Two barley blights, with comparison of species of Helminthosporium upon cereals

L. H. Pammel
*Iowa State College*

Charlotte M. King
*Iowa State College*

A. L. Bakke
*Iowa State College*

Follow this and additional works at: [http://lib.dr.iastate.edu/bulletin](http://lib.dr.iastate.edu/bulletin)

Part of the [Agriculture Commons](http://lib.dr.iastate.edu/bulletin) and the [Botany Commons](http://lib.dr.iastate.edu/bulletin)

**Recommended Citation**

Available at: [http://lib.dr.iastate.edu/bulletin/vol10/iss116/1](http://lib.dr.iastate.edu/bulletin/vol10/iss116/1)
EXPERIMENT STATION

IOWA STATE COLLEGE
OF AGRICULTURE AND MECHANIC ARTS

BOTANY SECTION

TWO BARLEY BLIGHTS

AMES, IOWA

Bulletin 116

June, 1910
STATE BOARD OF EDUCATION

Hon. A. B. Funk, Spirit Lake.
Hon. George T. Baker, Davenport.
Hon. Charles R. Brenton, Dallas Center.
Hon. E. P. Schoentgen, Council Bluffs.
Hon. T. D. Foster, Ottumwa.
Hon. Parker K. Holbrook, Onawa.
Hon. D. D. Murphy, Elkader.
Hon. Roger Leavitt, Cedar Falls.

OFFICERS

Hon. J. H. Trewin, Cedar Rapids .......... .................. Chairman
Hon. D. A. Emery, Ottumwa ................. .................. Secretary

FINANCE COMMITTEE

W. R. Boyd, President, Cedar Rapids.
Thos. Lambert, Sabula.
D. A. Emery, Secretary, Ottumwa.

STATION STAFF

A. B. Storms, M. A., D. D., President.
W. J. Kennedy, B. S. A., Animal Husbandry and Vice-Director.
S. A. Beach, M. S. A., Horticulture.
H. E. Summers, B. S., Entomologist.
M. Mortensen, B. S. A., Dairying.
H. D. Hughes, M. S., Farm Crops.
J. B. Davidson, B. Sc. in M. E., Agricultural Engineering.
Chas. A. Scott, B. S. A., Forester.
Laurenz Greene, B. S., M. S. A., Experimentalist in Horticulture.
L. C. Burnett, M. S. A., Assistant in Farm Crops.
M. L. King, B. M. E., Experimentalist in Agricultural Engineering.
S. L. Jodidlo, B. S., Ph. D., Experimentalist in Stock.
Ira G. McBeth, M. S., Experimentalist in Soil Bacteriology.
A. A. Wells, Experimentalist in Soils.
Stella Hartzel, A. M., B. S., Assistant in Chemistry.
R. L. Webster, A. B., Assistant in Entomology.
Charlotte M. King, Assistant in Botany.
Harriette Kellogg, A. M., Assistant in Botany.
F. E. Colburn, Photographer.
C. V. Gregory, Bulletin Editor.
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary</td>
<td>178</td>
</tr>
<tr>
<td>Yellow-leaf Disease, <em>Helminthosporium gramineum</em> Rabh</td>
<td>179</td>
</tr>
<tr>
<td>Late Barley Disease, <em>Helminthosporium sativum</em> n. sp.</td>
<td>180</td>
</tr>
<tr>
<td>Injury from these diseases observed in the field</td>
<td>180</td>
</tr>
<tr>
<td>Cultures and Infection Experiments</td>
<td>181</td>
</tr>
<tr>
<td>Cross inoculation experiments</td>
<td>183</td>
</tr>
<tr>
<td>The two described blights of barley distinct from species of <em>Helminthosporium</em> upon corn</td>
<td>183</td>
</tr>
<tr>
<td>Notes on life-history studies of species of <em>Helminthosporium</em></td>
<td>185</td>
</tr>
<tr>
<td>List of species of <em>Helminthosporium</em> found upon the Gramineae</td>
<td>185</td>
</tr>
<tr>
<td>Treatment</td>
<td>187</td>
</tr>
<tr>
<td>Comparison of species recorded for cereals</td>
<td>188</td>
</tr>
</tbody>
</table>
SUMMARY

1. During the past season there was a widespread disease on barley commonly called rust, but in no way related to this disease. It is caused by an imperfect fungus. There are two forms of these leaf spot diseases of the barley, one an early blight which has been designated as "the yellow leaf disease" and the other "the late barley blight."

2. The yellow leaf disease is caused by the fungus *Helminthosporium gramineum*. This appears earlier during the season and is characterized by yellowish longitudinal stripes alternating with darker lines. This is transmitted by the seed.

3. The late barley blight is caused by the fungus *Helminthosporium sativum*. This fungus causes brown spots of irregular outline, and occurs on the leaves, glumes and seed. The leaves are easily broken up and completely destroyed in some cases. The damage was great. It is the most serious barley disease in Iowa.

4. There are many species of *Helminthosporium* on grasses, one species occurs on the leaves of corn, sometimes doing much injury. Inoculation experiments with the late barley blight failed to produce the disease on corn.

5. The fungus is apparently transmitted with the seed. Not much can be said with reference to treatment. At present we advise formalin treatment the same as for barley smut.
TWO BARLEY BLIGHTS, WITH COMPARISON OF SPECIES OF HELMINTHOSPORIUM UPON CEREALS

L. H. PAMMEL    CHARLOTTE M. KING    A. L. BAKKE

YELLOW-LEAF DISEASE OF BARLEY

Early in June, 1909, the yellow-leaf disease (\textit{H. gramineum}) was prevalent in some fields of barley at Ames. It appeared just before heading of the grain, and destroyed .50 of one per cent of the barley.

This disease was first recorded* at Ames in 1890. It is characterized by longitudinal yellowish-green spots extending in parallel rows upon the leaves and sheaths. The yellowish-green areas are strongly contrasted to the green of the leaves. All the culms of a single stool are affected, and the diseased plants die prematurely. When the spots of the fungus begin to appear the plant ceases to grow and very little barley is produced. This species was referred to \textit{Helminthosporium gramineum} because it seems to agree with the fungus described by Rabenhorst. It was later found to be somewhat widely disseminated in barley-growing regions. The character of the fungus and its injury to barley were later worked out by several investigators.

Ericksson** of Sweden gives an account of it; and Kirchner† studied it in Germany and gives an excellent detailed description of it. That the fungus is common in Europe appears from the numerous references found in the literature of work by Stonner, Farneti, Diedicke, Noack, Ravn, Rippert, Johnson. It has not, however, been frequently reported in American literature although it must be much more common than the literature would seem to indicate.

Journal of Mycology. 7:36.
LATE BARLEY DISEASE

During the latter part of June, 1909, a disease which afterward proved to be very injurious, began to develop upon barley in a field at Ames. The presence of this disease was noted during the same season in South Dakota early in July, and in Minnesota and Saskatchewan also.

It had been observed at Ames in 1907 and 1908, but was not so destructive during those seasons as in 1909.

As published in a note* in 1909, the late disease of barley observed during the past summer is distinct from the yellow-leaf disease.

This new disease manifests itself in the form of brownish circular or somewhat elongated dark-colored spots much the same as in *Piricularia*, soon causing the leaves to become brown. The disease also occurs upon the glumes and spikelets, in some cases even affecting the grain. It has been often referred to as rust. The straw at harvest time has a dull brown color, and instead of standing erect, becomes a tangled mass.

The mycelium consists of branched septate threads in the interior of the leaf; when the grain is affected the mycelium penetrates the starch layer; the fascicled conidiophores break through the epidermis; they are fuscous brown, septate, 8u—10u in width; the divisions sometimes swollen between the septa. Each conidiophore bears a large, cylindrical dark brown spore, with from 7—12 divisions. The spores measure 105—130u by 15—20u.

INJURY FROM EARLY AND LATE BLIGHTS OBSERVED IN THE FIELD

Mr. L. C. Burnett has furnished the following record of observations of the effects of fungi upon twenty-two varieties of barley grown on the Experiment Station barley plots.

The table indicates the amount of smut and of blight present at date of full head. The fungus injury other than smut apparent at this time may be largely attributed to the early blight; also damage by fungus at date of ripening. The date of ripening corresponds with time of full development of the late blight. The injury manifested by the barley at this time may be attrib-

uted largely to this disease. The final column showing yield, indicates great falling off on account of diseases.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Grain Importation</th>
<th>Date Full Head</th>
<th>Smut</th>
<th>Fungus % Affected</th>
<th>Date Ripe</th>
<th>Fungus % Damaged</th>
<th>Lodged</th>
<th>Yield Bu per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primus</td>
<td>532</td>
<td>7—8</td>
<td>0</td>
<td>98</td>
<td>7—18</td>
<td>100</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>Manchuria</td>
<td>170</td>
<td>6—26</td>
<td>0</td>
<td>0</td>
<td>7—16</td>
<td>5</td>
<td>5</td>
<td>34</td>
</tr>
<tr>
<td>Kitting</td>
<td>167</td>
<td>7—9</td>
<td>0</td>
<td>95</td>
<td>7—17</td>
<td>50</td>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td>Kitting</td>
<td>150</td>
<td>7—9</td>
<td>0</td>
<td>95</td>
<td>7—17</td>
<td>50</td>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td>Princess</td>
<td>183</td>
<td>7—12</td>
<td>0</td>
<td>100</td>
<td>7—21</td>
<td>100</td>
<td>100</td>
<td>5</td>
</tr>
<tr>
<td>Princess</td>
<td>529</td>
<td>7—12</td>
<td>0</td>
<td>100</td>
<td>7—21</td>
<td>100</td>
<td>100</td>
<td>7</td>
</tr>
<tr>
<td>Hanna</td>
<td>203</td>
<td>7—1</td>
<td>2</td>
<td>20</td>
<td>16</td>
<td>90</td>
<td>100</td>
<td>19</td>
</tr>
<tr>
<td>Hannchen</td>
<td>531</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oderbruch</td>
<td>537</td>
<td>6—30</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>100</td>
<td>100</td>
<td>33</td>
</tr>
<tr>
<td>Chevalier</td>
<td>507</td>
<td>7—12</td>
<td>0</td>
<td>100</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Bohmes' Beardless</td>
<td>576</td>
<td>6—25</td>
<td>2</td>
<td>T</td>
<td>12</td>
<td>2</td>
<td>95</td>
<td>22</td>
</tr>
<tr>
<td>Little Hulless</td>
<td>335</td>
<td>7—3</td>
<td>T</td>
<td>6</td>
<td>11</td>
<td>1</td>
<td>40</td>
<td>14</td>
</tr>
<tr>
<td>Hulless</td>
<td>22</td>
<td>6—27</td>
<td>0</td>
<td>T</td>
<td>6</td>
<td>4</td>
<td>95</td>
<td>8</td>
</tr>
<tr>
<td>Black Hulless</td>
<td>596</td>
<td>6—28</td>
<td>0</td>
<td>T</td>
<td>10</td>
<td>3</td>
<td>85</td>
<td>26</td>
</tr>
<tr>
<td>Hulless</td>
<td>598</td>
<td>6—27</td>
<td>0</td>
<td>T</td>
<td>6</td>
<td>3</td>
<td>90</td>
<td>11</td>
</tr>
<tr>
<td>Colorado Hulless</td>
<td>475</td>
<td>6—27</td>
<td>T</td>
<td>T</td>
<td>7</td>
<td>4</td>
<td>95</td>
<td>9</td>
</tr>
<tr>
<td>Hulless</td>
<td>629</td>
<td>6—27</td>
<td>0</td>
<td>T</td>
<td>7</td>
<td>4</td>
<td>100</td>
<td>19</td>
</tr>
<tr>
<td>White Hulless</td>
<td>424</td>
<td>6—29</td>
<td>0</td>
<td>15</td>
<td>11</td>
<td>T</td>
<td>100</td>
<td>12</td>
</tr>
<tr>
<td>Bohmes' J</td>
<td>533</td>
<td>6—28</td>
<td>0</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>100</td>
<td>11</td>
</tr>
<tr>
<td>Del Notre</td>
<td>630</td>
<td>6—28</td>
<td>0</td>
<td>T</td>
<td>6</td>
<td>3</td>
<td>95</td>
<td>13</td>
</tr>
<tr>
<td>Sangatsuka</td>
<td>78</td>
<td>6—27</td>
<td>0</td>
<td>5</td>
<td>9</td>
<td>3</td>
<td>60</td>
<td>25</td>
</tr>
<tr>
<td>Arpa</td>
<td>528</td>
<td>6—26</td>
<td>10</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>95</td>
<td>9</td>
</tr>
</tbody>
</table>

NOTE: The damage seems to be twofold with the common barleys. Not only are the plants weakened in producing power, but the straw is decayed to such an extent that it lies flat on the ground, and does not fill. The odor from this rotten straw is very similar to that from rotting potatoes.

CULTURES AND INFECTION EXPERIMENTS

It was not difficult to get pure cultures of the organism by placing diseased leaves in sterile petri dishes containing agar with some extract from barley leaves.

In cultures the spores develop much more slowly than upon diseased leaves placed in moist petri dishes.

Infection experiments were subsequently made with the barley plant, from pure cultures. For this purpose the barley was allowed to germinate, and the young plants were inoculated by sprinkling with spores, and by inoculating the soil with spores. In the course of two weeks, when the plants were about four inches in height, yellowish spots appeared upon the leaves. It was found that at the point of inoculation, the fungus had penetrated the epidermis.
PLATE 1

*Helminthosporium sativum* from barley in field. 1, 2, 3 spores; 5, 6, 7, 8 conidiophores

*Helminthosporium* on *Festuca pratensis*. 9, 10 spores; 11 germinating spore; 12 conidiophore

*Helminthosporium* on barley in greenhouse. Transferred from *Helminthosporium sativum* on barley in field, 13, 14, 15, 16 spores
We had no difficulty last fall in producing positive infection results by use of dried specimens affected by the *Helminthosporium*. It would seem therefore, that the seed may sometimes be the source of infection, both of this disease, and of the yellow-leaf disease of barley.

**CROSS INOCULATION EXPERIMENTS**

An experiment was made in the field, to determine whether the *Helminthosporium* growing upon barley may infect corn. The results were wholly negative.

The fungus under consideration was submitted to Saccardo for examination, who reported it more like *H. teres* than like *H. gramineum*.

Cultures alone will conclusively determine whether *H. sativum* and *H. teres* are provisionally a separate name may be given to the new barley disease.

**THE DESCRIBED DISEASES UPON BARLEY DISTINCT FROM SPECIES OF HELMINTHOSPORIUM UPON CORN**

Several other species of *Helminthosporium* are recorded upon cereals; one *H. turcicum* described by Passerini, occurs upon corn. Stewart* subsequently described a disease found seriously affecting sweet and field corn on Long Island referring it to *H. inconspicuum*. The same has been reported by Thaxter on sweet corn in Connecticut in 1889. Ellis**, to whom the specimen of yellow-leaf disease on barley was submitted at the time of its first observation in Iowa, pronounced it *H. gramineum*, and identical with *H. turcicum*. In a later publication the opinion was stated that the fungi are different; also that the Italian fungus (*H. turcicum*) has not been observed here.

Regarding the identity of *H. turcicum*, with *H. gramineum*, Comes† holds them distinct, although closely related. Subsequently C. O. Smith states the opinion that the American fungus (*H. inconspicuum*) is probably identical with the *H. turcicum* of Italy.

Farnetti‡, who studied the various species of *Helminthosporiu*

---

‡†Crittogamia Agraria. 409.
Plate II

*Helminthosporium gramineum.*  1, conidiophore; 2, 3, 4, 5, 6 spores; 7 spore section.

*Helminthosporium teres.*  8, 9 conidiophores; 10, 11, 12, 13, 14 spores.
ium occurring on oats and barley (H. Avenae on oats and H. teres on barley) found that the species on oats gave few infections on barley, and none upon other cereals, and that the barley species infected only the barley plant.

LIFE HISTORY OF SPECIES OF HELMINTHOSPORIUM

A number of European writers have studied the life history of the H. gramineum and other species. Diedicke* discusses Pleospora trichostoma as the perithecial form of H. gramineum. Noack** agrees with Diedicke in this opinion. Johnson† calls attention to H. gramineum and to its ascospore stage in Ireland. Farneti‡ from his own studies concludes that Piricularia grisea, P. oryzae, Helminthosporium oryzae, and H. turcicum are different forms of one species. This seems hardly probable.

SPECIES OF HELMINTHOSPORIUM FOUND UPON GRAMINEAE

The genus is not uncommon upon various members of the gramineae, Saccardo in Sylloge Fungorum records the following species:

H. teres Sacc. (Hordeum sativum Italy); H. gramineum Rabb. (Hordeum vulgare Germany); H. avenae Oud. (Avena sativa Holland); H. avenaceum Curtis (“in stramine avenace” N. Am.); H. Sorokinianum Sacc. (Triticum and Secale Russia); H. tritici P. Henn. (Triticum vulgare Africa); H. inconspicuum Cano Ell. (Zea mays New Jersey); H. turcicum Pass. (Sorghum vulgare and Zea mays New Jersey); H. Sorghi Schw. (Sorghum N. Am.); H. Euchlaenae Zimm (Euchlaena mexicana Africa); H. sigmoideum Cav. (Oryza sativa Italy); H. foeculatum Pat. (Bambusae Tonkin); H. coaguazense Speg. (Bambusae Brazil); H. Bambusae Cooke (Bambusae Assam); H. rhabaloides Fres. Sacc. forma Bambusae P. Brun. (Bambusae arundinacea France) H. Ravenelii Curtis et Berk. (Sporobolus Carolina and Cuba); H. Tonkinense Karst. et Roum. (Sporobolus tenacissimus Tonkin); H. crustaceum P. Henn. (Sporobolus Java); H. nodulosum B. & C. (Eleusine Indica N. Am.); H. viticulosum Cr. (Phragmites communis France) H. fugax Wallr. (Agrostis spica-venta); H. Leer-

* Diedicke, H. Centbl. Bakt. u. Par. 2 Abt. 11:58-59. 1903
Helminthosporium inconspicuum. 1, 2, 3 conidiophores; 4, 5, 6 spores
Helminthosporium turcicum. 8, 9, 10 conidiophores; 11, 12, 13 spores
Helminthosporium inconspicuum var. Buchloe. 14, 15, 16 conidiophores; 17, 18, 19 spores, showing thick walls
sia Atk. (Leersia virginica Ala.); H. flagelloideum Atk. (Panici Ala.); H. geniculatum Tracy and Earle (Eragrostis rachitricha); H. hadrotrichoides Ell. & Ev. (Eragrostis major Faulkland, Del. N. Am.); H. parvulum Cke. (Gynerium argenteum New England); H. inconspicuum var. brittanicum Grove (Grasses England); H. graminis McAlp. (Ammophila arundinacea Australia). Here also may be noted H. teres forma avenae sativae (Exsiccati Briosi and Cavara Italy); H. inconspicuum C. & E. var. Buch. loes Ell. and Ev. (Exsiccati Ellis & Everhart) Buchloe dactyloides, Kansas. Reed distributed H. inconspicuum from Virginia; spores from this specimen are very thin-walled.

We collected on Festuca pratensis in fields near the barley, a fungus apparently identical with the late disease of barley. The spores, however, are smaller, although of the same shape. The leaf was not so abundantly spotted.

An English writer reports H. gramineum Rabh. on Hordeum sativum and on wild species of barley.

**TREATMENT**

Not much can be said at this time in regard to the treatment for the disease. Infection experiments have shown that the seed carries the fungus over from one season to another. It is probable that treating the seed with formaldehyde at the rate of 1 pound to 40-50 gallons of water will be efficacious in destroying the spores on the surface.