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The object of the present application is to stabilise the nomenclature of the cereal-root eelworm, a widespread species of great economic importance which is now known by two different names in different countries.

2. The Nematode genus Heterodera A. Schmidt, 1871* contains several species, all of them parasitic on the roots of plants, and all having a cystic stage in the life-history. They were at one time considered to be a single species, H. schachtii A. Schmidt, 1871, mainly parasitising sugar-beet, but having biologic races on other crop plants, notably (in the present connection) on cereals.

3. From time to time workers in this subject have raised one or other of the biologic races of H. schachtii to the rank of variety, subspecies or species, but these opinions were not generally accepted until one of us (M.T.F.) in 1940 described slight morphological differences between three of these races and raised them to specific rank under the names H. major O. Schmidt (the cereal "race"), H. rostochiensis Wollenweber (the potato "race") and H. goettingiana Liebscher (the pea "race"). The splitting of the wider concept of H. schachtii is now generally accepted among nematologists, but there is a lack of uniformity of usage in the name applied to the cereal-root eelworm. American, Canadian, Dutch, German, Israeli, Russian and some Italian authors use the specific name avenae for this pest, while British, Danish, Japanese and other German and Italian authors use the specific name major O. Schmidt, 1930. The analysis of usage since 1940 given in Appendix I to the present paper shows that the specific name major has been used in 44 works and the specific name avenae in 21 works published in the period reviewed, and that usage is divided cleanly on national grounds except that some Italian and German authors use one name and some the other.

4. German and Danish workers were the first to recognise that the cyst-forming Heterodera which damaged cereals behaved differently from other known forms of the genus, especially from the beet eelworm, H. schachtii (see Voigt, 1892; Hansen, 1904). Voigt recorded morphological differences between the "Hafernematode" and the "Rübennematode" which enabled him to distinguish between the two taxa, but he did not publish a name for the former. In Danish publications, occurrences of the oat eelworm ("Havreaal") were frequently reported from 1895 onwards and Mortensen, Rostrup &

* The generic name Heterodera A. Schmidt, 1871 was added to the Official List of Generic Names in Zoology in Opinion 104 and the specific name schachtii A. Schmidt, 1871 to the Official List of Specific Names in Zoology in Direction 77.

Kølpin Ravn (1908, Tidsskr. Landbr. Planteavl, 15: 145–158, see p. 151) were the first to use for it the name *Heterodera schachtii* var. *avenae*, but they gave only a record of the occurrence of the worm without any description. The oat eelworm had in fact been described by Hansen in the same Journal in 1904, but he gave no name and his description is not referred to by Mortensen, Rostrup & Kølpin Ravn.

5. The subspecific name *avenae* was regularly mentioned as a *nomen nudum* in the annual reviews of the occurrence of plant diseases and pests in Denmark for the years 1907 to 1925. Wollenweber (1934, *Ilustr. Landwirtsch. Z.* No. 12: 101) stressed the physiological and morphological differences between *H. schachtii* var. *avenae* (Haferälchen) and *H. schachtii* (Rübenälchen) and gave a table of measurements showing the size-differences between the “female worms (cysts)” of *H. radicicola* (Greeff) Müller [= *Meloidogyne* spp.], *H. rostochiensis* Wollenweber, *H. schachtii* var. *avenae* and *H. schachtii* A. Schmidt. A translation of his description read: “*Heterodera schachtii* var. *avenae*, the oat eelworm, clearly occupies a middle place between the beet and the root [-knot] nematodes, but which [place] has yet to be decided”. Wollenweber is here evidently referring to the figures given in his table which indicate that in the ratios of body length/width and body plus neck length/width the cereal eelworm cysts resemble cysts of *H. schachtii* and differ from those of *H. rostochiensis* and from females of root-knot eelworm, whereas in neck length and ratio of body length/neck length the cereal eelworm cysts are nearer *H. rostochiensis* than *H. schachtii* (see Table).

<table>
<thead>
<tr>
<th>Species or variety</th>
<th>Host plant</th>
<th>Eggs</th>
<th>Body</th>
<th>Female eelworms (cysts)</th>
<th>Stylet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>W</td>
<td>Body L</td>
<td>Total L</td>
</tr>
<tr>
<td><em>Heterodera</em></td>
<td></td>
<td></td>
<td></td>
<td>width</td>
<td>width</td>
</tr>
<tr>
<td><em>radicicola</em></td>
<td>Potato</td>
<td>80</td>
<td>44</td>
<td>553</td>
<td>479</td>
</tr>
<tr>
<td><em>H. rostochiensis</em></td>
<td>Potato</td>
<td>97</td>
<td>46</td>
<td>655</td>
<td>640</td>
</tr>
<tr>
<td><em>H. schachtii</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>var. <em>avenae</em></td>
<td>Oats</td>
<td>—</td>
<td>—</td>
<td>526</td>
<td>334</td>
</tr>
<tr>
<td><em>H. schachtii</em></td>
<td>Beet</td>
<td>106</td>
<td>45</td>
<td>686</td>
<td>440</td>
</tr>
<tr>
<td></td>
<td>Cabbage</td>
<td>115</td>
<td>43</td>
<td>667</td>
<td>425</td>
</tr>
</tbody>
</table>

* This is an error and should read 1.9.
** This is an error and should read 1.76
Measurements in μ.

We hold that by using the name in connection with differential measurements of the cysts of the females, coupled with a reference to the host plants, Wollenweber gave the status of availability to the subspecific name *avenae*. Cyst measurements alone are now known to be of little use for identification in this case, particularly when there is no indication of the number of measurements made and when immature female cysts are taken. (Stylet measurements are given, but in mature cysts the stylet is no longer visible.) Mention of the host plants alone (such as had frequently been given in the past by other writers) would not have sufficed for this purpose, though this evidence was, and still is, sufficient to identify the cereal root eelworm in practice without ambiguity.
Wollenweber, however, appears to have recognized that there were morphological differences between beet and oat eelworms, and he attempted to indicate what these differences were.

6. In 1930 Schmidt (O.) (Pflanzenbau 3: 420–464) published a thorough analysis of the differences between the larvae of the beet eelworm and the oat eelworm, based on 40,000 measurements of larvae from 60 populations, and described the morphological, host-preference and hatching-rhythm differences between the two. He divided the larvae into two groups, named H. schachtii var. major and var. minor respectively, and there is no doubt of the availability of both names as from his work. In 1934 Filipjev ([Nematodes beneficial and harmful to agriculture] in Russian, see p. 237) summarized O. Schmidt’s work and reproduced some of his illustrations. He used the name avenae as a specific name. Neither O. Schmidt nor Filipjev quoted Wollenweber’s work, but whereas Schmidt gave no indication that he knew of the earlier Danish records, Filipjev specifically mentions them. According to correspondence with Bovien in 1937, however, Filipjev was uncertain about the availability of the name avenae.

7. In 1940 Franklin (J. Helminth. 18: 193–208) used the binomen H. major O. Schmidt for the oat eelworm, being at that time unaware of Wollenweber’s work in which the name avenae had first been published as an available name. In 1957 (Nematologica 2: 149–151), still without having seen Wollenweber’s work, she held that H. major was the first name to have been validly published for the species, but noted the extensive prior use of avenae, and added: “It should, however, be emphasised that the important point is not so much which name should be adopted, but that only one name should be used, and that that one should be chosen in accordance with the International Rules of Zoological Nomenclature. Unless, therefore, some relevant publication or reference has been overlooked, it is clear that the correct name for the cereal-root eelworm is Heterodera major (O. Schmidt, 1930) Franklin, 1940.” In the same year she enquired of Mr. Hemming, then Secretary to the Commission, whether that name or Heterodera avenae should be used for the cereal-root eelworm and she repeated her enquiry in February, 1958 (having then seen Wollenweber’s paper and drawing the Secretary’s attention to it), but at that time the resources of the Commission’s office were devoted to the preparations for the London Colloquium and the publication in book-form of the Official Lists and Indexes.

8. In June, 1958, the two other authors of the present application approached the Commission (independently of Dr. Franklin) for a ruling on the validity of the name avenae as the name of the cereal-root eelworm, and correspondence between the three applicants and the office of the Commission has resulted in this joint application.

9. While it is obvious that Schmidt’s work appears to be thorough and careful, it is in fact of less practical use to agricultural nematologists. The majority of these workers, when confronted with females and brown cysts associated with the roots of cereals, find that the criteria given by Wollenweber are practical and satisfactory aids to identification, coupled with his statement that the species infests oats, barley, wheat and rye. Schmidt based the name major on the greater length of “oat eelworm” larvae compared with “beet
eelworm" larvae and supported this with numerous measurements which were later confirmed by Fenwick & Franklin (1951). But statistical analysis of great numbers of larvae is not a feasible method of identification for the ordinary worker. An experienced worker can judge by eye, on releasing larvae from a cyst, whether they are those of the oat eelworm or of the beet eelworm, if he has to choose between those two. One of us (M.O.), however, indicates that a strain of *Heterodera schachtii* on *Spergula arvensis*, which is found at different localities in the Netherlands and also occurs in Germany, has larvae which are as long as or longer than the oat eelworm (522–600 μ), though it can be separated from the oat eelworm on cyst form and other characters. It is therefore advisable to rely on the practical application of cyst-form and other characters as indicated under paragraph 11, in addition to host plant, and to use larval length with caution as an additional character.

10. It will be seen from the figures given in Appendix I that most of the references to *H. major* are from England, where most of the work on the species has been done. If workers in that country could be persuaded to adopt the name *avenae*, world usage would be preponderantly in favour of that name. It may also be pointed out that one of us (M.O.) has used the name *avenae* in describing morphological characters overlooked by previous authors by which the cereal-root eelworm can be readily recognized (Oostenbrink & den Ouden, 1954).

11. The material described by Wollenweber and O. Schmidt cannot be traced, and it is unlikely that the older Danish records were based on material stored in collections. It is therefore proposed to designate a neotype for the species. This specimen, which is shortly described in Appendix II, is deposited in the nematology collections of the Plantenziektenkundige Dienst, Wageningen, Netherlands, where specimens agreeing with the neotype will be kept available for distribution to other nematology centres on request. The oat eelworm, *Heterodera avenae* Wollenweber, 1924, as described from the type material mentioned above, differs from other known *Heterodera* species by the following characters: A broad lemon-shaped cyst with a low, tapering vulval cone and with an extremely short vulval slit (12 μ). Cyst wall thick (±9 μ), brown to black, with conspicuous irregular punctation; young cysts with a thick subcrystalline layer. Larvae on an average well above 500 μ long, with a slightly curved, long tail (±1½ × stylet length) and with a distinctly tapering head which appears rounded owing to the narrow (8–9 μ) lip.

12. We therefore request the International Commission:

(1) to rule that neither the name *minor* O. Schmidt, 1930, as published in the combination *Heterodera schachtii* subsp. *minor*, nor the name *major* O. Schmidt, 1930, as published in the combination *Heterodera schachtii* subsp. *major*, is to be used in preference to the name *avenae* Wollenweber, 1924, as published in the combination *Heterodera schachtii* var. *avenae*, by those zoologists who consider that all of those names apply to the same taxon;

(2) to rule that the nominal species *Heterodera avenae* is to be interpreted by reference to the neotype described in Appendix II to this application and made available for further study as indicated.
(3) to place the subspecific name *avenae* Wollenweber, 1924, as published in the combination *Heterodera schachtii* A. Schmidt var. *avenae*, on the Official List of Specific Names in Zoology.

**APPENDIX I**

*Literature on the Cereal Root Eelworm*

I. Papers in which the cereal root eelworm is referred to as *Heterodera avenae*.

(Numbers are the numbers given to the papers in the following list A.)

<table>
<thead>
<tr>
<th>Country of Author</th>
<th>Papers entirely about <em>H. avenae</em></th>
<th>Papers on <em>Heterodera</em> spp., including <em>H. avenae</em></th>
<th>Brief mention of <em>H. avenae</em> amongst other nematodes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>1, 11</td>
<td>10</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Germany</td>
<td>19</td>
<td>16, 21</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Holland</td>
<td>3, 7, 8</td>
<td>5, 15</td>
<td>12, 13, 14</td>
<td>8</td>
</tr>
<tr>
<td>Israel</td>
<td></td>
<td>9</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td>-</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>U.S.A.</td>
<td></td>
<td>-</td>
<td>17, 18, 20</td>
<td>3</td>
</tr>
<tr>
<td>U.S.S.R.</td>
<td></td>
<td>-</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>6</strong></td>
<td><strong>6</strong></td>
<td><strong>9</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

12 papers
by 10 authors from
4 countries

II. Papers in which the cereal root eelworm is referred to as *Heterodera major*.

(Numbers are the numbers given to the papers in the following list B.)

<table>
<thead>
<tr>
<th>Country of Author</th>
<th>Papers entirely about <em>H. major</em></th>
<th>Papers on <em>Heterodera</em> spp., including <em>H. major</em></th>
<th>Brief mention of <em>H. major</em> amongst other nematodes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Britain</td>
<td>2, 10, 12a, 16, 17, 18, 19, 19a, 24, 33, 34, 35, 36, 38</td>
<td>7, 11, 12, 15, 21, 26, 30, 37, 39, 40, 41</td>
<td>6, 14, 22, 23, 28, 31, 32</td>
<td>32</td>
</tr>
<tr>
<td>Denmark</td>
<td>1, 1a, 3, 5</td>
<td>-</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Germany</td>
<td>8, 13</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Ireland</td>
<td>9</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Israel</td>
<td></td>
<td>-</td>
<td>29</td>
<td>1</td>
</tr>
<tr>
<td>Italy</td>
<td>27</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td>20</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>U.S.A.</td>
<td></td>
<td>-</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>22</strong></td>
<td><strong>12</strong></td>
<td><strong>10</strong></td>
<td><strong>44</strong></td>
</tr>
</tbody>
</table>

34 papers
by 23 authors from
8 countries.
Totals refer to the number of papers listed in the respective lines of columns. Columns 2 and 3 are the important ones: papers listed in column 4 are general ones.

Distribution of the cereal root eelworm is in all countries in the first column, except the United States of America.

A. Papers in which the name *Heterodera avenae* is used.

C=Canada  G=Germany  H=Holland  Is=Israel  It=Italy


2 It Baresi, F. 1955. "La lotta contro le anguillule delle foglie dei crisantemi mediante l'insetticida sistemico selettivo 'Systox'." Notiziario sulle Malattie delle Piante, Milan, No. 29, 3–7. (General paper on control.)


16 G Scherney, F. 1957. “Morphologische und histologische Untersuchungen an Heterodera-Arten.” Z. PflKrankh. 64(3) : 131–139


B. Papers in which the name Heterodera major is used.

B=British D=Danish G=German It=Italian J=Japanese
Is=Israel Ir=Ireland USA=U.S.A.


1a D Andersen, S. 1959. “Resistance of barley to various populations of the cereal root eelworm (Heterodera major).” Nematologica 4(2) : 91–98

2 B Anon. 1957. “Cereal root eelworm.” Advisory Leaflet No. 421, Min. of Agric. Fish. & Food, pp. 4


B Bulletin of Zoological Nomenclature


APPENDIX II

Description of Neotype—by M. Oostenbrink.
(Practice—Aschersleben, Germany.)

A mature cyst with eggs and larvae on slide *Heterodera* f 141. Neoparasites on slides *Heterodera* f 133–140 and 142–152. The slides are deposited in the Nematology Collection of the Plantenziektenkundige Dienst, Wageningen, Netherlands, where they are available for study.

The neotype cyst has been cracked open so that more differential characters are readily seen. The cyst is clearly lemon-shaped, has a typical short vulval slit (12 μ long) and is brown to black with conspicuous punctation. The cyst wall is 9 μ thick. About 250 eggs and 15 larvae are visible. The eggs measure 126 μ long by 56 μ wide (mean of 20 specimens) and the larvae average 530 μ long (8 specimens). The larval tails are slightly curved and are about 1 1/2 times as long as the mouth stylet. The heads are tapering and rounded, with the lip region 3.9 μ high and 8.5 μ broad (average of 10 specimens). The larval stylets average 25 μ long (10 specimens).
Franklin, Mary T. 1959. "Proposal to stabilise the scientific name of the cereal root eelworm (class Nematoda)." *The Bulletin of zoological nomenclature* 17, 76–85. [https://doi.org/10.5962/bhl.part.29573](https://doi.org/10.5962/bhl.part.29573).

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