phenomenon. The observation requires no skill except what is necessary to find the male organs of reproduction at the right time, and crush them under the coverglass and recognize the manubrium. If nothing else comes of it it can not fail to add one, and that one the most striking and one of the most easily attainable of all, to the stock illustrations of the circulation of protoplasm.

Fungicides for the Prevention of Corn Smut. By Wm. Stuart.

During the present century the disease of the corn popularly known as "corn smut" (*Ustilago zeæ-mays*, [*DC.*] *Wint.*) has engaged the attention of some of its most eminent botanists. It has only been within the last half of the present century that the life history of the fungus has been well understood. When we consider that corn is the principal cereal crop of America, it is not to be wondered at that any fungus disease causing it much apparent injury should arouse a desire on the part of investigators to devise some means of preventing it.

The successful treatment of the smuts of wheat and oats by disinfection of the seed, either by hot water or chemical solutions, naturally turned the attention of Experiment Station workers to employing the same remedies for the smut of corn. The experiments of Arthur,[1] of Indiana, Kellerman and Swingle,[2] of Kansas, and those of Pammel and Stewart,[3] of Iowa, are perhaps the most noteworthy. These experiments included the disinfection of the seed by hot water and chemical solutions; the attempted infection of the seed by rolling in the spores of the smut; and the spraying of the plants with fungicides, the latter experiment being conducted by the Kansas Experiment Station[4] in 1890. The results of all these experiments were of a negative character, due to the fact that the fungus plant of the corn smut, unlike that of wheat and oats, can enter any young growing tissue of the host, while in the last two mentioned it can only enter the host when it is very young. This point has been ably demonstrated by Brefeld,[5] who, by a long series of carefully conducted experiments, showed conclusively that the germinating spores, or conidia, are capable of penetrating any portion of the young

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[1]Fourth Annual Report Indiana Experiment Station.

[2]Kansas Experiment Station Bulletins, Nos. 22, 23, 40, 41.

[3]Iowa Experiment Station Bulletins Nos. 16, 20, Proceedings of Iowa Academy of Sciences, 1894, p. 74.

[4]Kansas Bulletin No. 23, p. 101.

[5]Journal of Mycology, Vol. VI, Nos. I, II, and IV. (Translated from Nachrichten aus dem Klub der Landwirthe zu Berlin, Nos. 220, 222, by Erwin Smith.)

growing tissue of the host. It would therefore follow that the growing corn plants are susceptible to infection during the greater part of their growth, or until the fertilization of the pistils.

Realizing the importance of ascertaining some method for the prevention of the smut, the botanical department of the Indiana Experiment Station undertook, during the past season (1895), to carry out an experiment having as its main object the spraying of the plants with the best known fungicides. A portion of one of the Station cornfields was set aside for the experiment. In order to avoid any possibility of infection through smutted seed, a portion of the seed was treated with a copper sulphate solution, another with an ammoniacal copper carbonate solution, and a third with hot water, while a fourth portion was infected with germinating smut spores. The experimental plat was divided into five sections, as follows:

Section I. Seed untreated.

Section II. Seed treated with copper sulphate solution one-half hour.

Section III. Seed treated with ammoniacal copper carbonate solution one hour.

Section IV. Seed treated with hot water at 60° C. for five minutes.

Section V. Seed dipped in a nutrient solution containing germinating smut spores.

The plat was planted May 18th, and on June 8th when the plants were about six inches high, two cross sections containing five rows each were sprayed by means of a knapsack sprayer, the one with Bordeaux mixture and the other with ammoniacal copper carbonate. This divided the plat into twenty-five lesser ones, as will be seen by the following diagram:

1	6	11	16	21	Sec. I.
2	7	12	17	22	Sec. II.
3	8	13	18	23	Sec. III.
4	9	14	19	24	Sec. IV.
5	10	15	20	25	Sec. V.

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The strength of the Bordeaux solution consisted of six pounds of copper sulphate, four pounds of lime and fifty gallons of water, while that of the ammoniacal copper carbonate consisted of one ounce of copper carbonate dissolved in ammonia and diluted with nine gallons of water. The latter solution proved too strong, some of the plants showing considerable injury two days afterwards. Subsequent sprayings were made with a much weaker solution.

The plats were sprayed quite frequently during June. In July, owing to the absence of the writer during the early part of the month, and frequent showers during the middle part of it, the sprayings were somewhat interrupted. The partial failure of the fungicides in completely preventing the smut may be largely attributed to these facts:

On July 20th some injury to the plants from the Bordeaux was noted, and for the remaining sprayings the strength of the solution was reduced one-third. The last spraying was made August 14th, the plants being then supposed to be too mature for infection.

The dates of spraying were as follows:

Bordeaux.	Ammoniacal Copper Carbonate.
June 8	June 8
	June 12
June 13	June 13
June 17	June 17
	June 19
June 21	June 21
June 27	June 27
July 5	July 5
July 20	July 20
July 25	July 25
August 3	August 3
August 14	August 14

Just previous to harvesting the crop a careful record of the number of smutted stalks was made and gave the following percentages of smutted stalks:

Unsprayed plants ..... 13.37 per cent.

Those sprayed with Bordeaux ..... 3.83 per cent.

Those sprayed with ammoniacal copper carbonate, 6.72 per cent.

It will be readily seen from the above figures that there is a marked difference in the amount of smut between the sprayed and unsprayed plats.

SUMMARY.

The results of this experiment show conclusively:

That the Bordeaux mixture, properly applied to the plants during their period of growth, does materially lessen the smut.

That the ammoniacal copper carbonate was not as effective as the Bordeaux in preventing the smut.

That frequent applications of the fungicides are necessary during the growing period of the plant in order to be effective.

A New Station for Pleodorina Californica Shaw. By Severance Burrage.

During an investigation of the sanitary condition of the Wabash and Erie Canal as it runs through Lafayette, made in the laboratories at Purdue in September of the present year, *Pleodorina* was found in considerable abundance in the canal water. This comparatively new member of the *Volvox* family was first described by Walter R. Shaw, of Leland Stanford University, who found the plant in a ditch in Palo Alto in September, 1893 ("Botanical Gazette," Vol. 19, p. 279). Since then D. M. Mottier has reported it in Bloomington, Indiana, in May, 1894, and Messrs. Clinton and Burrill in Havana, Illinois ("Botanical Gazette," Vol. 19, p. 383), in June of the same year. It is now possible to add another station in Indiana, namely, Lafayette.

The microscopical examinations were made according to the Sedgwick-Rafter method, which has been used for several years by the Massachusetts State Board of Health in the enumeration of microscopical organisms, exclusive of bacteria, in water supplies. The average number of *Pleodorina* in one cubic centimeter of the canal water was four. The census of other organisms found in the same samples included, on the vegetable side, *Hydrodiction*, *Chara*, and *Spirogyra*, too large and abundant to enumerate; *Diatoms*, per cubic centimeter, eight; *Oscillaria*, fifty-six; *Anabaena*, three; *Scenedesmus*, one; *Protococcus*, eight; *Crenothrix*, ten; *Pandorina*, one; *mold hyphae*, three; and, on the animal side, principally *infusoria*, as *Peridinium*, two hundred and ninety-six; *Monas*, four; *Trachelomonas*, three; *Dinobryon*, three; and a few *Rotifera* and *Acarina*. The water was quite turbid, and had the general appearance of dilute sewage, and in fact the water of the canal was evidently polluted. This shows the nature of the water in which *Pleodorina* seems to flourish in Lafayette, and also many of its companions.