

Contamination with Germinating Weeds

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CONTENTS

LIST OF TABLES	4
SUMMARY	5
1. INTRODUCTION	6
2. EXISTING METHODOLOGY	7
3. EVALUATION OF DRAFTING A HORIZONTAL STANDARD	8
3.1 Dilution	8
3.1.1 Diluents	8
3.1.2 Salt content – threshold values	8
3.1.3 Moisture Content	8
3.2 Growing Conditions	9
3.3 Control Sample	9
4. CRITICAL POINT AND RECOMMENDATIONS	10
4.1 Criteria for the test method	10
4.2 Method recommendations	10
4.3 Research and development	10
4.4 Critical points	10
5. DRAFT STANDARD (CEN TEMPLATE)	11
5.1 Scope	11
5.2 Normative references	11
5.3 Terms and Definitions	11
5.4 Principle	11
5.5 Reagents	11
5.5.1 Inert Diluent	11
5.5.1.1 <i>WASHED PERLITE OR</i>	11
5.5.1.2 <i>QUARTZ SAND</i>	11
5.6 Apparatus	12
5.6.1 Seed tray (e.g. Styrofoam box), app. 540 mm x 400 mm x 80 mm	12
5.6.2 Glass plate for covering the tray	12
5.6.3 Temperature room or equivalent at 4°C ± 2°C	12
5.6.4 Testing facility: phytotron, plant growth room or greenhouse	12
5.7 Preparation of the sample	12
5.8 Procedure	12
5.8.1 Experimental design	12
5.8.2 Calculation and Expression of results:	12
5.9 Precision	13
5.10 Test report	13
REFERENCES	14

LIST OF TABLES

Table 1: Threshold Values for diluting

8

SUMMARY

EU directives require a reduction in landfill and where possible recycling of waste in the form of composted material. Especially if these materials are used for remediation or as a constituent for growing media, contamination with germinating weeds is an important quality parameter. There are only draft standard methods, but several methods are in use differing mostly due to the substrate they are dealing with. In the proposed draft standard, the most suitable conditions for soil, sludge and composted materials are combined.

1. INTRODUCTION

The contamination of sludge, soil and biowaste with weeds is of special importance if these materials are used for the following purposes:

- Remediation of landscape
- Constituents of growing media

The test for germinating weeds has mainly been developed for materials used as constituents for growing media. Most of the methods described deal with compost, composted material and peat. Soil only is only of concern if pollutants are supposed to be in the soil or the effect of pollutants is to be tested. The proposed draft tries to combine all the important factors mentioned in the different approaches to allow a widespread use.

2. EXISTING METHODOLOGY

There is no existing standard for the assessment of weeds and plant propagules. The following are draft standards

ISO/CD 17126: Soil quality – Determination of the effects of pollutants on soil flora – Seedling emergence, screening test with lettuce (*Lactuca sativa* (L.))

ÖNORM S 2021: Requirements for growing media

The methods mentioned below have been supplied by organisations other than standardisation bodies:

WRAP, The Composting Association (2002): Public Available Specification 100 – Specification for composted material, Annex D: Method to assess contamination by weed propagules and phytotoxins in composted material

Federal Compost Quality Assurance Association, Germany (1998): Determination and evaluation of the content of germinating seeds and plant propagules

International Peat Society, HOPE: Draft method for the determination of weeds in raised bog peat

Rijkslaboratorium Gent: Method Germinative Seeds or Weed Contamination

KIWA: Weed test

RHP-foundation: Contamination with weed

Furthermore, there are national laws dealing with weed contamination:

Austrian Compost Ordinance

German Ordinance on the utilization of Bio-Wastes on land used for agricultural, silvicultural and horticultural purposes

3. EVALUATION OF DRAFTING A HORIZONTAL STANDARD

For a standard to be suitable for soil, sludge and composted biowaste several factors have to be considered.

3.1 Dilution

Dilution of the tested material is necessary, if chemical properties, especially the salt content expressed as electric conductivity, might inhibit the germination of plants. In this case, the substrate has to be diluted using a suitable diluent.

3.1.1 Diluents

The different authors propose several materials:

- Peat
- Limed peat
- Quartz Sand
- Perlite

3.1.2 Salt content – threshold values

Again, there are several proposals made by different authors, though using varying methods for the determination:

Table 1: Threshold Values for diluting

Country	Threshold value for diluting
Austria	> 1,7 mS/cm
Germany	> 2g KCl/l fresh weight
UK	> 50 mS/m

To overcome this problem it seems to be most appropriate to use the determination of the salt content as electric conductivity as described in CEN 13037. However, up to now there is only little experience in the relationship between the values described above and the corresponding results according to CEN 13037. Therefore, research work in this field will be necessary.

3.1.3 Moisture Content

Due to the diversity of physical characteristics of the different materials it is hardly possible to define a specific moisture content for conducting the experiment, especially because different methods for the determination of the Water Holding Capacity (WHC) would apply. However, 100% WHC with or without drainage as suggested by Germany or the PAS 100 does not seem to be appropriate for all the materials to be tested. As a consequence, the WHC is not specified in detail.

3.2 Growing Conditions

The growing conditions can be set mostly in accordance with ISO/CD 17126/2.

3.3 Control Sample

To reveal local contamination, control samples are suggested. In closed environments (e.g. phytotrons), the control might be omitted.

4. CRITICAL POINT AND RECOMMENDATIONS

4.1 Criteria for the test method

The method should be simple to operate especially with regard to

- Further test methods necessary to apply (e.g. electric conductivity)
- Growing conditions

4.2 Method recommendations

With respect to the variety of test materials, no peat should be used as a diluent.

4.3 Research and development

The following tasks should be considered in further research work:

- Threshold values for salt content/electric conductivity according to CEN 13037 with regard to possible diluting of the test sample
- Suitable diluent
- Appliance of the method for samples with high content of large particles (> 40 mm)
- Appropriate particle size for conducting the experiment

4.4 Critical points

As has been pointed out earlier, it is hardly possible to define a specific WHC for performing the experiment or precise watering conditions. Therefore it is recommended that an experienced plants man or nurseryman conduct the trials.

5. DRAFT STANDARD (CEN TEMPLATE)

NOTE: Where italics appear in the draft method it indicates an area that requires additional work and confirmation

5.1 Scope

This Standard specifies a test procedure for the assessment of contamination by germinating weeds and plant propagules on various substrates.

5.2 Normative references

This method incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this method only when incorporated in it by amendment or revision. For undated references the latest edition of the publications referred to apply.

EN 13037 Soil improvers and growing media – Determination of electric conductivity

EN 13040 Soil improvers and growing media - Sample preparation for chemical and physical tests, determination of dry matter content, moisture content and laboratory compacted bulk density

5.3 Terms and Definitions

For the purpose of this standard, the definitions given in PD CR 13456, EN 12579, EN 13040 and PAS 100 apply.

5.4 Principle

The development of weeds, whether from seed or other plant propagules is determined after a 4 week incubation period under controlled conditions

5.5 Reagents

5.5.1 Inert Diluent

5.5.1.1 *washed perlite or*

5.5.1.2 *quartz sand*

5.6 Apparatus

5.6.1 Seed tray (e.g. Styrofoam box), app. 540 mm x 400 mm x 80 mm

5.6.2 Glass plate for covering the tray

5.6.3 Temperature room or equivalent at $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$

5.6.4 Testing facility: phytotron, plant growth room or greenhouse

5.7 Preparation of the sample

The sample preparation has to be carried out in accordance with EN 13040, clause 8. For this test, *material* < 20mm is used.

5.8 Procedure

5.8.1 Experimental design

Evenly spread 3l of sample in the seed tray (5.6.1). If the electric conductivity according to CEN 13038 is $> 50 \text{ mS/m}$, the sample has to be diluted using quartz sand (5.5.1.2) or washed perlite (5.5.1.1) until the electric conductivity does not exceed $50 \text{ mS/m} \pm 2,5 \text{ mS/m}$. For calculation of the dilution ratio, the electric conductivity of the mixing component is assumed to be 0 mS/m. After diluting, the electric conductivity has to be checked again.

Diluted samples have to be thoroughly mixed and distributed to a respective number of seed trays, e.g. if using a dilution ratio of 1 + 1 (v/v) of sample and sand, two trays containing 1,5 l sample and 1,5 l sand each have to be used.

If necessary, the test sample has to be moistened by gentle spraying. Consequently, the seed tray is covered by a glass plate and kept at 4°C for three days. Afterwards, the tray is kept in a phytotron, plant growth room or greenhouse at a temperature suitable for plant germination without exposure to direct sunlight. After 10 days remove the glass plate (5.6.2), leaving the tray exposed to daylight for a further 15 days. The sample has to be kept moist during the whole period. The number of germinated plants has to be recorded daily to avoid the missing of plants caused by, for example damping off. After this second exposition period, the total number of germinated plants is recorded and referred to 1 litre of the original substrate.

To reveal possible local contamination during the experiment, a control sample (perlite) has to be treated in the same way as the test sample. If using closed environments like phytotrons, the control sample is not obligatory.

The experiment has to be performed in duplicate.

5.8.2 Calculation and Expression of results:

The number of germinated plants per litre sample is given by equation (1)

$$GP = \frac{GP_{sample} - GP_{control}}{3} \quad (1)$$

where

GP is the number of germinated plants per litre sample

GP_{sample} is in the trays filled with sample material

$GP_{control}$ is the number of germinated plants in the trays filled with the control material

The final result is rounded to whole numbers; all results are reported

5.9 Precision

No data available at the moment

5.10 Test report

The test report shall include the following information:

A reference to this method

A complete identification of the sample

The EC figure according to EN 13037 before and after diluting

The kind of diluent

The dilution ratio

The total number emerged weed propagules per litre of sample (duplicate)

REFERENCES

ISO/CD 17126: Soil quality – Determination of the effects of pollutants on soil flora – Seedling emergence, screening test with lettuce (*Lactuca sativa* (L.))

ÖNORM S 2021 (draft): Requirements for growing media

WRAP, The Composting Association (2002): Public Available Specification 100 – Specification for composted material, Annex D: Method to assess contamination by weed propagules and phytotoxins in composted material

Federal Compost Quality Assurance Association, Germany (1998): Determination and evaluation of the content of germinating seeds and plant propagules

International Peat Society, Commission II: Industrial Utilisation of Peat and Peatlands for Horticulture, Energy, Environmental Protection and Other Purposes; Horticultural Peat Working Group (HOPE): Draft method for the determination of weeds in raised bog peat

VITO, (1996): Standard Operating Procedure: Method Germinative Seeds or Weed Contamination (Kiemkrachtige Zaden); <http://www.vito.be/milieu/milieumetingen8a1.htm>

Kipp, J.A., G. Wever and C. de Krej (ed.) (2000): International Substrate Manual: Analysis Characteristics Recommendations. Elsevier Doetinchem The Netherlands

Wever, G. (2003): Set of appendices on analytical methods. BRL-K10001 Substrate materials for the product certificate for Substrate materials. KIWA BRL-K10001, The Netherlands.
Austrian compost Ordinance. Federal Ministry of Agriculture, Forestry, Environment and Water Management, Federal Law Leaflet (BGBl.) II Nr. 292/2001. Vienna, 2001

German Ordinance on the utilization of Bio-Wastes on Land used for Agricultural, Silvicultural and Horticultural Purposes. (Biowaste ordinance – BioAbfV) Federal Ministry for Environment, Nature Protection and Reactor Safety. Status 21st of September 1998: Federal Law Leaflet I 1998, page 2955. Bonn, 1998