

## OBSERVATIONS CONCERNING THE DISEASE SUSCEPTIBILITY OF CEREALS AND WILD GRASSES.<sup>1</sup>

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During the past two years, the writer has observed a number of cases in which considerable differences were apparent as to the degree to which various varieties of the cereals or species of wild grasses were diseased. While it is recognized that all these differences may not actually denote degrees of susceptibility and resistance, possibly being due to differences in maturity, or initial seed infection, yet they may be of importance as a record of field behavior of the varieties and species and may be of interest and use to those investigating these diseases, either for the information they may add as to host range or for whatever possibilities of resistance they may suggest.

**Rust and Leaf Spot of Oats.** In the spring of 1923, the crown rust of oats, *Puccinia coronata* Corda, was very severe on the varieties grown by the Soils and Crops Department of the Purdue University Agricultural Experiment Station at Lafayette, Ind. Table 1 gives the amount of infection of each variety according to the scale used by the Office of Cereal Investigations, U. S. Department of Agriculture. According to these notes the varieties Iogren and Ohio 201 were the least rusted while Iowa 103, Irish Victor, Miami and Cornelian were only moderately rusted.

In the spring of 1924 but little crown rust of oats developed in the variety plots. However, a leaf spot due to a species of *Helminthosporium* was very severe especially upon some varieties. In answer to an inquiry concerning the identity of this species, Dr. A. G. Johnson writes that it is *Helminthosporium Avenae* Eidam (see Dreshler<sup>2</sup>) or since the status of that name is somewhat doubtful it should perhaps be called *Helminthosporium Avenae-sativae* (Br. & Cav.) Lindau. Table I gives the relative amount of infection produced by this disease. The varieties showing the least infection were Minota and Minn. 358. The varieties showing only a slight amount were Silvermine, Ohio 201, Ohio 202, Cornelian, Irish Victor, Kanota, Fulghum, White Cross. It is to be noted that the varieties Ohio 201, Cornelian, Irish Victor, were only slightly or moderately infected by both diseases.

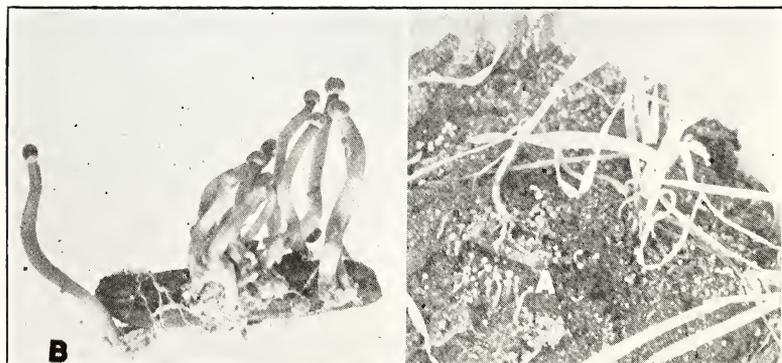
**Ergot, *Claviceps purpurea* Tul.** The spring and early summer of 1924 were very favorable for the development of ergot due to the very wet season. In connection with some studies of rye diseases, sclerotia of *Claviceps purpurea* from rye obtained from Prof. J. G. Dickson were

<sup>1</sup> Contribution from the Botanical Department, Purdue University Agricultural Experiment Station, Lafayette, Indiana.

<sup>2</sup> Dreshler, Charles. Some Graminicolous Species of *Helminthosporium*: 1. Jour. Agr. Res. 24:641-739. 1923.

TABLE I. Amount of Crown Rust and Leaf Spot on Oat Varieties in Plots of Soils and Crops Department, Purdue University Agricultural Experiment Station, Lafayette, Indiana.

Variety	Crown Rust 1923	Leaf Spot 1924
Swedish Select.....	65-100	Fair-moderate
Fairfield.....	75-100	Moderate-heavy
Fairfield.....	75-100	Moderate
Fairfield yellow.....	75-100	Moderate-heavy
Fairfield white.....	75-100	Heavy
Gopher Minn. 674.....	75-100	Heavy
Kherson.....	50-75	Heavy
Wisconsin No. 7.....	75-100	Moderate
Iowa 103.....	35-50	Heavy
White Cross.....	.....	Slight
Iowar.....	50-65	Fair
Fulghum.....	.....	Slight
Kanota.....	100	Slight
Idamine.....	.....	Moderate
Wolverine.....	.....	Heavy
C. I. 2053.....	.....	Moderate-heavy
Trotter.....	50-65	Moderate
Miami.....	35-65	Heavy
Irish Victor.....	35-65	Slight
Minn. 358.....	65-75	Trace
Cornellian.....	35-50	Slight
Ohio 201.....	15-50	Slight
Ohio 202.....	50-75	Slight
Wasa.....	50-75	Fair
Victory.....	50-65	Slight-Moderate
Minota.....	75-100	Trace-Slight
Iogren.....	15-35	Fair-Moderate
Silvermine.....	75-100	Slight
Big Four.....	75-100	Moderate

Fig. 1. Sporophores of *Claviceps purpurea*. A. Surface of soil showing sporophores arising from partially buried sclerotia. B. Sclerotium with sporophores enlarged.

wintered. This was done by shallowly covering the freshly collected sclerotia with sand in pots and placing these, buried to the top, in soil out of doors for the winter. In May an abundance of sporophores developed from these sclerotia, (fig. 1). The pots with developing sporophores were placed in the rye nursery and a heavy infection of the rye resulted, being favored by wet weather and the prolongation of the period of blossoming of the rye.

To the west of the infected rye, there was situated a nursery containing a number of varieties of winter and spring wheat and barley. Bordering this on the west was a garden containing many wild grass species. From the rye the ergot infection spread into these nurseries.

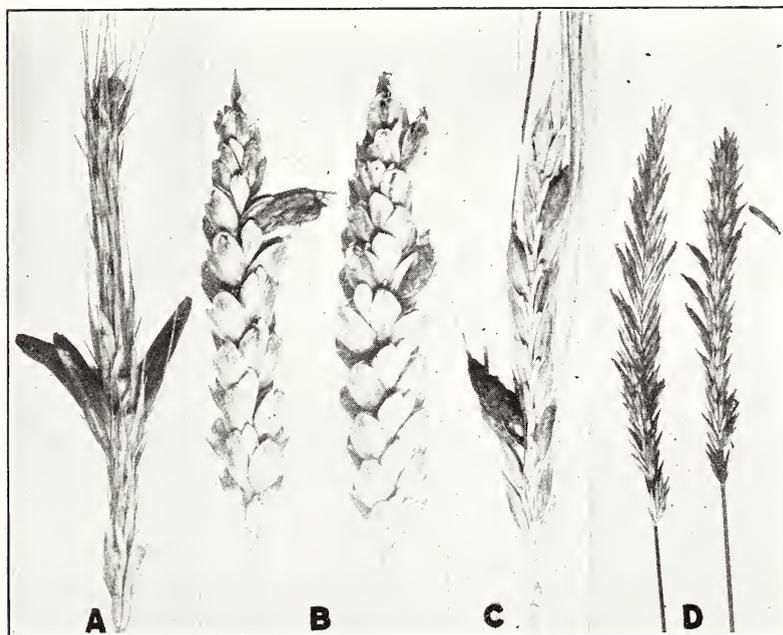


Fig. 2. *Claviceps purpurea* on various hosts. A. Head of rye. B. Two heads of Yeoman wheat. C. Head of Kitzing barley. D. Two heads of *Agropyron cristatum*.

While occasional sclerotia were found in many varieties of wheat, one especially was outstanding in its susceptibility. This was the variety Yeoman C. I. 6223<sup>3</sup> (fig. 2) which became quite heavily infected. The varieties Wisconsin Wonder and Warden C. I. 4994, also showed considerable infection although not to the same extent as Yeoman.

Among the barley varieties, Kitzing C. I. 189<sup>3</sup> (fig. 2) and Princess C. I. 1428<sup>3</sup> showed heavy infection. It is rather unusual for wheat and barley to show infection in this region. The durum wheats in North Dakota are, however, occasionally very severely infected (see Weniger<sup>4</sup>).

<sup>3</sup> Variety received from the Office of Cereal Investigations, U. S. Department of Agriculture, and bearing the accession numbers of that office.

<sup>4</sup> Weniger, Wanda. Ergot and Its Control. N. D. Agr. Exp. Sta. Bull. 176. 1924.

In the grass garden, the infection upon a number of the species of wild grasses was very heavy. The species of grasses showing infection were as follows:

Grasses Heavily Infected by *Claviceps purpurea*.

<i>Dactylis glomerata</i> L. <sup>5, 6</sup>	<i>Agropyron inerme</i> (Schribn. & Smith) Rydb. *
<i>Bromus marginatus</i> Nees. *	
<i>Bromus secalinus</i> L. <sup>5</sup>	<i>Agropyron repens</i> (L.) Beauv. <sup>5, 6</sup>
<i>Bromus inermis</i> Leyss. <sup>5*</sup>	<i>Agropyron Smithii</i> Rydb. <sup>5, 6</sup>
<i>Agropyron cristatum</i> Gaertn. (fig. 2.)	<i>Hystrix Hystrix</i> (L.) Millsp. <sup>5, 6</sup>
	<i>Elymus condensatus</i> Presl. <sup>5 *</sup>

Moderately Infected.

<i>Festuca elatior</i> L. <sup>5, 6 *</sup>	<i>Elymus virescens</i> Piper *
<i>Poa palustris</i> L. *	<i>Elymus triticoides</i> Buckl.
	<i>Agropyron tenerum</i> Vasey <sup>5, 6 *</sup>

Slightly Infected.

<i>Stipa minor</i> (Vasey) Schribn.	<i>Poa compressa</i> L. <sup>5, 6 *</sup>
<i>Alopecurus pratensis</i> L. <sup>5, 6 *</sup>	<i>Elymus virginicus</i> L. <sup>5, 6</sup>
<i>Arrhenatherum elatius</i> (L.) Mert. & Koch. <sup>5 *</sup>	<i>Phleum pratense</i> L. <sup>5, 6</sup>

Prof. A. S. Hitchcock kindly identified a number of the species concerning which there was some doubt as to the identity. These are designated by an asterisk (\*).

Apparently a number of these species (those not marked 5 or 6) have not been noted previously as hosts for this disease.

A collection of sand beach grass, heavily infected by ergot, made by Dr. M. W. Gardner at Marquette, Michigan, was identified by Prof. A. S. Hitchcock as *Ammophila breviligulata* Fernald and apparently this is also a new host for this disease.

A number of species as listed below showed no infection. These include several species which are known to be hosts. Apparently these escaped due probably to blossoming late during a period of very dry weather. In consequence the lack of infection in these species is not necessarily resistance, in some cases at least being due to escaping the disease.

<sup>5</sup> Listed as hosts for *Claviceps purpurea* in the compilation made by Atanasoff, Ergot of Grains and Grasses. Mimeographed and distributed by the Office of Cereal Investigations, U. S. Department of Agriculture, 1920.

<sup>6</sup> Listed as occurring in North Dakota by Miss Weniger (l. c. 4).

## Not Infected.

<i>Andropogon scoparius</i> Michx.	<i>Festuca capillata</i> Lam.
<i>Tripsacum dactyloides</i> L.	<i>Festuca rubra</i> L. <sup>5</sup>
<i>Sorghastrum nutans</i> (L.) Nash.	<i>Festuca ovina</i> L.
<i>Oryzopsis miliacea</i> Benth. & Hook.	<i>Hordeum jubatum</i> L. <sup>5, 6</sup>
<i>Muhlenbergia Schreberi</i> J. F. Gmel.	<i>Hordeum pusillum</i> Nutt
<i>Muhlenbergia racemosa</i> (Michx.)	<i>Elymus striatus</i> Willd. <sup>5, 6</sup>
B. S. P.	<i>Elymus canadensis</i> L. <sup>6</sup>
<i>Sporobolus asper</i> (Michx.) Kunth.	<i>Elymus robustus</i> Schribn. & J. G.
<i>Agrostis alba</i> L. <sup>6</sup>	Sm. <sup>5, 6</sup>
<i>Agrostis oregonensis</i> Vasey.	<i>Elymus glaucus jepsoni</i> Davy
<i>Agrostis palustris</i> Huds.	<i>Bouteloua oligastachys</i> Torr.
<i>Agrostic perennans</i> (Walt.)	<i>Bulbilis dactyloides</i> (Nutt.) Raf.
Tuckerm.	<i>Agrostis alba maritima</i> (Lam.)
	Meyer

**Wheat Scab.** In the spring of 1924, considerable difference in susceptibility to scab were noted among the spring wheat varieties planted for a study of leaf rust susceptibility. These were planted in ten-foot rows with the rows about 10 inches apart. The varieties may be grouped as follows according to the amount of scab:

Very heavy:—Marquis, Sbei C. I. 4588<sup>3</sup>, unnamed varieties with Office of Cereal Investigation numbers 3142, 3747, 3756.

Heavy:—Yaraslov C. I. 1526, Peliss C. I. 1584, Acme S. D. 284, Arnautka C. I. 1493, Arnautka C. I. 1494, Arnautka Minn. 337, Polish C. I. 3007, Polish C. I. 5524, Velvet Don C. I. 1445, Marouani C. I. 1593, Kubanka C. I. 1440, Kubanka C. I. 2094, Kahla C. I. 5529, Bidi C. I. 3811, Blanco C. I. 2192, Indian Runner C. I. 5136, Erivan C. I. 2397, unnamed Office of Cereal Investigations numbers 3779, 3778, 3769.

Moderate:—Iumillio, Buford C. I. 5295, Madona C. I. 2448, Warden C. I. 4994, Chul C. I. 2227, Office of Cereal Investigations numbers 3739, 3210, 3774, 3780, 4131.

Fair amount:—Monad C. I. 3320, Mindum C. I. 5296.

Trace or Slight:—Norka C. I. 4377, Khapli C. I. 4013, Emmer S. D. 283, Common Emmer, Bearded Spelt C. I. 1774, Dixon C. I. 6295, Dixon C. I. 6049, Einkorn C. I. 2433, Vernal Emmer C. I. 1524, Yeoman C. I. 6223, Blount's Lambrigg C. I. 5021, Glaicia C. I. 2463, Red Resaca C. I. 6391, Huron C. I. 2315, unnamed Office of Cereal Investigations numbers 5100, 5490, 3258.

The two varieties Norka C. I. 4377 and unnamed C. I. 3756 were grown in adjacent rows in the nursery and their difference in amount of infection was very pronounced. Prof. J. G. Dickson<sup>7</sup> informs me, however, that the results of their inoculations do not show such marked differences both being more or less susceptible, Norka, however, being less infected. He states, however, that ideal conditions were given for infection, conidial suspensions being sprayed into the glumes during flowering or immediately past flowering. The above notes cannot therefore be considered as indicating the susceptibility of these varieties under

<sup>7</sup> Data furnished in letter of Oct. 20, 1924, with permission to quote.

the most favorable conditions for infection. They, however, may be of value when taken with additional data in throwing light on the field action of varieties to this disease.

**Marasmius on Festuca.** In 1923 several clumps of *Festuca capillata* Lam. in the wild grass garden started to die. The dead areas in each clump increased during the summer until nearly all of the clump was dead. From the dead and dying grass stems and leaves there developed fruiting bodies of an agaric (fig. 3) which appeared to be a species of



Fig. 3. Sporophores of *Marasmius* arising from dead and dying culms and leaves of *Festuca capillata*.

*Marasmius*. Dr. C. H. Kauffman to whom specimens were submitted states that it is nearest to *Marasmius institutus* Fr. Tehon<sup>8</sup> has reported finding a *Marasmius* parasitizing wheat. It therefore appears that, while species of this genus commonly develop on dead plant parts, apparently they may occasionally attack and kill living plants.

**Southern Corn Root Worm.** In connection with studies of corn rust, a nursery consisting of approximately 250 three- to five-year selfs of the sweet corn varieties Country Gentleman, Golden Rod, Golden Ban-

<sup>8</sup> Tehon, L. R. *Marasmius* on Wheat. *Mycologia* 16:132-133, 1924.

tam, Stowell's Evergreen, Early Evergreen, Narrow Grained Evergreen, Howling Mob, and field corn varieties Silver King, Golden Glow and Early Yellow Dent was planted at Lafayette, Indiana, in the spring of 1924. This planting became badly infested with a root worm which Prof. J. J. Davis of the Entomology Department identified as the Southern Corn Root Worm, *Diabrotica 12-punctata* Oliv.

These strains of corn for the most part were not especially vigorous on account of having been repeatedly selfed. The action of the corn root worm in consequence was much more noticeable than in open pollinated varieties nearby. Plants attacked by the worm were also invaded by root-rotting fungi which helped to complete the destruction of the root system. In addition a period of very dry weather occurred. Those strains of corn which were the most severely attacked showed the results first and in a more pronounced manner by the rolling of their leaves. In examining the varieties, the ease with which the plants could be pulled was also correlated with the destruction of the root system resulting from the worm.

The effect of the worm on the sweet corn selfs was the most severe. Most of these were so severely injured that they became stunted and many died during the dry weather. Several selfed strains each of Golden Bantam, Golden Rod, Early Evergreen, Narrow Grained Evergreen and Howling Mob, while fairly heavily infested, appeared better able to stand the attack. These threw out secondary roots and were recovering to some extent when their development was again checked by drought. The selfed lines of the field corn varieties appeared in general better able to stand the attack although some of these were as badly affected as the sweet corns. A few lines of Golden Glow and Early Yellow Dent were outstanding in that they showed little or no attack by the worm. Adjoining strains showed heavy infestation. On account of the heavy infestation which so generally occurred throughout the plot, it would appear rather unlikely that these few uninfested strains had not been exposed to infestation and it therefore seems probable that these few lines were actually resistant to infestation by the worm.

While these observations do not by any means conclusively prove that resistance to southern root worm exists, yet they are suggestive that such may occur. Only by close study in localities where this insect is commonly severe could this be decided.

#### NOTE:

Since writing this paper P. A. Young has described this *Marasmius* on wheat as a new species, *M. tritici*. (Phytopath. 15:115-118. 1925.) A comparison of the collections on *Festuca* and wheat indicates that the two are different species.

