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Soil quality — Determination of the toxic effects of pollutants on germination and early growth of higher plants

Qualité du sol — Détermination des effets toxiques des polluants sur la germination et la croissance primaire des plantes supérieures

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Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Principle **3**
5 Reagents, test organisms and media **3**
6 Apparatus and materials **4**
7 Treatment and preparation of samples **6**
8 Procedure **6**
9 Measurement **8**
10 Calculation of the percentage inhibition **9**
11 Reference chemical **10**
12 Precision **10**
13 Validity criteria **11**
14 Test report **11**
Annex A (informative) **Application of the phytotoxicity test in transparent test plates on natural and artificial soils and soil materials, with different plant species** **12**
Annex B (informative) **Assemblage of test plates for the phytotoxicity test** **14**
Annex C (informative) **International interlaboratory comparisons on the phytotoxicity test** **15**
Bibliography **20**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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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 4, *Biological methods*.

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Introduction

Ecotoxicological testing of test soils or waste materials to be disposed on soil are required to assess the potential environmental risk resulting from soil pollution or the disposal of wastes such as sewage sludge on farmland. There is also a need to monitor the quality of soil after reclamation of industrial sites. Therefore, a very practical and rapid germination and growth test has been developed based on seed germination and seedling growth in controlled environmental conditions.

The assay, which does not require any pretreatment of the seeds, is performed in "transparent test plates", incubated vertically, to allow the roots and the shoots of the germinated seeds to be seen. After 72 h exposure, a picture of the transparent test plates is taken and can be analysed "by image analysis" for multiple endpoints, such as percentage of seed germination and of length of roots and shoots. To account for the plant species variability in sensitivity, the assays are performed with the seeds of three plant species: one monocotyl (*Sorghum saccharatum*) and two dicotyls (*Lepidium sativum* and *Sinapis alba*).

A major advantage of this test is that after the shooting and storing of the pictures of the test plates, the measurements by image analysis can be postponed to any appropriate timing.

Reference or standard soils can be used as negative controls, such as, for example, the ISO standard artificial soil according to ISO 11269-1 and ISO 11269-2.

Commercially available seeds, with a shelf life longer than one year, allow the use of this test at any time of the year.

Two International interlaboratory comparisons demonstrated that the test provides good results.

A substantial number of studies report data on the application of this test on various types of soils and soil materials with several types of plant species.

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Soil quality — Determination of the toxic effects of pollutants on germination and early growth of higher plants

1 Scope

This International Standard describes a technique for determining the effects of soil and soil-related materials on the seed germination and early growth of higher plants. These endpoints are useful indicators for the assessment of the quality of a soil as a habitat for organisms. This International Standard is applicable to all soils in which soil organisms are active and may be used to evaluate:

— the effects on plants due to toxicity of solid or liquid chemicals contaminating soil or materials (compost, sludge, waste) and chemicals added to soil;

— the changes in the soil effect on plants after restoration measures.

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 11269-1, *Soil quality — Determination of the effects of pollutants on soil flora — Part 1: Method for the measurement of inhibition of root growth*

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/TS 20281, *Water quality — Guidance on statistical interpretation of ecotoxicity data*

3 Terms and definitions

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

3.1
artificial soil
mixture of sand, kaolinite, peat and calcium carbonate prepared according to ISO 11269-1 and ISO 11269-2

3.2
control soil
reference or standard soil used as a control and as a medium for preparing dilution series with test soils or a reference substance

3.3
reference soil
uncontaminated site-specific soil (e.g. collected in the vicinity of a contaminated site) with similar properties (nutrient concentrations, pH, organic carbon content and texture) as the test soil

3.4
standard soil
field-collected soil or artificial soil whose main properties (e.g. pH, texture, organic matter content) are within a known range

Note 1 to entry: The properties of standard soils can differ from the test soil.

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EXAMPLE Euro-soils[1], artificial soil[2], LUFA soil.[1)]

3.5
test soil
either a natural or an artificial clean soil that is spiked with the test substance or a contaminated natural soil (a site soil)[5]

3.6
seeding emergence
appearance of a visible seedling above the surface of the cover material

[SOURCE: ISO 17126:2005, 3.1, modified]

3.7
germination
appearance of a root of at least 1 mm of length

3.8
pure water
grade of water, produced, for example, by single distillation, by de-ionization, by ultra-filtration or by reverse osmosis[5]

3.9
root length
length of the root from seed to root tip

3.10
shoot length
length of the part that grows upward, from seed to tip

3.11
water saturation
maximum water content that a soil can retain against gravity under undisturbed soil conditions, conventionally stated as water content two days to three days after full saturation with water

[SOURCE: ISO 11074:2015, 2.1.5 field capacity, modified]

3.12
water saturated soil
soil which has reached its maximum water content

3.13
water-holding capacity
mass of water that evaporates from soil saturated with water when the soil is dried to constant mass at 105 °C, divided by the dry mass of the soil[7]

3.14
negative control
any well-characterized material or substance that, when tested by a specific procedure, demonstrates the suitability of the procedure to yield a reproducible, appropriately negative, non-reactive or minimal response in the test system

[SOURCE: ISO 10993-10:2010, 3.12, modified]

3.15
effect percentage
percentage decrease of the seed germination and the growth of the plant roots and/or shoots in the test soil in comparison to the control soil

1) Euro-soils, artificial soil and LUFA soil are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

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