as a habitat for micro-organisms, plants, soil-living animals, and their interactions (biocenosis)

[SOURCE: ISO 11074:2005, 3.4.3]

3.5
trace element
chemical element in soil occurring at concentration generally less than 100 mg kg^{-1}

Note 1 to entry: Given according to Reference [16].

3.6
retention function
ability of soil/soil materials to adsorb pollutants in such a way that they cannot be mobilized via the water pathway and translocated into the terrestrial food chain

[SOURCE: ISO 11074:2005, 3.4.13]

3.7
rhizosphere
volume of soil around living roots that is influenced by root activities

Note 1 to entry: Given according to Reference [17].

3.8
soil
upper layer of the earth's crust transformed by weathering and physical/chemical and biological processes. It is composed of mineral particles, organic matter, water, air, and living organisms organized in genetic soil horizons

[SOURCE: ISO 11074:2005, 2.1.8]

3.9
soil material
material coming from soil and displaced and/or modified by human activity, including excavated soil, dredged materials, manufactured soils, and treated soils and fill materials

[SOURCE: ISO 17402:2008, 3.16]

3.10
toxicological bioavailability
internal concentration of pollutant accumulated and/or related to a toxic effect

[SOURCE: ISO 17402:2008, 3.18]

4 Principle

This International Standard describes the experimental procedure of the biotest developed initially by References [18], [19], and [20]. This biotest consists of two successive steps of plant growth (see Figure 1). During the first step (i.e. preculture period), plant seedlings are grown in hydroponics for 14 d to achieve an adequate plant biomass and a dense, planar root mat. During the second step (i.e. test culture period), the root mat of pre-grown plants is put in contact for 8 d with a 6 mm-thick layer of soil sample sieved to 2 mm.