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Seed-Borne Parasites : a Bibliography

C. R. Orton

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Seed-Borne Parasites

A Bibliography

BY C. R. ORTON

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Seed-Borne Parasites—A Bibliography

by C. R. ORTON*

ASSEMBLING OF DATA on seed-borne parasites was begun by the compiler more than fifteen years ago, but the impetus to an organized effort to prepare something comparable to a cosmopolitan list of such organisms was furnished by the Advisory Board of the American Phytopathological Society, which appointed a committee of three to engage in this task. Two preliminary mimeographed lists were prepared and sent to phytopathologists in the United States and Canada as well as to workers in foreign countries. These lists must have been of special interest, for since the date of the last circulation the compiler has received numerous requests for them from many parts of the world. It has been this insistent and continued demand for these data which has led to a continued effort in bringing together the appended list which, while acknowledged to be incomplete and in many ways unsatisfactory, is a basis for further work upon this important phase of phytopathology.

EARLY HISTORY OF SEED TRANSMISSION OF PARASITES

The idea that plant parasites were associated with the seed dates back at least two hundred years. In 1733 Jethro Tull *(1)* recorded the observations of farmers near Bristol, England, that seed wheat salvaged from sea water was free from bunt. This record is also one of the first milestones in seed disinfection and led to the use of salt-water steeps which were in vogue until the 19th century. It was not until 1755 that proof of seed carriage of a plant parasite was presented when Tillet *(2)* published his studies on wheat bunt, which were later corroborated and elaborated by Gleichen *(3)* and Tessier *(4)* who demonstrated that wheat plants become infected with bunt only when the spores of Tilletia are present on the planted grains.

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*The compiler was assisted by M. F. Barrus, Department of Plant Pathology, Cornell University, and M. T. Munn, Division of Botany, New York (Geneva) Agricultural Experiment Station, in the preparation of the early lists of seed-borne parasites which were prepared by this group working as a committee of the American Phytopathological Society.

Thanks are especially due Dr. J. Ramsbottom, Curator, British Museum, London, England; Dr. H. W. Wollenweber, Biologische Reichsanstalt, Dahlem-Berlin, Germany; and Dr. G. H. Pethybridge, Ministry of Agriculture, Harpenden, Herts, England, for the help they rendered in circulating a preliminary list to their associates and obtaining additions and suggestions which have been very helpful in making this work more complete. Many others throughout the world have cooperated in furnishing special data and to these the compiler acknowledges his indebtedness.

(1) Horsehoeing Husbandry, etc., London.

(2) Dissertation sur la cause qui corrompt et noircit les grains de ble dans les epis, etc., Bordeaux.

(3) Auserlesene mikrosk. Entdeckungen. 1781.

(4) Traite des maladies des grains. Paris 1783; Moyens eprouves pour preserver les froments de la carie. Avignon, 1786.

A century elapsed before the first proof of seed transmission by a parasite other than a smut was presented. Frank *(5)* demonstrated that the fungus causing bean anthracnose was seed-borne by means of the mycelium, which grows through the seed pod into the seed coat during its early maturing period. The first bacterial plant pathogen proved to be seed-borne was *Bacterium phaseoli,* which was demonstrated by Beach *(6)* to be carried within the seed. Since that time the evidence that plant parasites are commonly carried with the seed has been steadily accumulating. That nematodes were transmitted in this manner was proved by Maize *(7)* in 1906 in the case of *Tylenchus dipsaci,* although the presence of this nematode in the seed had been established by Kuehn *(8)* in 1858.

ECONOMIC IMPORTANCE OF PARASITES WHOLLY OR LARGELY SEED-BORNE

A study of the following tabulated data taken from "The Plant Disease Reporter" of the United States Department of Agriculture clearly indicates the importance of this manner of distributing plant diseases. It is also helpful in showing the importance of seed disinfection, which is very effective in controlling certain cereal diseases. While these data apply to the United States only it is reasonable to assume that they are comparable to conditions in other countries where these diseases occur and where control measures are comparably applied.

Estimated annual losses to certain crops in the United States from seed-borne parasites during the nine-year period 1919-27

	Bushels (000 omitted)									
Crop and Disease	1919	1920	1921	1922	1923	1924	1925	1926	1927	Ave.
Wheat bunt	10,219	14,088	10,988	5,798	11,308	26,038	16,633	33,786	28,888	17,527
Loose smut	17,863	9,754	7,889	10,484	9,964	9,800	8,465	8,373	7,359	9,994
Total	28,082	23,842	18,877	16,282	21,272	35,838	25,098	42,159	36,247	27,521
Barley stripe	1,898	786	1,041	1,172	1,369	1,981	3,647	2,415	2,751	1,896
Loose smut	1,369	1,385	764	1,481	1,875	1,573	2,064	2,186	2,559	1,695
Covered smut	1,868	1,992	694	1,903	990	1,146	5,757	3,557	2,509	2,268
Total	5,135	4,163	2,499	4,556	4,234	4,700	11,468	8,158	7,821	5,859
Oats. Loose and covered smuts	39,238	40,143	35,810	29,378	35,278	52,907	51,267	49,852	51,359	42,804
Beans										
Anthracnose	354	155	49	163	392	...	114	...	38	180
Bacterial blight	808	141	1,040	647	895	...	674	...	330	647
Total	1,162	296	1,089	810	1,287	...	788	...	368	827
Cotton*										
Anthracnose	468	579	154	62	229	172	22	188	144	224
Angular leaf-spot	187	213	213	59	632	443	292	561	138	304
Total	655	792	367	121	861	615	314	749	282	528

*Bales.

(5) Ber. deutsch. Bot. Gesell. *1*: 31. 1883.
(6) N. Y. (Geneva) Agr. Exp. Sta. Bul. 48. 1892.
(7) Bul. Soc. Bot. France IV: 6: 53 (Sess. Extra) LXXV - LXXVII. 1906.
(8) Zeit. Wiss. Zool. *9*: 129-137. 1858.

Thus it is seen that the economic losses occasioned by these few seed-borne parasites, selected because of the availability of data, are enormous. With wheat alone an approximate average of 27,500,000 bushels could be added annually to the crop in the United States by treatment which would cost from two to five cents per bushel for the seed planted, the cost depending upon the method and materials used.

DISTRIBUTION OF IMPORTANT PLANT DISEASES BY SEED

A study of seed transmission clearly shows that certain pathogens are distributed almost wholly in this manner, while other pathogens may be transmitted in a number of ways in addition to being seed-borne. The smuts of cereals and grasses, *Bacterium phaseoli, Colletotrichum lindemuthianum, Helminthosporium gramineum, Nematospora phaseoli, Ascochyta pisi,* and *Tylenchus dipsaci* are examples of pathogens which are wholly or largely disseminated by seeds. Such organisms as *Fusarium subulatum, Gibberella saubinetii, Mycosphaerella brassicicola, Phoma lingam, Septoria pisi, Sclerospora graminicola, Phytophthora phaseoli, Albugo tragopogonis,* and certain mosaics such as those of beans and other legumes are quite invariably seed-borne but are often transmitted in other ways.

Such pathogens as those included in the first group could be almost wholly restricted in their further distribution by seed selection and disinfection.

MANNER IN WHICH PATHOGENS ARE SEED-BORNE

The manner in which plant pathogens exist with seeds is variable. A modification of Dorogin's *(9)* outline is as follows:

1. Pathogens composed of sclerotia which become mixed with the seed but not attached to it: e. g., *Sclerotinia trifoliorum* and *Sclerotium rolfsii.*
2. The pathogen forms a mummified structure composed of seed or fruit and parasite in an intimate relation: e. g., the pseudo-sclerotium of *Sclerotinia vaccinii, S. carunculoides* and *Claviceps purpurea,* and the mummies of *Tylenchus tritici.*
3. The pathogen forms a fructification on the surface of the seed: e. g., *Phoma lingam* on crucifers, *Botrytis cinerea* on corn.
4. Spores or other reproductive stages of the pathogen are carried mechanically on the surface of the seed; e. g., *Tilletia laevis, Urocystis occulta,* and many other smuts; *Fusarium lycopersici* and many other species of this genus; *Polyspora lini* on flax. Some bacterial pathogens are undoubtedly carried in this manner.
5. Bacterial organisms, certain viruses, and the mycelium of pathogenic fungi are localized within the seedcoat, or in the reproductive organs of the seed: e. g., *Ustilago tritici* and other smuts with similar manner of

(9) Notwendigkeit die Samen auf die Pilzparasiten bei Samenkontrolle zu untersuchen. Ann. Essai Semences *5*: 19-27. 1927.

seed infection; *Gibberella saubinetii* in wheat and other cereals; *Diplodia zeae* and *Fusarium moniliforme* in corn seed; and a host of other fungous parasites such as *Bacterium phaseoli, B. stewartii,* and numerous other bacterial pathogens including the mosaic of beans and other legumes.

Chen *(10)* has made a study of certain internal parasites of agricultural seeds and Heald *(11)* and Gardner *(12)* have discussed this subject in connection with the more general topic of dissemination of fungi and bacteria.

NATURE OF SEED-BORNE PARASITES

Many sorts of organisms may be carried with seeds as outlined above, but the most important from the standpoint of disease transmission are bacteria, fungi, nematodes, and insects. In this treatment the last group has been omitted, although there is no doubt that the insects present an important phase of the problem. The nematodes have been included as is customary in phytopathological literature.

Judging from the list of seed-borne organisms, any of the bacterial phytopathogens are likely to be transmitted by seed. In fact from the rapidly accumulating data it appears that every bacterial disease of plants should be considered potentially dangerous from the angle of seed transmission.

While there is no proof that Myxomycetes or Chytrids can be transmitted by seed, nevertheless it is evident that representatives of most of the other important groups of fungi are capable of being seed-borne. For instance, representatives of the Zygomycetes and Oomycetes are present in the list. In the Ascomycetes there are many representatives which are seed-borne in their asexual stages, but few if any are known to be transmitted by ascospores with the possible exception of the yeast-like fungi, Nematospora, etc. Several rusts (Uredinales) are known to be seed-borne and probably this group will be much more extensively represented when studied more fully from this standpoint. The smuts (Ustilaginales) are abundantly represented and it is not exaggerating to state that practically all of the grass smuts are seed-borne as well as many of the smut fungi attacking other host plants. Only comparatively few of the Hymenomycetes have been shown to be transmitted in this manner: e. g., Corticium (Rhizoctonia) and Coprinus.

Of the nematodes which may be seed-borne it appears that the two species of Tylenchus, viz., *T. tritici* and *T. dipsaci,* are quite generally seed-infesting and therefore naturally transmitted in this manner. Other plant-inhabiting nemas should be studied from this standpoint.

The remaining group of diseases represented in the list are those attributed to viruses of the mosaic type. Proof is lacking that any yel-

(10) Maryland Agric. Exp. Sta. Bul. 240: 81-110. 1920.
(11) The dissemination of fungi causing disease. Trans. Am. Micros. Soc. *32*: 1-29. 1913.
(12) Mode of dissemination of fungous and bacterial diseases of plants. Mich. Acad. Sci. Rept. *20*: 357-423. 1918.

lows type of virus disease is seed-borne, and many tests with aster and peach yellows indicate that these diseases are rarely if ever transmitted in this manner. That the ease of mechanical transmission of a virus is not a criterion of seed transmissibility is evidenced by tobacco mosaic, which is one of the most readily transmitted viruses of plants. Repeated tests by different workers have failed to show any indications of seed transmission.

COMMERCIAL ASPECT OF SEED TRANSMISSION OF PLANT PARASITES

Man is the chief agent responsible for the spread of plant pathogens by seed or other reproductive organs. During the developmental stages of crop introduction, from regions where seed-borne parasites have become established, seeds have been shipped into new regions where the parasites carried with them have found suitable environments for development. This movement has been world-wide and has resulted in the distribution of such parasites to many new regions where they had not previously existed. This condition may be said to have reached its climax in the case of the smuts of small grains, bean anthracnose, and some few other diseases, but there are many other serious seed-borne plant diseases which have not yet reached some of the world's important agricultural regions. There are undoubtedly many important pathogens in foreign countries which have not yet reached the United States. Some of these which are known to be seed-borne are marked with a star (*) in the subtended list.

Every means possible should be utilized in preventing this harmful distribution of destructive parasites. Galloway *(13)* has plainly outlined the problem and pointed out the remedy so far as general policies apply. The compiler *(14, 15, 16)* has frequently urged seedsmen and others concerned to take a more active interest in this problem of seed transmission of parasites, and some progress has been made. Munn *(17)* has ever been insistent that the seed analyst should take cognizance of this problem in the routine of seed germination tests, and we hope that some day this will become a regular part of the seed analyst's work in the United States as it has in Holland through the studies of Miss Doijer *(18)*. Seed introduction is now attended in part by seed disinfection and testing, and some seedsmen are practicing seed treatment. Many farmers are applying seed disinfection and this practice is gradually increasing—a procedure which will have considerable effect upon the spread of dangerous parasites through seeds. The importance of giving attention to these factors in seed production was outlined by

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(13) Some of the broader phytopathological problems in their relation to foreign seed and plant introduction. Phytopathology 8: 87-97. 1918.

(14) Seed borne diseases. Am. Seed Trade Assoc. Proc. *40*: 74-82. 1922.

(15) Seed borne parasites. A general consideration of the problem. Science *59*: 539-546. 1924.

(16) Seeds as carriers of disease. Jour. N. Y. Bot. Garden *27*: 54-63. 1926.

(17) The seed analyst's responsibility with reference to seed-borne diseases. Proc. Assoc. Off. Seed Analysts *11*: 31-35. 1919.

(18) Infecties van Zaaizaden in verschillende jaren. Rijksproefs v. Zaadcontrole Wageningen 1925.

Norton and Leathers *(19)* in 1918, and their publication has no doubt been influential in the organization of certified seed production associations which are just beginning to realize the importance of the parasite factor in their efforts.

If the efforts of seed producers, seed tradesmen, seed analysts, the manufacturers of seed disinfectants, and official agencies could be brought into cooperation on this problem it would take but a short time to reduce the losses through seed-borne parasites to a point where this phase of disease control would be adequately handled. To these efforts should be added those of the research worker who will find in the problem of seed-borne parasites an interesting and little-developed field which would be very productive in bringing forward the data needed to show how the multifarious parasites exist within and upon seeds.

EXPLANATION OF THE SUBTENDED LIST

The list of seed-borne parasites which follows has been gathered from many sources over a considerable period. Throughout the work the word "seed" is used in the popular sense to connote the various botanical entities containing an embryo and used for propagation. No attempt has been made to include the numerous and important pathogens which are borne upon or within vegetative organs such as bulbs, corms, tubers, cuttings, etc. These would perhaps constitute an equally large number and it seems best to reserve such a task for a later date. Such a list is being prepared at least in part at Dahlem-Berlin under the direction of Dr. H. Pape, to whom the compiler is indebted for several additions to this list.

There has been no attempt in this work to include a full bibliography in connection with the specific parasites. Only those which seemed to be the most important references are included. In many cases the earliest reference to the seed-borne nature of the parasite and one or more later references which more fully established the case have been included. There are included also a number of pathogens which critical workers would call "doubtful cases". The wisdom of this may be questioned but it seems well to include them with the statement frankly made that full proof is lacking. Most if not all of these examples will eventually be shown properly to belong in the category of seed-borne parasites. It has also seemed advisable to include a few specific cases of parasites which have been proved by competent workers to be seed-borne, but which have not been published to date. These are included with the consent of the worker and in a few instances represent important additions. The compiler takes all responsibility for errors and other shortcomings which he has attempted to reduce to a minimum but which undoubtedly may exist in a work of this nature.

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(19) Conditions detrimental to seed production. Md. Agr. Exp. Sta. Bull. 216: 175-226. 1918.

SEED-BORNE PARASITES*

African Millet *(Eleusine coracana)*

**Ustilago eleusines* Kulk. *Smut*

Narasimhan, M. J. Mysore Dept. Agr. Rept. 1922-1923: pt. 2, 13-15. Controlled by Cu So_4, Cu So_4 and lime, or by formaldehyde treatment of seed.

Agropyron

(See quackgrass, wheat grass, and western rye grass)

Alfalfa *(Medicago sativa)*

Alternaria sp. *Seed-rot*

Peglion, V. Staz. Sper. Agr. Ital. *36:* 198-204. 1903.

Stewart, F. C. New York (Geneva) Agr. Exp. Sta. Bul. 305: 398-400. 1908. Described by Peglion in Italy as *Alternaria tenuis* and is claimed to have a perfect stage, *Pleospora alternariae* Griff. & Gib. Stewart is uncertain whether the disease he describes is the same or not, but the trouble is prevalent in commercial alfalfa seed from many sources and is certainly an internal organism. Its association with any field disease is undetermined.

Bacillus lathyri Manns & Taub. *Streak*

Taubenhaus, J. J. Delaware Agr. Exp. Sta. Bul. 106: 62-69. 1914. The disease is found also on *Phaseolus vulgaris, Pisum sativum, Soja (Glycine) max, Trifolium pratense,* and *Vicia faba.*

Colletotrichum trifolii Bain. *Anthracnose*

Bain, S. M., & S. H. Essary. Tenn. Agr. Exp. Sta. Bul. 75: 1906. This disease is thought by the authors to be seed-borne but actual proof is lacking, though the appearance of the disease on seedlings grown in greenhouse may be considered *prima facie* evidence. Primarily important on red clover.

Peronospora trifoliorum deBary. *Downy mildew*

Campbell, Carlo. Ann. di Bot. *15:* 283-284. 1922. Seed from Argentina grown in Italy developed the disease.

Tylenchus dipsaci Kuehn. *Alfalfa-stem nematode*

Orton, W. A., & G. H. Godfrey. Mo. Bul. Dept. Agric. Calif. *12:* 299. 1923. Carried with the seed and may be eliminated by steam treatment.

Alsike Clover *(Trifolium hybridum)*

Bacillus lathyri Manns & Taub. *Streak* (See alfalfa)

Bacterium trifoliorum Jones, Will., Wolf, & McCull. *Bacterial leaf-spot*

Jones, L. R., M. M. Williamson, F. A. Wolf, & L. McCulloch. Jour. Agr. Res. *25:* 471-490. 1923. Not proved to be seed-borne, but floral parts become infected and there is every opportunity for seed infection to take place. Attacks red, white, crimson, and other species of clover. Artificial infection was successful on lima bean and velvet bean.

Mosaic (Virus)

Dickson, B. T. McDonald College Tech. Bul. 2: 82, 86. 1922.

Alyssum (See sweet alyssum)

Arrhenatherum (See oat grass)

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*Species preceded by an asterisk (*) are not reported from the United States.

ARBOR VITAE *(Thuja occidentalis)*

Keithia thujina Durand. *Leaf blight*

Pethybridge, G. H. Quart. Jour. Forest. *13:* 93-97. 1919. Field evidence indicates that this parasite may have been introduced to British Isles from America on or with seed, since the trees as such are not imported. Professor A. Henry of Dublin, Ireland, expressed a similar opinion in letter to the compiler, October 29, 1924.

ARDISIA CRISPA

**Bacillus foliicola* Miehe. *Bacterial "symbiont"*

Miehe, H. Jahrb. f. Wiss. Bot. *53:* 1-54. 1913. Invariably present in the seed and considered necessary for healthy development of seedlings.

ASCLEPIAS CURASSAVICA = MILKWEED

AVENA = OATS

BARLEY *(Hordeum vulgare)*

Bacterium cerealinum (Gentner) Elliott. *Bacteriosis*

Gentner, G. Centralbl. f. Bakt. *50:* 428-441. 1920. Seed treatment with one percent formaldehyde reduces but does not eliminate the disease. Also attacks rye and wheat.

Bacterium translucens Jones, Johns., & Reddy. *Bacterial blight*

Jones, L. R., A. G. Johnson, & C. S. Reddy. Jour. Agr. Res. *11:* 625-644. 1917. ——— ——— & ——— Phytopath. *5:* 69. 1917. Attacks also *H. distichum* and *H. hexastichum.*

**Cladosporium herbarum* (Pers.) Link. *Black-end disease*

Perfect stage is *Mycosphaerella tulasnei* Janc. (See RYE)

Claviceps purpurea (Fries) Tul. *Ergot*

Sclerotia are carried with the seed.

Colletotrichum graminicolum (Ces.) Wils. *Anthracnose*

Selby, A. D., & T. F. Manns. Ohio Agr. Exp. Sta. Bul. 203: 1909.

Gibberella saubinetii (Mont.) Sacc. *Seedling blight* and *"scab"* (See WHEAT)

Helminthosporium californicum Mack. & Pax. *Rusty blotch*

Behaves like *H. sativum* on seed, according to correspondence with W. W. Mackie, Univ. of California, College of Agriculture.

Helminthosporium gramineum Rabenh. *Stripe*

Ravn, F. K. Bot. Tidsskr. *23:* 101-321. 1900. Mycelium in seed coats and in the seed. Perfect stage shown to be *Pleospora trichostoma* by Diedicke. (Centralbl. Bakt. II, *9:* 317-329. 1902; *11:* 52-59. 1903.)

Helminthosporium sativum. P. K. & B. *Spot blotch*

Evans, N. S. Phytopath. *12:* 34. 1922. Attacks rye also. Seed disinfection with certain organic mercury compounds is effective.

Pammel, L. H., C. M. King, & A. L. Bakke. Iowa Agr. Exp. Sta. Bul. 166: 78-90. 1910.

Helminthosporium teres Sacc. *Net blotch*

Ravn, F. K. Bot. Tidsskr. *23:* 101-321. 1900. Mycelium in seedcoats and in seed. Perfect stage said to be *Pyrenophora teres* (Died.) Drechs.

Rhynchosporium secalis (Oud.) Davis. *Leaf spot* (See RYE)

**Tilletia panicii* Bub. & Ran. *Covered smut*

Adachi, M. Jour. Plant Protect. *11:* 275-280. 1924.
———— Ann. Phytopath. Soc. Japan *1.* 1925.

Ustilago Hordei (Pers.) Kell. & Sw. *Covered smut*

Brefeld, O. Die Brandpilze II: *11.* 1895.
Clinton, G. P. Ill. Agr. Exp. Sta. Bul. 57. 1900.
Herzberg, P. Zopfs Beitr. Phys. Morph. Organ. *5:* 1-36. 1895.
Kellerman, W. A., & W. T. Swingle. Kans. Agr. Exp. Sta. Rept. *2:* 213. 1890.

Ustilago nuda (Jens.) Kell. & Sw. *Loose smut*

The Agr. Gazette & Jour. Council of Agr. Tasmania *4:* 92-95. 1896.
Brefeld, O. Brandpilze IV: *13.* 1905.
F. Council of Agr. of Tasmania 1897.
Hecke, L. Zeitschr. f. Landw. Versuch. Oesterr. *7:* 59-64. 1904.
———— Ber. Deutsch. Bot. Gesell. *23:* 248. 1905.

Bean *(Phaseolus vulgaris)*

Alternaria sp. Relation to field disease undetermined

Chen, C. C. Maryland Agr. Exp. Sta. Bul. 240: 95. 1920.

**Ascochyta phaseolorum* Sacc. *Leaf spot*

Seed-borne in Japan, according to Prof. T. Matsumoto *fide* Dr. H. W. Wollenweber.

Bacillus lathyri Manns & Taub. *Streak* (See ALFALFA)

Bacterium flaccumfaciens Hedges. *Bacterial wilt*

Burkholder, W. H. Phytopath. *16:* 915-927. 1926. Also occurs on lima bean.
Hedges, Florence. Science *55:* 433-434. 1922.

Bacterium medicaginis phaseolicola (Burk.) Link & Hall. *Halo blight*

Burkholder, W. H. Phytopath. *16:* 919. 1926. The same organism causes "halo blight" of Kudzu, lima, and scarlet runner beans.
Higgins, B. B. Ga. Agr. Exp. Sta. Bul. 161: 1-20. 1930. Experiments indicate seed disinfection to be quite effective.

Bacterium leguminiperdum (von Oven) Stevens. *von Oven's bacterial disease*

v. Oven, S. Centralbl. f. Bakt. II. *16:* 69-74. 1906. Infection of pods extends to seeds. Attacks also Lupinus, *Lycopersicum esculentum,* and *Pisum sativum.*

Bacterium phaseoli EFS. *Bacterial blight*

Beach, S. A. N. Y. (Geneva) Agr. Exp. Sta. Bul. 48: 318. 1892.
———— N. Y. (Geneva) Agr. Exp. Sta. Rept. 1892: 553-554. 1893.
Halsted, B. D. N. J. Agr. Exp. Sta. Rept. 1892: 283-286. 1893.
Whetzel, H. H. Cornell Agr. Exp. Sta. Bul. 239: 210-212. 1906.
Zaumeyer, W. J. Phytopath. *19:* 96. 1929.
Organism may pass through vascular system into developing seed or from dorsal suture of pod into the funiculus and through raphe into seed coat. Entrance of bacteria may also be made through micropyle when the bacteria invade the cavity of seed pod. Cotyledon infection generally occurs during germination of seed. Reported hosts are: *Dolichos lablab, Phaseolus aconitifolius, P. acutifolius latifolius, P. angularis, P. aureus, P. lunatus, P. lunatus macrocarpus, P. multiflorus, P. mungo, P. vulgaris, Soja (Glycine) max, Stizolobium deeringeanum. Strophostyles helveola,* and *Vigna sinensis.* Seed treatment with mercury compounds reduces the disease but does not eliminate it.

**Bacterium phaseoli* var. *fusca* Burk.

Burkholder, W. H. N. Y. (Cornell) Agr. Exp. Sta. Mem. 127: 22-29. 1930. Similar to the common bacterial blight but differing in certain cultural re-

spects and in host plants. Attacks *P. vulgaris, P. lunatus,* and *P. coccineus.* Reports disease from Switzerland and states that Hedges isolated what appears to be this organism from bean seed imported from South America.

Bacterium puerariae Hedges = *B. medicaginis phaseolicola*

See Hedges, Florence. Phytopath. *20:* 140. 1930.

Bacterium vignae Gard. & Kend. *Bacterial spot of cowpea* (See COWPEA)

Attacks: *Phaseolus angularis, P. limensis, P. limensis* var. *limenanus, P. lunatus macrocarpus,* and other leguminous hosts.

Bacterium vignae var. *leguminophila* Burk.

Burkholder, W. H. N. Y. (Cornell) Agr. Exp. Sta. Mem. 127: 1-88. 1930. Artificial infection was obtained on *Phaseolus lunatus, Dolichos lablab, Pueraria hirsuta, Vigna sinensis, V. sesquipedalis, Soja (Glycine) max,* and *Vicia faba.* This organism has a wider range of hosts than *Bacterium vignae.*

**Bacterium (Phytomonas) viridiflava* Burk.

Burkholder, W. H. N. Y. (Cornell) Agr. Exp. Sta. Mem. 127: 1-88. 1930. Found in Switzerland and England. Artificial infection obtained on *Phaseolus coccineus, P. lunatus, Dolichos lablab, Vigna sinensis, Pueraria hirsuta,* and *Soja (Glycine) max.*

Colletotrichum lindemuthianum (Sacc. & Magn.) Briosi & Cav. *Anthracnose*

Beach, S. A. N. Y. (Geneva) Agr. Exp. Sta. Rept. *1892:* 283-286. 1893.
Frank, A. B. Ber. deutsch. Bot. Gesell. *1:* 31. 1883.
Whetzel, H. H. N. Y. (Cornell) Agr. Exp. Sta. Bul. 239: 1906.

Fusarium sp. Relation to field disease undetermined

Chen, C. C. Maryland Agr. Exp. Sta. Bul. 240: 95. 1920.

Macrosporium sp. Relation to field disease undetermined

Chen, C. C. Maryland Agr. Exp. Sta. Bul. 240: 95. 1920.

Mosaic (Virus)

Pierce, W. H., & C. W. Hungerford. Idaho Agr. Exp. Sta. Bul. 7. 1929.
Reddick, D., & V. B. Stewart. Phytopathology *9:* 443-451. 1919.

Tylenchus dipsaci Kuehn. *Nematode*

Geffart, H. Zeits. f. Pflanzenkr. *40:* 401. 1930.

BECKMANNIA ERUCAEFORMIS (See GRASSES)

BEET *(Beta vulgaris),* including SUGAR BEET

Bacterium aptatum Brown & Jamieson. *Bacterial leaf-spot*

Hirati, Eikiti. Jour. Agr. Exp. Sta. Gov. Gen. Korea *17:* 1-33. 1928. The organism survives not only in sugar-beet seed but also in tops left in the field.

Cercospora beticola Sacc. *Leaf spot*

Nakata, K., T. Nakajima, & K. Takimoto. Tech. Rept. Korea Indus. Model Farm No. 6: 118. 1922.

Coprinus sp. *Seed fungus*

Buller, A. H. R., & Dorothy Newton. Ann. Bot. *41:* 663-670. 1927. Identified as *Coprinus lagopus.* Apparently not parasitic on seedlings.
Pape, H. Mitt. der Biol. Reichs. *17:* 13-16. 1919. Thought to be *Coprinus nycthemerus* Fries. Destroys the seed.

Peronospora schachtii Fckl. Downy mildew

Anon. Calif. Agr. Exp. Sta. Rept. *1930:* 85. 1931. Evidence found that this fungus is carried in and on the seed.

Phoma betae (Oud.) Fr. *Root disease*

Edson, H. A. Jour. Agr. Res. *4:* 135-168. 1915. Found pycnidia and spores on seed. Recognized for years in Europe where seed disinfection is generally practiced.

Stemphylium sp. *Seed fungus*

McWhorter, F. P. Va. Truck Exp. Sta. Bul. 58: 534. 1927. Found on garden-beet seed causing blackening of seed and loss of vitality. Not associated with any field disease of mature plants.

Bermuda Grass = capriola dactylon

Black Walnut *(Juglans nigra)*

Bacterium juglandis (Pierce) EFS. *Bacteriosis*

Smith, R. E., C. O. Smith, and H. J. Ramsey. Calif. Agr. Exp. Sta. Bul. 231: 113-398. 1912. The organism penetrates the kernels, which may become blackened and killed. Also attacks *Juglans californica, J. cinerea, J. hindsii, J. regia,* and *J. sieboldiana.*

Bluegrass *(Poa pratense)*

Colletotrichum graminicolum (Ces.) Wils. *Anthracnose*

Selby, A. D., and T. F. Manns. Ohio Agr. Exp. Sta. Bul. 203. 1909.

Brassica spp.

(See broccoli, brussels sprouts, cabbage, cauliflower, charlock, kale, kohlrabi, mustard, pak-choi, pe-tsai, rape, swedes, turnip)

Broad Bean *(Vicia faba)*

**Bacillus lathyri* Manns & Taub. *Chocolate spot*

Riker, A. J. Phytopath. *18:* 136. 1928. The disease was studied in England.

Ascochyta pisi Lib.?

Rathschlag, H. Phytopath. Zeitschr. *2:* 493-501. 1930. The fungus enters the cotyledons of the seed through the pod. Seed transmission not proved but very probable.

Broccoli *(Brassica oleracea* var. *acephala)*

Mycosphaerella brassicicola (Fr.) Lindau. *Ring spot*

Weimer, J. L. Jour. Agr. Res. *32:* 97-132. 1926. Also attacks cabbage, cauliflower, brussels sprouts, kale, and turnips.

Brome Grass *(Bromus* spp.)

Bacterium coronafaciens atropurpureum Reddy & Godkin. *Bacterial spot*

Reddy, C. S., & J. Godkin. Phytopath. *13:* 75-86. 1923. Disease probably overwinters in seed. Also attacks quackgrass *(Agropyron repens)* and oats *(Avena).*

Ustilago bromivora (Tul.) Fisch. de Waldh.

A common head smut in many species of Bromus. Undoubtedly seed-borne.

Broom Corn *(Holcus sorghum)*

Bacterium holci Kend. *Holcus bacterial-spot.* (See sorghum)

Brussels Sprouts *(Brassica oleracea gemmifera)*

Bacterium campestre (Pamm.) EFS. *Black rot.* (See CABBAGE)

Mycosphaerella brassicicola (Fries) Lindau. *Ring spot.* (See BROCCOLI)

Phoma lingam (Tode) Desm. *Black leg*

Clayton, E. E. N. Y. (Geneva) Agr. Exp. Sta. Bul. 550. 1927. (See CABBAGE)

Bryanopsis laciniosa

Bacterium lachrymans Smith & Bryan. *Angular leaf spot.* (See CUCUMBER)

Bur Clover *(Medicago hispida)*

Cercospora medicaginis E. & E. *Leaf spot*

Hopkins, E. F. Phytopath. *10:* 66. 1920 (Abstract).

———— Phytopath. *11:* 311-318. 1921. Transmitted almost wholly by seed which bears the hibernating mycelium of the parasite in the seed coat. Suggests seed treatment in formaldehyde (1-240) for two hours.

Pseudoplea medicaginis Miles. *Leaf spot*

Miles, L. E. Phytopath. *15:* 677-690. 1925. The fungus is found in the seeds and has been isolated from them. Final proof that the fungus is seed-transmitted not presented.

Butternut *(Juglans cinerea)*

Bacterium juglandis (Pierce) EFS. *Bacteriosis.* (See BLACK WALNUT)

Cabbage *(Brassica oleracea capitata)*

Alternaria brassicae (Berk.) Sacc. *Black spot*

Chupp, C. C. Manual of Vegetable Garden Diseases 148-149. New York. 1925. May be shown in cabbage seed after treatment with $HgCl_2$, which does not kill the fungus. Hot-water treatment is effective.

Bacterium campestre (Pammel) EFS. *Black rot*

Harding, H. A., F. C. Stewart, and M. J. Prucha. N. Y. (Geneva) Agr. Exp. Sta. Bul. 215: 177-194. 1904.

Walker, J. C., & W. B. Tisdale. Phytopath. *10:* 175-177. 1920.
Hot-water treatment of the seed for 30 minutes at 50° C. is effective in killing organisms in seed but may cause some injury to germination. Chemical disinfection not completely effective. The organism attacks many hosts of the crucifer family.

Fusarium conglutinans Wollenw. *Wilt* or *yellows*

Harter, L. L., & L. R. Jones. U. S. Dept. Agr. Farmers' Bul. 925. 1918.

Manns, Thos. F. Ohio Agr. Exp. Sta. Bul. 238. 1911.
Positive proof of seed dissemination appears to be lacking, though seed disinfection is recommended since the appearance of the disease in certain seedbeds indicates such transmission.

Phoma lingam (Tode) Desm. *Black leg*

Henderson, M. P. Phytopath. *8:* 379-432. 1918. Hot-water treatment of the seed for 25 to 30 minutes at 50° C. is most effective but may cause some injury to the seed. Chemical disinfection not completely effective on cabbage and cauliflower according to Clayton, N. Y. (Geneva) Agr. Exp. Sta. Tech. Bul. 137: 1928. See references under TURNIP. Henderson successfully infected cauliflower; brussels sprouts; kohlrabi; kale; rape; collards; rutabaga; turnip; white, black, Chinese, tumble, hedge, and worm-seed mustard; charlock; cultivated and wild radish; stock; and sweet alyssum. Presumably the disease may be transmitted on the seed of all these plants.

CAPRIOLA *(Cynodon dactylon)* BERMUDA GRASS

**Aplanobacter rathayi* EFS. *Rathay's disease*

Dorph-Peterson, K. Tidsskr. Planteavl. *31:* 87-148. 1925. See also ORCHARD GRASS *(Dactylis)* and RYE *(Secale).*

CARROT *(Daucus carota)*

**Phoma rostrupi* Sacc. = *Ph. sanguinolenta* Rostr.

Rostrup, E. Zeit. f. Pflanzenkr. *4:* 195-196. 1894.

CASTOR BEAN *(Ricinus communis)*

Sclerotinia ricini Godfrey. *Gray mold*

Godfrey, G. H. Jour. Agr. Res. *23:* 679-715. 1923. Immersion for 15 minutes in corrosive sublimate or formaldehyde solution recommended.

CAULIFLOWER *(Brassica oleracea botrytis)*

Alternaria brassicae (Berk.) Sacc. *Leaf spot* and *brown rot*

Weimer, J. L. Jour. Agr. Res. *29:* 421-441. 1924.

Bacterium maculicola McCulloch. *Bacterial spot*

Clayton, E. E. N. Y. (Geneva) Agr. Exp. Sta. Bul. 506: 3-15. 1924.

Bacterium campestre (Pammel) EFS. *Black rot* (See CABBAGE)

Mycosphaerella brassicicola (Fr.) Lindau. *Ring spot* (See BROCCOLI)

Phoma lingam (Tode) Desm. *Black leg*

Clayton, E. E. N. Y. (Geneva) Agr. Exp. Sta. Bul. 550. 1927. (See CABBAGE)

CELERY *(Apium graveolens)*

Phoma apiicola Speg. *Scab, rootrot*

Klebahn, H. Zeitschr. f. Pflanzenkr. *20:* 1-40. 1910.

Septoria apii (Br. & Cav.) Rostr. *Septoria leaf spot, late blight*

Klebahn, H. Jahrb. Hamburg. Wiss. Anst. *30:* B. *3:* 1-57. 1912.

Krout, W. S. Jour. Agr. Res. *21:* 369-372. 1921. Recommends old seed upon which fungus has died.

CHARLOCK *(Brassica arvensis)*

Bacterium campestre (Pamm.) EFS. *Black rot* (See CABBAGE)

CHESTNUT *(Castanea dentata)*

Endothia parasitica (Murr.) And. & And. *Blight*

Collins, J. F. Science *38:* 857-858. 1913.

———— Phytopath. *5:* 233-235. 1915.

Rumbold, Caroline. Phytopath. *5:* 64-65. 1915. Fruits become infected and are thus able to spread the disease.

CHINA ASTER *(Callistephus hortensis)*

Alternaria sp. *Seedling blight*

Gloyer, W. O. N. Y. (Geneva) Agr. Exp. Sta. Tech. Bul. 177. 1931.

May possibly be the conidial stage of *Pleospora herbarum.*

Ascochyta asteris (Bres.) Gloyer. *Leaf spot*
Gloyer, W. O. Phytopath. *14:* 64. 1924.

Botrytis cinerea Pers. *Gray mold*
Gloyer, W. O. Phytopath. *14:* 64. 1924.

Fusarium conglutinans var. *callistephi* Beach. *Wilt*
Beach, W. S. Mich. Acad. Sci. 20. 1918.
Gloyer, W. O. Phytopath. *14:* 64. 1924.

Pleospora herbarum (Pers.) Rab. *Seedling blight*
Gloyer, W. O. N. Y. (Geneva) Agr. Exp. Sta. Tech. Bul. 177. 1931.

Septoria callistephi Gloyer. *Leaf blight*
Gloyer, W. O. Phytopath. *11:* 50-51. 1921.
———— Phytopath. *14:* 64. 1924.

Clover *(Trifolium* spp.)

(See alsike clover, red clover, white clover, etc.)

Cocoanut *(Cocos nucifera)*

**Aphelenchus cocophila* Cobb. *Red-ring nematode*
Field evidence that it was introduced into Grenada and St. Vincent in the husks of seed nuts. Also present in Trinidad, Tobago, South, and Central America.
Stevenson, J. A. Foreign Plant Diseases, U. S. D. A., p. 127. 1926.

Coffee *(Coffea arabica* et al.)

**Cercospora coffeicola* Berk. & Cooke. *Leaf spot*
Nowell, W. Diseases of Crop Plants in Lesser Antilles. London, p. 228. 1923.

**Colletotrichum coffeanum* Noack. *Anthracnose*
Berries become attacked and their market value reduced thereby.
Stevenson, J. A. Foreign Plant Diseases, U. S. D. A., p. 50. 1926.

**Corticium koleroga* (Cooke) von Hach. *"Koleroga" disease*
Berries become infected, as shown by blackened grains.
Stevenson, J. A. Foreign Plant Diseases, U. S. D. A., p. 50. 1926.

**Nematospora coryli* Peglion. *Stigmatomycosis*
Wallace, G. B. Trop. Agr. *7:* 141. 1930. Carried in the beans and probably spread by *Antestia lineaticollis.*

Coffea liberica

**Trachysphaera fructigena* Tabor. & Bunting. *Mealy pod*
Stevenson, J. A. Foreign Plant Diseases, U. S. D. A. p. 51. 1926.

Coix lachrymans *(Job's-tears)*

**Ustilago Coicis* Bref. *Coix smut*
Thomas, C. C. Phytopath. *10:* 331-333. 1920. Occurred on plants grown from seed received from Philippine Islands. Disease not known to be established in U. S.

Corn *(Zea mays,* including sweet corn)

Alternaria sp.
Manns, T. F., & J. F. Adams. Jour. Agr. Res. *23:* 495-524. 1923.
Valleau, W. D. Ky. Agr. Exp. Sta. Unpublished data: relation to field symptoms unknown. Not controlled by half hour's treatment in $HgCl_2$ 1:1000.

Aspergillus niger VanTiegh. *Black mold*

Taubenhaus, J. J. Texas Agr. Exp. Sta. Bul. 270: 1-38. 1920. Carried in seed and produces death of seedlings.

Bacterium stewartii EFS. *Bacterial wilt*

Smith, E. F. Bacteria in Relation to Plant Diseases *3:* 114-129. 1914.

Stewart, F. C. N. Y. (Geneva) Agr. Exp. Sta. Bul. 130: 437. 1897.
Seed disinfection not effective. Widely distributed by sweet-corn seed. It also attacks flint varieties and to a lesser extent certain dent corns.

Basisporium gallarum Moll. *Dry rot*

Arzberger, E. G. Ohio Agr. Exp. Sta. Bul. 265: 69-82. 1913. Published under name *Coniosporium Gecevi* Bubák.

Durrell, L. W. Iowa Agr. Exp. Sta. Res. Bul. 84: 139-160. 1925.

Botrytis cinerea Pers. *Gray mold*

Pape, H. Mitteil. Biol. Reichs. f. Land. u. Först. *21:* 34-36. 1921. The fungus forms sclerotia on the kernels, which become readily killed.

Cephalosporium acremonium Corda. *Black-bundle disease* (See next entry)

Cephalosporium sacchari Butler. *Wilt* and *root rot*

Manns, T. F., & J. F. Adams. Del. Agr. Exp. Sta. Bul. 138: 3-24. 1921.

Norton, J. B. S., & C. C. Chen. Science *52:* 250-251. 1920. Isolated from sweet corn seed.

Reddy, C. S., & J. R. Holbert. Jour. Agr. Res. *27:* 177-205. 1924.
The relationships of *C. sacchari* and *C. acremonium Corda* are not fully understood. Reddy & Holbert believe that *C. acremonium* is the correct name to apply to this disease, which they designate as the "black bundle disease of corn."

Chaetomium sp. Isolated from internally infected seed grown in several states

Manns, T. F., & J. F. Adams. Jour. Agr. Res. *23:* 495-524. 1923.

Cladosporium sp.

Manns, T. F., & J. F. Adams. Jour. Agr. Res. *23:* 495-524. 1923.

Colletotrichum graminicolum (Ces.) Wils. Isolated from internally infected seed grown in several states: relation of seed infection to field symptoms unknown

Manns, T. F., & J. F. Adams. Jour. Agr. Res. *23:* 495-524. 1923.

Diplodia frumenti E. & E. *Ear rot*

Eddins, A. H. Phytopath. *20:* 733-742. 1920. The organism hibernates as dormant mycelium in the seed and also overwinters in the old cornstalks in the field.

Diplodia macrospora Earle. *Gray ear-mold*

Anon. Fla. Agr. Exp. Sta. Ann. Rept. *1930:* 104. 1931. The fungus overwinters in plant debris in the soil as well as by dormant mycelium in the seed.

Diplodia zeae (Schw.) Lev. *Diplodia ear-rot, seedling blight*

Burrill, T. J., & J. T. Barrett. Ill. Agr. Exp. Sta. Bul. 133: 65-109. 1909.

Melhus, I. E., & L. V. Durrell. Iowa Agr. Exp. Sta. Cir. 78: 2-8. 1922.
Seed disinfection with mercuric dusts is quite effective in reducing loss in stand from this disease.

Fusarium moniliforme Sheldon = *Gibberella moniliforme. Root rot*

Holbert, J. R., W. L. Burlison, B. Koehler, *et al.* Ill. Agr. Exp. Sta. Bul. 255. 1924.

Valleau, W. D. Kentucky Agr. Exp. Sta. Bul. 226. 1920.

Gibberella moniliforme (Sheld.) Wineland

Wineland, G. O. Jour. Agr. Res. *28:* 909-922. 1924. The perfect stage of *Fusarium moniliforme* Sheld.

Gibberella saubinetii (Mont.) Sacc. *Seedling blight, root rot,* and *ear diseases*

Atanasoff, Dimitr. Jour. Agr. Res. *20:* 1-32. 1920. 10-40 percent of infected seeds produced seedling blight. Seed disinfection with mercuric dusts is quite effective in reducing losses.

Pammel, L. M., C. M. King, & J. L. Seal. Iowa Agr. Exp. Sta. Res. Bul. 33: 115-131. 1916.

Selby, A. D., & T. F. Manns. Ohio Agr. Exp. Sta. Bul. 203: 212-236. 1909.

Helminthosporium sp. Relation to field symptoms undetermined

Manns, T. F., & J. F. Adams. Jour. Agr. Res. *23:* 495-524. 1923.

Valleau, W. D. Ky. Agr. Exp. Sta. Unpublished data. Carried internally in a high percentage of seed. Occasionally causing death of seedlings. Not controlled by seed treatment with mercury compounds.

Hormodendron sp. Isolated from internally infected seed grown in North Dakota

Manns, T. F., & J. F. Adams. Jour. Agr. Res. *23:* 495-524. 1923.

Mosaic (Virus)

C. W. Edgerton, La. Agr. Exp. Sta., informed the compiler at Toronto meeting Am. Assoc. Adv. Sci. (1921) that this virus disease is carried in corn seed up to one percent.

Penicillium sp.

Manns, T. F., & J. F. Adams. Jour. Agr. Res. *23:* 495-524. 1923.

Physoderma zeae-maydis Shaw. *Physoderma disease*

Tisdale, W. H. U. S. D. A. Farmers' Bul. 1124: 1-9. 1920. The disease may be carried on the surface of seedcorn to new localities.

Rhizopus nigricans Ehr. *Seedling blight*

Adams, J. F., & A. M. Russell. Phytopath. *10:* 435-453. 1920.

Hoffer, G. N., & J. R. Holbert. Indiana Agr. Exp. Sta. Bul. 224. 1918.

Sclerospora philippinensis Weston. *Philippine downy mildew*

Weston, Wm. H. Jour. Agr. Res. *19:* 97-122. 1920.

———— Jour. Agr. Res. *24:* 853-859. 1923. Serious in the Philippine Islands on several varieties of maize. Recently recognized in U. S. Mycelium from badly infected ears enters undeveloped parts of aborted kernels and occasional hyphae may be found in chaff, seed coats, and endosperm of kernels, but not in embryo; however, attempts to develop the disease from such infected kernels have failed thus far. Weston thinks it more likely that oospores may be seed-borne.

Sphacelotheca reiliana (Kuehn) Clinton. *Head smut* (See SORGHUM)

Spicaria sp.

Manns, T. F., & J. F. Adams. Jour. Agr. Res. *23:* 495-524. 1923.

Torula sp. Isolated from internally infected seed grown in Delaware

Manns, T. F., & J. F. Adams. Jour. Agr. Res. *23:* 495-524. 1923.

COTTON (*Gossypium* spp.)

Alternaria sp. Relation to field disease undetermined

Crawford, R. F. Phytopath. *13:* 501-503. 1923.

Ascochyta gossypii Syd. *Blight*

Wells, B. W., F. A. Wolf, & S. G. Lehman. N. Car. Agr. Exp. Sta. Ann. Rept. *48:* (1925) 34. 1926.

Bacterium malvaccarum EFS. *Angular leaf-spot; black arm*

Archibald, R. G. Soil Science *33:* 5-9. 1927.

Faulwetter, R. C. So. Car. Agr. Exp. Sta. Bul. 198. 1919. Concluded that internal transmission of the bacteria was rare and that external transmission was general.

Rolfs, F. M. So. Car. Agr. Exp. Sta. Bul. 184: 14-17. 1915. Thought the bacteria were borne internally.

Worsham, E. Lee. Ga. State Board Ent. Bul. 51: 20-21. 1918. Two-year old seed practically free from infection; one hour treatment with $HgCl_2$ or H_2SO_4 gave control on one-year-old seed.

Cephalothecium sp. Relation to field disease undetermined

Crawford, R. F. Phytopath. *13:* 501-503. 1923.

Diplodia gossypina Cooke. *Black boll-rot*

Crawford, R. F. Phytopath. *13:* 501-503. 1923.

Elliott, J. A. Ark. Agr. Exp. Sta. Bul. 173: 15. 1921.

Fusarium No. 1

Crawford, R. F. Phytopath. *13:* 501-503. 1923.

Fusarium No. 2 Seedling blight

Crawford, R. F. Phytopath. *13:* 501-503. 1923.

Fusarium No. 3 Pink boll-rot

Crawford, R. F. Phytopath. *13:* 501-503. 1923.

Fusarium moniliforme Sheldon. *Dry root-rot*

Woodroff, Naomi C. Phytopath. *17:* 227-238. 1927.

Fusarium vasinfectum Atk. *Wilt*

Elliott, J. A. Phytopath. *12:* 50-51. 1922.

———— Jour. Agr. Res. *23:* 387-393. 1923.

Glomerella gossypii (South.) Edg. *Anthracnose*

Barre, H. W. So. Car. Agr. Exp. Sta. Ann. Rept. *23:* 23-26. 1910.

———— So. Car. Agr. Exp. Sta. Ann. Rept. *24:* 23-45. 1911.

———— So. Car. Agr. Exp. Sta. Bul. 164: 11-15. 1912.

Crawford, R. F. Phytopath. *13:* 501-503. 1923.

Edgerton, C. W. La. Agr. Exp. Sta. Bul. 137: 81-85. 1912.

Elliott, J. A. Phytopath. *12:* 50-51. 1922.

Gilbert, W. W. U. S. D. A. Farmers' Bul. 555: 4-6. 1913.

Worsham, E. Lee. Ga. State Board Ent. Bul. 51: 20. 1918. Cotton seed treated with $HgCl_2$ and H_2SO_4 for one hour gave no control of anthracnose.

Nematospora coryli Pegl. *Boll rot*

Ashby, S. F., & W. Nowell. Ann. Bot. *40:* 69-83. 1926.

Plant Disease Reporter. U. S. D. A. *12:* No. 14. 145-146. 1928.

**Nematospora gossypii* Ashby & Nowell

Ashby, S. F., & W. Nowell. Ann. of Bot. *40:* 69-83. 1926. (Also see *Datura metel)*

**Nematospora nagpuri* D. & S.

Dastur, J. F., & J. Singh. Ann. Myc. *28:* 291-296. 1930. Associated with insect punctures resulting in fibre and embryo infections.

**Spermophthora gossypii* Ashby & Nowell

Ashby, S. F., & W. Nowell. Ann. of Bot. *40:* 69-83. 1926. Found on *Gossypium* spp. in Jamaica and the Lesser Antilles. (Also see COWPEA.)

Cowpea *(Vigna catjang)*

Bacterium pisi (Sack.) EFS. *Bacterial blight* (See PEA)

Bacterium vignae Gard. & Kend. *Bacterial spot*

Gardner, M. W., & J. B. Kendrick. Science *57:* 275. 1922.
——— & ——— Jour. Agr. Res. *31:* 841-863. 1925.
It is believed that the disease may be avoided by using seed from disease-free pods. The pathogen attacks also *Desmodium canescens, Dolichos lablab, Phaseolus angularis, P. limensis, P. limensis* var. *limenanus, P. lunatus macrocarpus, Stizolobium deeringeanum,* and *Vigna sesquipedalis.*

Cladosporium vignae Gard. *Cladosporium spot*

Gardner, M. W. Phytopath. *15:* 453-462. 1925.

Macrosporium sp. Relation to field disease undetermined

Chen, C. C. Md. Agr. Exp. Sta. Bul. 240: 97. 1920.

**Spermophthora gossypii* Ashby & Now.

Ashby, S. F., & W. Nowell. Ann. Bot. *40:* 69-83. 1926. Reported on seeds of cowpea in St. Vincent. Not proved to be seed-transmitted. (Also see COTTON.)

Cranberry *(Vaccinium oxycoccus* and *V. macrocarpum)*

Phoma radiciis oxycocci et al formae Ternetz. *Endotrophic mycorrhiza*

Rayner, M. C. Ann. Bot. *43:* 55-70. 1929. Fungus penetrates deeply into endosperm of seed.
Ternetz, C. Jahrb. Wissen. Bot. *44:* 353-408. 1907.

Cress *(Lepidium sativum)* (GARDEN CRESS)

Phoma lingam (Tode) Desm. *Black leg* (See CABBAGE)

Crimson Clover *(Trifolium incarnatum)*

Bacterium trifoliorum Jones, Will., Wolf, & McCull. *Bacterial leaf-spot* (See ALSIKE CLOVER)

Cucumber *(Cucumis sativus)*

Bacterium lachrymans Smith & Bryan. *Angular leaf-spot*

Carsner, E. Jour. Agr. Res. *15:* 201-220. 1918.
Gilbert, W. W., & M. W. Gardner. Phytopath. *8:* 229-233. 1918.
Meier, F. C., & G. K. K. Link. U. S. D. A. Cir. 234: 1-5. 1922. The pathogen also attacks *Bryanopsis laciniosa, Cucumis anguria, C. dipsaceus, Lagenaria leucantha,* and *Luffa acutangula,* upon which it may also be seed-borne. Seed disinfection with mercuric compounds is quite effective in controlling the disease in seedbeds.

Cercospora melonis Cooke

Eriksson, J. Centralb. f. Bakt. Par. u. Inf. II, *44:* 116-128. 1915. Thought this fungus was seed transmitted by "mycoplasm".

Cladosporium cucumerinum Ellis & Arth. *Scab*

Doolittle, S. P. Mich. Acad. Sci. *17:* (1915): 87-116. 1916. Suggests probability that fungus is disseminated on seed.
Eriksson, J. Centralb. f. Bakt. Par. u. Inf. II, *44:* 116-128. 1915. Thought this fungus was transmitted through seed by "mycoplasm."

Colletotrichum lagenarium (Pass.) Ellis & Hals. *Anthracnose*

Gardner, M. W. U. S. D. A. Bul. 727. 1918.
Garman, H. Ky. Agr. Exp. Sta. Bul. 91. 1901.

Mosaic (Virus)

Bewley, W. F. Nursery & M. G. Ind. Exp. & Res. Sta. Ann. Rept. Cheshunt *11:* 85. 1925.

Doolittle, S. P. U. S. D. A. Bul. 879. 1920. Transmitted through seed in rare cases.

CUCUMIS ANGURIA ; C. DIPSACEUS

Bacterium lachrymans Smith & Bryan. *Angular leaf-spot* (See CUCUMBER)

CYNODON (See BERMUDA GRASS)

DACTYLIS = ORCHARD GRASS

DANDELION *(Taraxacum officinale)*

Tylenchus dipsaci Kuehn. *Nematode gall*

Godfrey, G. H. Jour. Agr. Res. *28:* 473-478. 1924.

DARNEL *(Lolium temulentum)*

Seed fungus. (Smut?)

Freeman, E. M. Proc. Roy. Soc. (London) *71:* 27-30. 1902.

———— Science *19:* 172. 1904.

———— Minn. Bot. Studies (3d ser.) pt. *3:* 329-334. 1904. Demonstrated the mycelium in the embryo and characterized it as a symbiont.

Guerin, P. Bot. Gaz. *28:* 136-137. 1899. Described the constant presence of fungous mycelium within the seed.

DARSO = SORGHUM

DATURA METEL

**Nematospora gossypii* Ashby & Nowell

Ashby, S. F., & W. Nowell. Ann. Bot. *40:* 69-83. 1926. On seeds in Montserrat. Also attacks cotton and milkweed.

DESMODIUM (See TICK TREFOIL)

DIANTHUS BARBATUS = SWEET WILLIAM

DOLICHOS LABLAB = HYACINTH, BLACK, OR EGYPTIAN BEAN
(See bacterial diseases under BEAN, PEA, and COWPEA)

DURRA (See SORGHUM)

EGG PLANT *(Solanum melongena)*

Phomopsis vexans Harter. *Blight*

Edgerton, C. W., & C. C. Moreland. La. Agr. Exp. Sta. Bul. 178. 1921.

Haenseler, C. M. N. J. Agr. Exp. Sta. (Unpublished data). Ninety percent of seeds showing black sclerotial patches and 10 percent of apparently healthy seed yielded pure culture after treatment in $HgCl_2$ 1-1000 for 5 minutes.

Sherbakoff, C. D. Fla. Agr. Exp. Sta. Rept. *1917:* 76R-86R. 1918.

ELYMUS = WILD RYE

Puccinia impatientis (Schw.) Arth. *Leaf rust* (See GRASSES)

ENGLISH WALNUT *(Juglans regia)*

Bacterium juglandis (Pierce) EFS. *Bacteriosis* (See BLACK WALNUT)

EUCHLAENA MEXICANA = TEOSINTE

(See *Sclerospora graminicola* under MILLET)

EVENING PRIMROSE *(Oenothera* spp.)

**Bacillus* (?) *anthracoides* Gal.

Galippe, V. Compt. Rendu. Acad. Sci. Paris. *161:* 112-115. 1915. Constantly present within the seed.

FALSE DANDELION *(Hypochaeris radicata)*

Tylenchus dipsaci Kuehn. *Stem nematode*

Godfrey, G. H. Jour. Agr. Res. *28:* 473-478. 1924.
Hodson, W. E. H. Jour. Helminthol. *7:* 143-152. 1929.

FESCUE *(Festuca* spp.)

Cladochytrium graminis Busgen. (See GRASSES)

FETERITA (See SORGHUM)

Bacterium holci Kend. *Holcus bacterial spot* (See SORGHUM)

FLAX *(Linum* spp.)

Alternaria sp. *Damping-off of seedlings,* or *boll disease*

Bolley, H. L. Proc. Soc. Prom. Agr. Sci. *23:* 82-85. 1902.

**Botrytis cinerea* Auct. *Gray mold*

Schilling, E. Fasorfors. *4:* 212-234. 1925.
Schoevers, T. A. C. Rept. Internat. Conf. Phytopath. & Econ. Ent. Holland, 116-117. 1923.

Colletotrichum linicola Peth. & Laff. *Canker*

Bolley, H. L. N. Dak. Agr. Exp. Sta. Bul. *87:* 142-144. 1910.
Pethybridge, G. H., & H. A. Lafferty. Sci. Proc. Royal Dublin Soc. *15:* 359-384. 1918.

Colletotrichum sp. *Seedling blight*

Anon. Dept. Agr. & Tech. Inst. Ireland Ann. Gen. Rept. *18.* 1917-18, p. 60.

Fusarium Lini Bolley. *Wilt*

Bolley, H. L. No. Dak. Agr. Exp. Sta. Bul. *50.* 1901.
———— No. Dak. Agr. Exp. Sta. Bul. *87:* 142-144. 1910.
Tochinai, Y. Jour. Coll. Agr. Hokkaido Imp. Univ. Sapporo, Japan, *14:* 171-236. 1926.

**Gloeosporium lini* West. *Anthracnose*

Westerdijk, Johanna. Jahr. Verein. Angew. Bot. *16:* 1-8. 1918.
This fungus perhaps is the same as *Colletotrichum linicola.*

Melampsora lini (Schum.) Desm. *Rust*

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. *36:* 12-14. 1926.
Pethybridge, G. H. Jour. Dept. Agr. & Tech. Instr. Irel. *22:* 3-20, 1922.
When telia are mixed with the seed and sown the resultant crop may become rusted. Apparently urediniospores do not readily transmit the disease in the same way nor when dusted on the seed.

Phlyctaena linicola Speg. *Pasmo disease*

Brentzel, W. E. Jour. Agr. Res. *32:* 25-37. 1926.

Polyspora lini Laff. *Browning* and *stem break*

Lafferty, H. A. Sci. Proc. Royal Dublin Soc. *16:* 238-274. 1921. The spores retained their viability on dry seed for 2½ years after harvesting.

Foxtail *(Setaria, Chaetochloa)*

Bacterium holci Kend. (See sorghum and millet)

Sclerospora graminicola (Sacc.) Schroet. *Downy mildew*

Melhus, I. E., F. H. Van Haltern, & D. E. Bliss. Iowa Agr. Exp. Sta. Res. Bul. 111. 1928. Proof that this fungus is transmitted naturally on the seed appears to be lacking, but the fact that infection may be produced when the oospores are placed upon the seed at planting time, indicates that this method of transmission is effective and strongly suggests that the disease has become widely established in this manner. There are several other susceptible grass hosts including corn, teosinte, sorghum, and sugar cane.

Gourds *(Cucumis* spp., *Luffa, Lagenaria)*

Bacterium lachrymans Smith & Bryan. *Angular leaf-spot* (See cucumber)

Grasses

See bermuda grass *(Capriola),* darnel *(Lolium), Euchlaena,* brome grass *(Bromus),* fescue, foxtail *(Setaria, Chaetochloa),* job's tears *(Coix),* johnson grass *(Holcus),* oat grass *(Arrhenatherum),* orchard grass *(Dactylis),* millet *(Setaria),* rye grass *(Lolium),* quack, western rye, or wheat grass *(Agropyron)*

Bacterium coronafaciens atropurpureum Reddy & Godkin. *Bacterial spot of bromes*

Reddy, C. S., & James Godkin. Phytopath. *13:* 75-86. 1923. It is suspected that this disease is transmitted by the seed. The pathogen attacks *Agropyron repens, Avena sativa, Bromus inermis,* and 23 other species of Bromus.

**Cladochytrium graminis* Busgen. *Grass blight*

Butler, E. J. Mem. Dept. Agr. India. *1:* 44. 1917. On *Dactylis glomerata* and *Festuca.*

Puccinia beckmanniae McAlpine. *Leaf rust*

McAlpine, D. The Rusts of Australia 43. 1906. On *Beckmannia erucaeformis.* Introduced into Australia on seed from the United States.

Puccinia impatientis (Schw.) Arthur. *Leaf rust*

McAlpine, D. The rusts of Australia 43. 1906. On *Elymus condensatus.*

Sclerospora graminicola (Sacc.) Schroet. *Downy mildew* (See foxtail and millet)

Hawk's Beard *(Crepis taraxacifolia)*

Tylenchus dipsaci Kuehn. *Nematode*

Maige. Bul. Soc. Bot. France (ser. 4 to 6) *53:* Sess. Extra LXXV-LXXVI. 1906. This nema occurs on several hosts in U. S. but not on Crepis so far as known.

Heather *(Calluna vulgaris)*

Phoma radiciis callunae Tern. *Endophytic mycorrhiza*

Rayner, M. C. New Phytol. *12:* 59-77. 1913. Fungus invades seedlings from testa of seed coats.

Ternetz, C. Jahrb. Wissen. Bot. *44:* 353-408. 1907.

Hegari (See sorghum)

Hibiscus

**Bacterium hibisci* Nak. & Tak. *Bacterial blight*

Nakata, N., & K. Takimoto. Ann. Phytopath. Soc. Japan *1:* 13-19. 1923. Can be controlled by seed disinfection with mercuric compounds, or by soaking in water at 55°C. for 10 minutes.

Hippeastrum

Mosaic (Virus)

Dickson, B. T. McDonald College Tech. Bul. 2: 86. 1922.

Newhall, A. G. Phytopath. *13:* 104-106. 1923.

Hordeum (See barley)

Horse Chestnut *(Aesculus hippocastanum)*

Guignardia aesculi (Pk.) Stew. *Leaf blotch*

Detmers, F. Ohio Agr. Exp. Sta. Unpublished data. Lesions in immature fruits noted but their relation to the blotches on leaves not determined, nor whether seed was directly infected. In 1902 seeds collected under a seriously infected tree were planted in the greenhouse. Leaves of the resulting seedlings were seriously blotched.

Hyacinth Bean *(Dolichos lablab)*

(See bacterial diseases under bean, cowpea, and pea)

Hypochaeris radicata = false dandelion

Job's-tears = coix lachrymans

Johnson Grass *(Holcus halapensis)*

(See *Bacterium holci* under sorghum)

Juglans *(Walnut)*

Bacterium juglandis (Pierce) EFS. *Bacteriosis* (See black walnut)

Kale *(Brassica oleracea acephala)*

Bacterium campestre (Pammel) EFS. *Black rot* (See cabbage for this and other diseases)

Mycosphaerella brassicicola (Fr.) Lindau. *Ring spot* (See broccoli)

Phoma lingam (Tode) Desm. (See cabbage)

Kafir (See sorghum)

KOHLRABI *(Brassica oleracea caulo-rapa)*

Bacterium campestre (Pammel) EFS. *Black rot* (See CABBAGE for this and other diseases)

Phoma lingam (Tode) Desm. *Black leg* (See CABBAGE)

KAOLIANG (See SORGHUM)

KUDZU *(Pueraria thunbergiana)*

Bacterium puerariae Hedges. *Halo blight*

Hedges, Florence. Phytopath. *20:* 140. 1930. This disease is said by Miss Hedges to be the same as that of beans caused by *Bact. medicaginis phaseolicola* Burk. The organism attacks also *Phaseolus lunatus macrocarpus.*

LAGENARIA LEUCANTHA

Bacterium lachrymans Smith & Bryan. *Angular leaf-spot* (See CUCUMBER)

LATHYRUS LATIFOLIUS = EVERLASTING PEA

Bacterium pisi (Sack.) EFS. *Bacterial blight* (See PEA)

LATHYRUS ODORATUS = SWEET PEA

LETTUCE *(Lactuca sativa)*

Alternaria sp. Relation to field symptoms undetermined

Valleau, W. D. Ky. Agr. Exp. Sta. Unpublished. Found generally in certain lots of seed. Determined both by culture and by sectioning seed.

Marssonina panattoniana (Berl.) Magn. *Anthracnose*

Proof of seed transmission not published up to 1918. Claimed to be seed-borne in England. Also stated by Brittlebank to be introduced into Australia on seed.

Mosaic (Virus)

Newhall, A. G. Phytopath. *13:* 104-106. 1923.

Septoria sp. *Leaf spot*

Smith, E. F. Trans. Mass. Hort. *1897:* 129. 1898. "Appears to be carried over from year to year and spread from place to place in the seed." Probably *S. consimilis* E. & M., which is rather widely distributed.

LIMA BEAN *(Phaseolus lunatus macrocarpus)*

Bacterium flaccumfaciens Hedges. *Bacterial wilt* (See BEAN)

Bacterium medicaginis var. *phaseolicola* (Burk.) L. & H. *Halo blight* (See BEANS)

Bacterium phaseoli EFS. *Bacterial blight* (See BEANS)

Bacterium phaseoli var. *sojense* Hedges. *Bacterial pustule* (See SOYBEANS)

Bacterium puerariae Hedges = *B. medicaginis* var. *phaseolicola*

Bacterium vignae Gard. & Kend. *Bacterial spot of cowpea* (See COWPEA)

Bacterium viridifaciens T. & W. *Bacterial spot.* = *B. vignae* Gard. & Kend.

Tisdale, W. B., & Maud M. Williamson. Jour. Agr. Res. *25:* 141-153. 1923.

Diaporthe phaseolorum (C. & E.) Sacc. *Pod blight*

Halsted, B. D. N. J. Agr. Exp. Sta. Bul. 151: 24-25. 1901. Described as *Phyllosticta subcircinata* E. & E., but not demonstrated by Halsted as seed-borne.

Harter, L. L. Jour. Agr. Res. *11:* 473-506. 1917.

Elsinoe canavaliae Rac. *Scab*

Jenkins, A. E. Jour. Agr. Res. *42:* 13-23. 1931. Fruits are commonly infected. The organism is very likely seed-borne but proof is lacking.

Fusarium sp. Relation to field disease unknown

Chen, C. C. Md. Agr. Exp. Sta. Bul. 140: 97-98. 1920. Fungus emerges through hilum. Possibly this may be a wilt fungus.

Mosaic (Virus)

McClintock, J. A. Phytopath. *7:* 60-61. 1917.

Nematospora phaseoli Wingard. *Seed spot*

Wingard, S. A. Phytopath. *12:* 525-532. 1922.

Phytophthora phaseoli Thaxter. *Downy mildew*

Butler, E. J. Fungi and Disease in Plants, 234-235. 1918.
Clinton, G. P. Ill. Agr. Exp. Sta. Bul. 57. 1900.

Luffa acutangula

Bacterium lachrymans Smith & Bryan. *Angular leaf-spot* (See cucumber)

Lupine (*Lupinus* sp.)

Bacterium leguminiperdum (von Oven) *Stevens* (See beans)

Mangel (See sugar beet)

Martynia louisiana

Bacterium martyniae Elliott. *Bacterial leaf-spot*

Elliott, C. Jour. Agr. Res. *29:* 487-490. 1924. Author recommends using seed only from healthy plants of the host.

Meibomia (See tick trefoil)

Melandryum album

**Ustilago violacea* (Pers.) Tul. *Anther smut*

Brefeld, O., & R. Falck. Untersuch. Gesammt. Myk. *13:* 1-75. 1905.

Milkweed (*Asclepias curassavica*)

**Nematospora gossypii* Ashby & Nowell

Ashby, S. F., & W. Nowell. Ann. Bot. *40:* 69-83. 1926. In seeds of *A. curassavica* in Trinidad and W. Indies.

MILLET *(Chaetochloa, Panicum, Pennisetum, Setaria)*

Bacterium panici Elliott. *Stripe disease.* See also AFRICAN MILLET *(Eleusine)*

Elliott, C. Jour. Agr. Res. *26:* 151-159. 1923. The disease attacks panicles of *Panicum miliaceum,* where every opportunity for seed infection is afforded.

Phoma sp.

Porter, R. H., T. F. Yu, & H. K. Chen. Phytopath. *18:* 917-918. 1928. Commonly found on millet *(Setaria italica)* seed in China.

Sclerospora graminicola (Sacc.) Schroet. *Downy mildew*

Melhus, I. E., F. H. Van Haltern, & D. E. Bliss. Iowa Agr. Exp. Sta. Bul. 111: 297-338. 1928. There is every evidence that intercontinental spread has been accomplished by oospores in or on the seed. Reported on *Euchlaena mexicana, Holcus sorghum, Panicum miliaceum, Pennisetum typhoideum, Saccharum officinarum, Setaria glauca, S. italica, S. magna, S. verticillata, S. viridis* and varieties of *Zea mays,* including pop, sweet, and field corns.

Weston, W. H. Jour. Agr. Res. *24:* 854. 1923.

Ustilago crameri Koern. *Head smut*

Butler, E. J. Fungi and Disease in Plants, 234-235. 1918.

Clinton, G. P. Ill. Agr. Exp. Sta. Bul. 57: 1900.

Porter, R. H., T. F. Yu, & H. K. Chen. Phytopath. *18:* 911-919. 1928. Seed disinfection with mercury, copper, and arsenic dusts is quite effective. On *Chaetochloa (Setaria) italica.*

Ustilago panici-miliacei (Pers.) Wint. *Head smut*

Butler, E. J. Fungi and Disease in Plants, 235-238. 1918. On *Panicum miliaceum* and other species allied.

MILO (See SORGHUM)

MULBERRY *(Morus* spp.)

**Microglossum shiraianum* P. Henn.

Siegler, E. A., & A. E. Jenkins. Jour. Agr. Res. *23:* 833-836. 1923. Forms sclerotia in fruits.

Sclerotinia carunculoides Sieg. & Jenk. *Popcorn disease*

Siegler, E. A., & A. E. Jenkins. Jour. Agr. Res. *23:* 833-836. 1923. Fungus infects individual druplets, causing complete infection of ovaries and transformation of druplets into swollen sclerotial bodies which later produce apothecia.

**Sclerotinia shiraiana* P. Henn. *Sclerotium disease*

Siegler, E. A., & A. E. Jenkins. Jour. Agr. Res. *23:* 833-836. 1923. Causes formation of sclerotium, involving entire aggregate fruit.

MUSKMELON *(Cucumis melo)*

Colletotrichum lagenarium (Pass.) Ellis & Hals. *Anthracnose* (See CUCUMBER)

Cardinell, H. H., & E. M. Page. Mo. Agr. Exp. Sta. Service Circ. *110:* 13. 1922.

Link, G. K. K., & F. C. Meier. U. S. D. A. Circ. 217: 1-4. 1922.

MUSTARD *(Brassica alba, B. campestris, B. juncea, B. nigra)*

Bacterium campestre (Pammel) EFS. *Black rot* (See CABBAGE)

Phoma lingam (Tode) Desm. *Black leg* (See CABBAGE)

OATS *(Avena sativa)*

Bacterium coronafaciens Elliott. *Halo blight*

Elliott, Charlotte. Jour. Agr. Res. *19:* 139-172. 1920.

Bacterium coronafaciens atropurpureum Reddy & Godkin. *Bacterial spot*

Reddy, C. S., & J. Godkin. Phytopath. *13:* 75-86. 1923.

Bacterium striafaciens Elliott. *Bacterial stripe blight*

Elliott, Charlotte. Jour. Agr. Res. *35:* 811-824. 1927. Since the disease attacks pedicels, glumes, and the entire panicle, there is every opportunity for seed infection.

Cephalobus elongatus Sch. *Nematode disease*

Hodson, W. E. H. Nature *116:* 135. 1925. Nemas of this species are disseminated by oat seeds and in this manner transmitted to the resultant seedlings.

Colletotrichum graminicolum (Ces.) Wils. *Anthracnose* (See BARLEY, RYE, and WHEAT)

**Fusarium avenaceum* (Fries) Sacc.

Tu, C. Phytopath. *19:* 143-154. 1929. Inoculation caused headblight in oats. Ample opportunity is thus afforded for seed transmission though experimental proof seems to be lacking.

Fusarium culmorum (W. G. Sm.) Sacc.

Tu, C. Phytopath. *19:* 143-154. 1929. (See note under *F. avenaceum.)*

Fusarium graminearum Schwabe = *Gibberella saubinetii*

Fusarium nivale Sor. = *Calonectria graminicola* (B. & Br.) Wr. *Snow mold*

Tu, C. Phytopath. *19:* 143-154. 1929.
This disease is well known in Europe, where it is undoubtedly seed-borne. Reported by H. W. Wollenweber, Phytopath. *3:* 34. 1913, as widely distributed in North America.

Fusarium solani (Mart. p. par.) Ap. & Wr.

Tu, C. Phytopath. *19:* 143-154. 1929. See note under *F. avenaceum.*

Gibberella saubinetii (Mont.) Sacc. *Scab*

Atanasoff, D. Jour. Agr. Res. *20:* 1-32. 1920.
Dickson, J. G. U. S. D. A. Farmers' Bul. 1599. 1929.

Helminthosporium avenae Eidam. *Leaf spot*

Atanasoff, D., & A. G. Johnson. Jour. Agr. Res. *18:* 379-390. 1920.
Rathschlag, H. Phytopath. Zeitschr. *2:* 469-492. 1930. Establishes the perfect stage as *Pleospora avenae* Schaff. & Rath.
Ravn, F. K. Bot. Tidsskr. *23:* 101-321. 1900.
Sawada, K. Formosa Agr. Exp. Sta. Spec. Bul. *19:* 638. 1919.

Ustilago avenae (Pers.) Jens. *Loose smut*

Kuehn, J. Krankheiten der Kulturgewächse, 1858.
Wolff, R. Der Brand des Getreides, Halle. p. 1-34. 1873.
Zade, A. Angew. Bot. *6:* 113-125. 1924.

Ustilago levis (Kell. & Sw.) Magn. *Covered smut*

Clinton, G. P. Ill. Agr. Exp. Sta. Bul. 57. 1900.
Kellerman, W. A., & W. T. Swingle. Kansas Agr. Exp. Sta. Rept. *2:* 213. 1890.

OAT GRASS *(Arrhenatherum elatius = Avena elatior)*

Ustilago perennans Rostr. *Smut*

Rostrup, E. Overs. K. Danske Vidensk. Selsk. Forh. *1890:* 1-16. 1890.

OKRA *(Hibiscus esculentus)*

Ascochyta abelmoschi Harter. *Pod spot*

Harter, L. L. Jour. Agr. Res. *14:* 207-212. 1918.

ONION *(Allium cepa)*

Botrytis allii Munn. *Neck rot*

Munn, M. T. N. Y. (Geneva) Agr. Exp. Sta. Bul. 437. 1917. Spores found on centrifuged seed.

Macrosporium porri Ellis. *Brown mold*

Chapman, G. H. Mass. Agr. Exp. Sta. Rept. *22:* 164-167. 1910.

Peronospora schleideni Unger. *Downy mildew*

Chapman, G. H. Mass. Agr. Exp. Sta. Rept. *22:* 164-167. 1910. Spores commonly present in commercial samples of onion seed.

Cooke, H. T. Phytopath. *20:* 139-140. 1930. Demonstrated mycelium in ovary and ovules.

Whetzel, H. H. N. Y. (Cornell) Agr. Exp. Sta. Bul. 218. 1904. Spores are found in sets and may thus disseminate the disease.

Urocystis cepulae Frost. *Smut*

Chapman, G. H. Mass. Agr. Exp. Sta. Rept. *22:* 164-167. 1910.

Kokubu, K. Jour. Plant Protect. *8:* 245-250. 1921.

Munn, M. T. N. Y. (Geneva) Agr. Exp. Sta. Bul. 437. 1917.

ORCHARD GRASS *(Dactylis glomerata)*

**Aplanobacter rathayi* EFS. *Rathay's disease*

Smith, E. F. Carnegie Inst. Wash. *3:* No. 27, 155-160. 1914.

Cladochytrium graminis Busgen (See GRASSES)

Colletotrichum graminicolum (Ces.) Wils. (See WHEAT)

ORCHIDS

(Cattleya, Cypripedium, Epipactis, Neottia, Odontoglossum, etc.)

Rhizoctonia spp. *Endotrophic mycorrhizas*

Bernard, N. Compt. Rend. Acad. Sci. Paris *138:* 828-830. 1904.

———— Ann. Sci. Nat. Bot. Ser. *9:* 1-196. 1909.

Burgeff, H. Die Wurzelpilze der Orchideen. Fischer, Jena. 1909. Described these fungi as species of *Orcheomyces.*

PAK-CHOI *(Brassica chinensis)*

Bacterium campestre (Pamm.) EFS. *Black rot* (See CABBAGE)

PANSY *(Viola* spp.) (See VIOLET)

PEA *(Pisum sativum)*

Ascochyta pinodella Jones. *Ascochyta foot-rot*

Jones, L. K. N. Y. (Geneva) Agr. Exp. Sta. Bul. 547: 1-46. 1927. This fungus has smaller conidia than either *A. pisi* or *A. pinodes.* It is of importance in the seed producing regions as a foot rot and also a blight of seedlings.

Ascochyta pisi Lib. *Leaf* and *pod-spot*

Halsted, B. D. N. J. Agr. Exp. Sta. Rept. *1893:* 357-362. 1894.

Krueger, F. Central. Bakt. u. Parasit. *1:* 620-624. 1895.

Van Hook, J. M. Ohio Agr. Exp. Sta. Bul. 173: 231-239. 1906. Observed by Halsted and Krueger on seed but proved to cause infection of plants from such source by Van Hook.

Bacillus lathyri Manns & Taub. *Streak* (See ALFALFA)

Bacterium leguminiperdum (von Oven) Stevens (See BEANS)

Bacterium pisi (Sack.) EFS. *Bacterial blight*

Jennison, H. M. Phytopath. *11:* 104. 1921.
Jones, F. R., & M. B. Linford. Wis. Agr. Exp. Sta. Res. Bul. 64: 25-26. 1925.
Sackett, W. G. Colo. Agr. Exp. Sta. Bul. 218: 1-43. 1916.
Skoric, Vladimir. Phytopath. *17:* 611-627. 1927. The bacteria overwinter on and in the seed and transmit the disease to the resultant seedlings. The pathogen also attacks *Lathyrus odoratus. L. latifolius, Vigna* sp., and *Dolichos lablab.*

Bacterium seminum (Cayley) Stevenson. *Marsh spot*

Cayley, Dorothy. Proc. Royal Soc. (London) Ser. B. *86:* 171-173. 1913.
Paine, S. G. Ann. Appl. Biol. *5:* 62-67. 1918.

Erysiphe polygoni DC. *Powdery mildew*

Crawford, R. F. New Mexico Agr. Exp. Sta. Bul. 163: 1-13. 1927. The only case known of a powdery mildew which has been proved to be seed-borne.

Macrosporium sp. Relation of disease to field infection not determined

Munn, M. T. Unpublished. On garden peas; also on Canada field peas.

Mosaic (Virus)

Blaringhem, L. Compt. Rend. Acad. Sci. Paris. *175:* 1432-1434. 1922.
Dickson, B. T. McDonald College Tech. Bul. 2: 86. 1922.

Mycosphaerella pinodes (Berk. & Blox.) Stone. *Mycosphaerella blight*

Jones. L. K. N. Y. (Geneva) Agr. Exp. Sta. Bul. 547: 1-46. 1927. This disease was confused in the earlier literature with *A. pisi,* with which it has no genetic connection according to present workers. The conidial stage is *Ascochyta pinodes* (Berk. & Blox.) Jones.

Septoria pisi West. *Leaf blotch*

Jones, F. R., & M. B. Linford. Wis. Agr. Exp. Sta. Res. Bul. 64: 24. 1925. "Seed infection is not infrequent."

PEANUT *(Arachis hypogaea)*

Cercospora personata (B. & C.) Ellis. *Blotch* or *tikka disease*

Butler, E. J. Fungi and Disease in Plants. 319-323. 1918.
Wolf, F. A. Ala. Agr. Sta. Bul. 180: 127-139. 1914.

Sclerotinia minor Jagger (?) *Root rot*

Valleau, W. D. Ky. Agr. Exp. Sta. Unpublished. Sclerotia found inside shells. Determined as probably *S. minor* by H. H. Whetzel. Roots badly diseased.

Sclerotium rolfsii Sacc. *Sclerotial rot*

Wolf, F. A. Ala. Agr. Exp. Sta. Bul. 180: 142-147. 1914. Also widely disseminated in the soil and upon all sorts of vegetation.

PEPPER *(Capsicum annuum)*

Bacterium vesicatorium Doidge. *Bacterial canker* (See TOMATO)

Higgins, B. B. Phytopath. *12:* 501-516. 1922.

Cercospora capsici Heald & Wolf. *Leaf spot*

Higgins, B. B. Phytopath. *13:* 57-58. 1923.
———— Ga. Agr. Exp. Sta. Bul. 141: 57-59. 1923.

Colletotrichum sp. *Fruit spot*

Higgins, B. B. Phytopath. *13:* 57-58. 1923.

Gloeosporium piperatum E. & E. *Anthracnose*

Higgins, B. B. Phytopath. *13:* 57-58. 1923.
———— Ga. Agr. Exp. Sta. Bul. 141: 48-75. 1923.
———— Phytopath. *16:* 333-345. 1926. Surface disinfection of seed reduces disease greatly.

Macrosporium solani E. & M. *Early blight*

Higgins, B. B. Phytopath. *13:* 57-58. 1923.
———— Ga. Agr. Exp. Sta. Bul. 141: 66-67. 1923.

Phoma destructiva Plowr. *Phoma fruit-rot*

Higgins, B. B. Phytopath. *13:* 57-58. 1923.
———— Ga. Agr. Exp. Sta. Bul. 141: 67-69. 1923. (See TOMATO also.)

Phytophthora capsici Leonian. *Stem* and *fruit-blight*

Leonian, L. H. Phytopath. *12:* 401-408. 1922. Demonstrated seed transmission by planting infected seed. Recommends seed selection.

Vermicularia capsici Syd. *Fruit rot*

Higgins, B. B. Ga. Agr. Exp. Sta. Bul. 162: 1-10. 1930.

PERNETTYA MUCRONATA

Endotrophic mycorrhiza

Raymer, M. C. Tran. Bul. Mycol. Soc. *8:* 62. 1922. Seedling infection from seed coats was observed in seeds germinating viviparously.

PE-TSAI *(Brassica pe-tsai)*

Bacterium campestre (Pamm.) EFS. *Black rot* (See CABBAGE)

PETUNIA *(Petunia hybrida)*

Ring spot (Virus) (See TOBACCO)

Henderson, R. G. Phytopath. *21:* 225-229. 1931. Tobacco "ring spot" is seed-borne on this host to the extent of about 20 percent.

PIGEON PEA *(Cajanus indicus)*

Colletotrichum cajani Rangel. *Anthracnose*

Tucker, C. M. Jour. Agr. Res. *34:* 589-596. 1927.

PISUM SATIVUM = PEA

PLANTAIN *(Plantago maritima, P. major)*

Tylenchus dipsaci Kuehn. *Stem nematode*

Hodson, W. E. H. Jour. Helminthol. *7:* 143-152. 1929.

POMEGRANATE *(Punica granatum)*

Nematospora coryli Pegl. *Inspissosis*

Fawcett, H. S. Phytopath. *19:* 479-482. 1929. Seed infection reported. Transmission not proved but probable.

POPPY *(Papaver* spp.)

Bacterium papavericola Bryan & McWh.

Bryan, M. K., & F. P. McWhorter. Jour. Agr. Res. *40:* 1-9. 1930. Pods become infected and ample opportunity for seed infection is afforded.

Pumpkin *(Cucurbita pepo)*

Undetermined fungus. Relation to field infection not demonstrated.
Munn, M. T. Proc. Assoc. Off. Seed Analysts *12-13:* 57-59. 1921. Germination affected seriously.

Quackgrass *(Agropyron repens)*

Bacterium coronafaciens atropurpureum Reddy & Godkin. (See brome grass)

Radish *(Raphanus sativus)*

Bacterium campestre (Pamm.) EFS. *Black rot* (See cabbage)

Bacterium vesicatorium raphani White. *Bacterial spot*

White, H. E., & M. W. Gardner. Phytopath. *19:* 97. 1929.
White, H. E. Phytopath. *20:* 653-662. 1930. This disease also attacks turnips, cabbage, brussels sprouts, cauliflower, mustard, and tomato, but seed transmission has been proved only in the case of radish.

Phoma lingam (Tode) Desm. *Black leg* (See cabbage)

Rape *(Brassica napus)*

Bacterium campestre (Pamm.) EFS. *Black rot* (See cabbage)

Phoma lingam (Tode) Desm. *Black leg* (See cabbage)

Red Clover *(Trifolium pratense)*

Alternaria sp. *Seed fungus*

Fergus, E. N., & W. D. Valleau. Ky. Agr. Exp. Sta. Bul. 269: 197-199. 1926. Frequently isolated from seeds disinfected in formaldehyde.
Munn, M. T. N. Y. (Geneva) Agr. Exp. Sta. (unpublished) on Italian red clover. Possibly same organism as that found by Fergus and Valleau.

Bacillus lathyri Manns & Taub. *Streak* (See alfalfa)

Bacterium trifoliorum Jones, Will., Wolf, & McCull. *Bacterial leaf spot* (See alsike clover)

•*Botrytis anthophila* A. Bond. *Blossom mold*

Bondarstev, A. S. Zap. Sta. Isp. Siem. Imp. Bot. Sad. *2:* No. 3: 3-23. 1914.
Jaczewski, A. A. Min. Zem. Biûro. Mik. Fitopat. Uchen. Kom. 31-37. 1916.

Colletotrichum trifolii Bain. *Anthracnose* (See alfalfa)

Sampson, Kathleen. Comparative Studies of *Kabatiella caulivora* (Koch.) Karuk. and *Colletotrichum trifolii* Bain and Essary, Two Fungi which Cause Red Clover Anthracnose. Trans. Brit. Myc. Soc. *13:* 103-142. 1928. Found *C. trifolii* transmitted to seedlings when seed was contaminated with spores.

Gloeosporium caulivorum Kirch. *Anthracnose*

Drayton, F. L. Dom. Canada Plant Dis. Sur. p. 32. 1923. The disease was destructive in seed plots planted with seed obtained in Europe. Species of clover not stated. Proof of seed-borne character not yet proved.
Sampson, Kathleen. Comparative studies of *Kabatiella caulivora* (Koch.) Karuk. and *Colletotrichum trifolii* Bain and Essary, Two Fungi which Cause Red Clover Anthracnose. Trans. Brit. Myc. Soc. *13:* 103-142. 1928. Spores (conidia) lived on red clover seed for 18 months under laboratory conditions. Infested seed produced the disease.

Kabatiella caulivora = *Gloeosporium caulivorum*

Macrosporium sarcinaeforme Cav. *Large leaf-spot*

Krakover, L. J. Mich. Acad. Sci. Rept. *19:* 275-328. 1917. Proof of seed dissemination not yet fully established, but *prima facie* evidence points strongly in this direction.

Mosaic (Virus)

Dickson, B. T. McDonald College Tech. Bul. 2: 82-86. 1922.

Mycelia sterilia. Seed fungus

Fergus, E. N., & W. D. Valleau. Ky. Agr. Exp. Sta. Bul. 269: 197-199. 1926. Found occasionally on formaldehyde disinfected seed. Hyphae rust-colored.

Peronospora trifoliorum deBary. *Downy mildew*

Campbell, Carlo. Ann. di Bot. *15:* 283-284. 1922.
Reported in U. S. on *T. repens.* U. S. Dept. Agr. Dept. Bul. 1366. 1926.

Sclerotinia trifoliorum Eriks. *Root rot*

Wolf, F. A., & R. O. Cromwell. N. C. Agr. Exp. Sta. Tech. Bul. 16: 15-18. 1919. Sclerotia found with the seed.

Sphaerulina trifolii Rostr. *Sphaerulina leaf-spot*

Hopkins, E. F. Phytopath. *13:* 117-126. 1923. Infection of seed may occur. Occurs on white clover as well.

Tylenchus dipsaci Kuehn. *Nematode* or *eelworm disease*

Smith, Ralph H. Idaho Agr. Exp. Sta. Bul. 130: 1922. Carried chiefly on plant debris "with" the seed. Thorough cleaning is of considerable benefit in preventing its spread. Dr. Cobb found this nematode in seed harvested in Idaho.

Rice *(Oryza sativa)*

Alternaria sp. *Leaf spot*

Tisdale, W. H. U. S. Dept. Agr. Bul. 1116: 4-5. 1922. Isolated from seed and found associated with a leaf-spot of rice in the field from which Alternaria was readily isolated.

Aspergillus, Epicoccum, Fusarium, and *Penicillium.* Seed-borne organisms whose relation to disease in field has not been established.

Tisdale, W. H. U. S. Dept. Agr. Bul. 1116: 4. 1922. Thinks these organisms enter kernels before they are mature; the spores probably lodging between glumes at flowering time.

**Fusarium heterosporium* Nees. *"Bakanae" disease*

Sawada, K. Formosa Agr. Exp. Sta. Spec. Bul. 19: 251. 1919.
——— Formosa Agr. Exp. Sta. Agr. Bul. 21.
The perfect stage is claimed to be *Lisea fujikuroi* Sawada.

Gibberella saubinetii (Mont.) Sacc. *Seedling blight, head blight,* and *stem rot*

Kasai, M. Ber. Ohara Inst. Landw. Forsch. *2:* 259-272. 1923.

Helminthosporium oryzae Miy. & Hori. *Brown spot, "sesame"*

Nishikado, Y., & C. Miyake. Jour. Plant Protect. *5:* 693-712. 1918. About 50 percent of the disease arises from infected seed. Soak the seed 24 hours in water at room temperature and follow with water at 52° C. for 10 minutes, or 54° C. for 5 minutes.

Tisdale, W. H. U. S. Dept. Agr. Bul. 1116: 4. 1922. Isolated Helminthosporium from seed and considered it to be parasitic. Its identity with *H. oryzae* is probable.

Lisea fujikuroi Sawada = *Fus. heterosporium*

Piricularia grisea (Cooke) Sacc. *Blast*

Tisdale, W. H. U. S. Dept. Agr. Bul. 1116: 4. 1922. Isolated from seed though not usually considered to be a seed-borne parasite. Nishikado & Miyake failed to control Piricularia by the hot-water treatment and regarded this as additional evidence that the fungus was not seed-borne.

**Protoascus colorans* Wolk. *Yellow grain*

Wolk, P. C. van der. Mycol. Centralbl. *3:* 153-157. 1913.

Sclerotium oryzae Catt.

Stevenson, J. A. Foreign Plant Diseases, U. S. Dept. Agr., p. 126. 1926. The sclerotia which are small, black, and spherical are carried with the seed and were introduced from the Orient to the U. S. A. in this manner.

Sclerotium sp. *Seedling blight*

Godfrey, G. H. Phytopath. *10:* 342-343. 1920.
Tisdale, W. H. U. S. Dept. Agr. Bul. 1116: 1-11. 1922.

Tilletia horrida Tak. *Covered smut*

Butler, E. J. Fungi and Disease in Plants. 226. 1918. The method of infection is not known with certainty.
Fulton, H. R. La. Agr. Exp. Sta. Bul. 105: 24-28. 1908.
Takahashi, Y. Bot. Mag. Tokio *11:* 16-20. 1896.

Rose (*Rosa* spp.)

Botrytis cinerea. Bud rot

Whetzel, H. H. In correspondence of Feb. 2, 1929, Dr. Whetzel states that sclerotia of a Botrytis causing bud-rot of certain varieties of rose sometimes are found attached to the seeds. The disease may be distributed in this manner.

Rye (*Secale cereale*)

**Aplanobacter rathayi* EFS. *Rathay's disease*

Flachs. Illust. Landw. Zeit. Berlin *47:* 262. 1927. Assumed to be seed-borne on rye because of our knowledge concerning this feature on *Capriola* and *Dactylis.*

Bacterium translucens var. *undulosum* Smith, Jones, & Reddy. *Bacterial blight* (See WHEAT)

**Bacterium cerealinum* (Gentner) Elliott. *Bacteriosis of Gentner* (See BARLEY)

Cladosporium herbarum (Pers.) Link. *Black end; sooty mold*

Corda. Oekonom. Neuigk. Verhandl. *72:* 651. 1846. Corda recognized the destructive action of this fungus on rye plants and especially the seed grains, which become shriveled and worthless.
Haberlandt, G. Wiener Land. Zeit. 245. 1878. Believed that the disease was transmitted on seed and also by straw in the manure.
Lapriore, G. Land. Jahrb. *23:* 969, 1008. 1894. Proved that seed transmitted the disease. Perfect stage claimed to be *Mycosphaerella tulasnei* Janc.

Claviceps purpurea (Fries) Tul. *Ergot*

"Sclerotia" are carried with the seed.

Colletotrichum graminicolum (Ces.) Wils. *Anthracnose* (See WHEAT)

Dilophospora alopecuri Fries. *Dilophospora disease*

Atanasoff, D. Phytopath. *15:* 11-40. 1925. The infected seed invariably carries the nematode *Tylenchus tritici* (Stein.) Bast. Also such seed galls are quite generally distributed with the seed. The galls may be separated from seed by the salt-solution method. Also attacks wheat and spelt.

**Fusarium avenaceum* (Fr.) Sacc. = *F. subulatum*

Fusarium culmorum (W. G. Smith) Sacc. *Scab* and *seedling blight*

Appel, O., & Fuchs. Mitt. Kaiserl. Biol. Anst. *14:* 10. 1913.

Fusarium graminearum Schwabe = *Gibberella saubinetii*

Fusarium herbarum (Corda) Fries. *Head* and *seedling blight*

Atanasoff, D. Meded. Land. (Wageningen) *27:* No. 4, p. 56, 73-75. 1923. Known in Holland and U. S. A.

Fusarium metachroum App. & Wollenw. = *F. herbarum* (Corda) Fries, according to Atanasoff

Fusarium nivale (Fries) Ces. = *Calonectria graminicola* (B. & Br.) Wr. *Snow mold* and *root disease*

Hiltner, L., and G. Ihssen. Landw. Jahrb. Bayern *1:* 20-60, 315-362. 1911. Records experiments in seed treatment with 1% $HgCl_2$, which produced better germination, more vigorous growth, and larger yields than was obtained from untreated seed.

Schaffnit, E. Landw. Jahrb. *43:* 521-648. 1913.

**Fusarium subulatum* App. & Wollenw. *Seedling* and *head blight*

Naumov, N. A. Min. Zeml. (Russia) Trudy Biûro Mykol. i. Fitopat. Uchen. Kom. No. *12:* 1-216. 1916.

Now known to be rather widely distributed in Europe. Often listed as *F. avenaceum.*

Gibberella saubinetii (Mont.) Sacc. *Scab* (See WHEAT)

Helminthosporium sp. *Helminthosporium blight*

Stakman, L. J. Minn. Agr. Exp. Sta. Bul. 191: 4-18. 1920.

Helminthosporium sativum P. K. & B. *Spot blotch* (See BARLEY)

Rhynchosporium secalis (Oud.) Davis

Heinsen, E. Jahr. Hamb. Wiss. Anst. *3:* No. 18: 43-55. 1901.

**Sclerotinia temulenta* (Pr. & Del.) Sacc. & D. Sacc. *Sclerotium disease of rye* in France

Prillieux, E. Mal. Pl. Agr. *2:* 453-459. 1897. Described as *Stromatinia temulenta* P. & Del. The conidial stage is described as *Endoconidium temulentum* Pr. & Del.

Seed fungus (See RYE GRASS)

Tilletia tritici (Bjerk.) Wint. *Bunt* or *stinking smut of wheat*

Gaines, E. F., & F. J. Stevenson. Phytopath. *13:* 210-215. 1923. It is suggested that *Tilletia secalis* is probably this species, which only rarely infects rye.

**Tilletia secalis* (Corda) Kuehn. *Stinking smut of rye* (See TILLETIA TRITICI)

Tylenchus tritici (Stein.) Bast. *Nematode* (See WHEAT)

Urocystis occulta (Wall.) Rab. *Flag smut*

Tisdale, W. H., & V. F. Tapke. U. S. Dept. Agr. Farmers' Bul. 1540. 1927.
Wolff, R. Bot. Zeit. *31:* 657, 673, 689. 1873.

Ustilago tritici (Pers.) Rostr. *Loose smut of wheat*

Tisdale, W. H., & V. F. Tapke. U. S. Dept. Agr. Farmers' Bul. 1540. 1927.

Rye Grass (*Lolium* spp.)

Seed fungus (See DARNEL)

Freeman, E. M. Roy. Soc. (London) Phil. Trans. (B) *196:* 1-27. 1903.

Jodidi, S. L., & J. Peklo. Jour. Agr. Res. *38:* 69-91. 1929.
Occurs also in wheat, rye, and barley. This organism is probably a smut of the type of *Ustilago tritici.*

Salsify (*Tragopogon porrifolius*)

Albugo tragopogonis (DC.) SFG. *White rust*

Heald, F. D. Trans. Am. Microscop. Soc. *32:* 9. 1913.
"The seed of the oyster plant may be so badly infested with the white rust as to entirely destroy the crop."

Scarlet Runner Bean (*Phaseolus multiflorus*)

Phytomonas medicaginis var. *phaseolicola* Burk. *Wilt* and *halo blight*

Burkholder, W. H. Phytopath. *16:* 915-927. 1926. Also on common bean and lima bean.

Sesamum (*S. orientale*)

**Fusarium* sp. *Wilt*

Stevenson, J. A. U. S. Dept. Agr. For. Pl. Dis. 169. 1926. A serious disease in India.

Snapdragon (*Antirrhinum majus*)

Phyllosticta antirrhini Syd. *Leaf-spot; stem rot*

Buddin, W., & E. M. Wakefield. Gard. Chron. (London) *76:* 150-151. 1924.
Transmitted on diseased capsules included with seed; probably also on seed.

Soja max = soybean

Sorgo (See sorghum)

Sorghum

(*Holcus sorghum* L., *Andropogon sorghum,* including the varieties known as broom corn, darso, durra, feterita, hegari, Indian millet, kafir, kaoliang, milo, sorgo, Sudan grass, and Sudan corn)

Bacterium andropogoni EFS. *Bacterial stripe*

Elliott, Charlotte, & E. F. Smith. Jour. Agr. Res. *38:* 1-22. 1929. Strongly suspected of being seed-borne, but full proof lacking. Hosts are broom corn, feterita, Sudan grass, and corn.

Bacterium holci Kend. *Holcus bacterial-spot*

Kendrick, J. B. Iowa Agr. Exp. Sta. Res. Bul. 100. 1926.
The disease also attacks Johnson grass, broom corn, Sudan grass, pearl millet, foxtail, and dent, flint, sweet, and pop corn in addition to 22 varieties of sorghum types. Seed transmission was demonstrated in 11 varieties of sorghum of the red amber, white milo, hegari, kafir, and feterita types. It is probable that all of the hosts here listed may carry infection of the bacterium in the seed, although the results with corn are considered negative.

Bacterium holcicola Elliott. *Bacterial streak*

Elliott, C. Jour. Agr. Res. *40:* 963-976. 1930. Believes the organism to be spread by seed.

Fusarium moniliforme Sheldon. *Root rot*

Valleau, W. D. Ky. Agr. Exp. Sta. Bul. 226. 1920.

Phoma insidiosa F. Tass. *Leaf spot*

Koch, Elizabeth, & Caroline Rumbold. Phytopath. *11:* 253-268. 1921. A generally prevalent disease wherever the host is grown.

Sclerospora graminicola (Sacc.) Schroet. *Downy mildew* (See MILLET)

Sorosporium reilianum (Kuehn) McAlpine. *Head smut*

Hori, S. Bul. Imp. Con. Agr. Exp. Sta. Japan, *1:* 163-166. 1907.

Potter, A. A. Jour. Agr. Res. *2:* 339-371. 1914. Known to infect durra varieties, sorgho varieties, sorghum, and corn. Soil infestation usual source of infection but the spores must be carried with the seed at times in order to account for the distribution of this smut.

Sphacelotheca cruenta (Kuehn) Potter. *Loose kernel-smut*

Potter, A. A. Phytopath. *5:* 149-154. 1915.

Sphacelotheca sorghi (Link) Clinton. *Covered kernel-smut*

Known to infect broom corn, durra, feterita, kafir, kaoliang, sorgo, Sudan grass, shallu, milo, etc. Of these suscepts, milo, feterita, darso, dwarf hegari, and Sudan corn are highly resistant.

Clinton, G. P. Ill. Agr. Exp. Sta. Bul. 47. 1897.

———— Ill. Agr. Exp. Sta. Bul. 57. 1900.

Kellerman, W. A. Kans. Agr. Exp. Sta. Bul. 23: 95. 1891.

Reed, G. M., & L. E. Melchers. U. S. Dept. Agr. Bul. 1284: 2-5. 1925.

Soy Bean *(Soja, Glycine)*

Bacillus lathyri Manns & Taub. (See ALFALFA)

Bacterium glycineum Coerper. *Bacterial blight*

Coerper, Florence M. Jour. Agr. Res. *18:* 179-194. 1919.

Kendrick, J. B., & M. W. Gardner. Phytopath. *11:* 340-342. 1921.

Wolf, F. A. Phytopath. *10:* 119-132. 1920.

Only seed from disease-free pods should be planted.

Bacterium glycineum var. *japonicum* (Tak.) Elliott

Takimoto, S. Jour. Plant Prot. (Tokyo) *14:* 559-566. 1927. The disease is similar to that caused by *B. glycineum.* Spots on pods brownish to blackish and sunken. Not proved to be seed-borne but highly probable.

Bacterium phaseoli EFS. *Bean blight* (See BEANS)

Bacillus phaseoli sojense Hedges. *Bacterial pustule*

Lehman, S. G. Jour. Agr. Res. *39:* 795-805. 1929.

Wolf, F. A. Jour. Agr. Res. *29:* 57-68, 229-251. 1924.

Columbia variety most resistant of 40 var. tested. The disease is also known on lima and garden beans.

Bacterium sojae Wolf = *B. glycineum*

Cercospora diazu Miura. *Frog-eye spot*

Lehman, S. G. Jour. Agr. Res. *36:* 811-833. 1928.

**Cercosporina kikuchii* Mats. & Tom. *Leaf spot*

Matsumoto, T., & R. Tomoyasu. Ann. Phytopath. Soc. Japan *1*[6]*:* 1-14. 1925.

Fusarium sp. Relation to field symptoms undetermined

Chen, C. C. Md. Agr. Exp. Sta. Bul. 240: 98. 1920.

Macrosporium sp. Relation to field symptoms undetermined

Chen, C. C. Md. Agr. Exp. Sta. Bul. 240: 98. 1920.

Mosaic (Virus)

Gardner, M. W.. & J. B. Kendrick. Jour. Agr. Res. *22:* 111-114. 1921.
Kendrick, J. B., & M. W. Gardner. Jour. Agr. Res. *27:* 91-98. 1924.

Peronospora manshurica (Naoum.) Syd. = *P. sojae* Wolf

Peronospora sojae Wolf. *Downy mildew*

Wolf, F. A. Jour. Elisha Mitchell Soc. *39:* 164-169. 1924.
———— & S. G. Lehman. No. Car. Agr. Exp. Sta. Report *49* (1924): 82-85. 1925.

Phomopsis sojae Lehman. *Pod* and *stem blight*

Lehman, S. G. Jour. Elisha Mitchell Soc. *38:* 13. 1922. The causal fungus penetrates the pod wall and invades the developing seed.

Sclerotinia libertiana Fuckel = *S. sclerotiorum* (Lib.) Mass. *Sclerotium disease*

Pape, H. Mitteil. Biol. Reichs. f. Land. Först. *21:* 36-42. 1921.

Septoria glycines Hemmi. *Brown spot*

Wolf, F. A., & S. G. Lehman. Jour. Agr. Res. *33:* 365-374. 1926. Disease probably imported on seed from Japan.

Spurge *(Euphorbia* spp.)

Uromyces dictyosperma Ellis & Ev. *Rust*

Mains, E. B. Proc. Ind. Acad. Sci. *1921:* 137-139. 1922. Exact method of transmission unknown but author suggests external by spores, possibly teliospores. On *Euphorbia arkansana.*

Uromyces proeminens (DC) Pass. *Rust*

Carleton, M. A. U. S. Dept. Agr. Bur. Pl. Ind. Bul. 63: 9-11. 1904.
Mains, E. B. Proc. Indiana Acad. Sci. *1921:* 137-139. 1922. Exact method of transmission unknown but author suggests externally-borne spores, possibly teliospores. On *Euphorbia dentata.*

Stizolobium = velvet bean

Stock *(Matthiola incana annua)*

Bacterium matthiolae Briosi. *Bacteriosis*

Briosi, G., & L. Pavarino. Atti R. Inst. Bot. Univ. Pavia Ser. 2. *15:* 135-141. 1912. Authors recommend seed treatment with mercuric chloride.

Phoma lingam (Tode) Desm. *Black leg* (See cabbage)

Stramonium *(Datura stramonium)*

Mosaic (Virus)

Blakeslee, A. F. Proc. Nat. Acad. Sci. *7:* 116-118. 1921.
———— Jour. Genetics *11:* 17-36. 1921. Transmitted through pollen to seed of 79% of offspring.

Strawberry Tree *(Arbutus unedo)*

Endotrophic mycorrhiza

Raymer, M. C. Ann. Bot. *29:* 97-133. 1915.
———— New Phytol. *25:* 185. 1926. Ovarial infection recorded.

Sudan Corn (See sorghum)

Sudan Grass (See sorghum)

SUGAR BEET (See BEET)

SUNFLOWER (*Helianthus* spp.)

Plasmopara halstedii (Farl.) Berl. & deToni. *Downy mildew*

Young, P. A., & H. E. Morris. Am. Jour. Bot. *14:* 551-552. 1927. Complete proof lacking, but evidence points to the overwintering of the fungus in the seed.

Sclerotinia sclerotiorum (Lib.) Mass. *Stem-rot*

Drayton, F. L. Dominion of Canada P. D. S. 40. 1923.

Young, P. A., & H. E. Morris. Mont. Agr. Exp. Sta. Bul. 208. 1927. Large numbers of sclerotia are carried with seed, from which they are difficult to separate.

SWEDES (*Brassica campestris*)

Alternaria sp. *Seed fungus*

Cunningham, G. H. New Zealand Dept. Agr. Bul. 133. 1927. Reported as common on swedes and turnip seed. Probably same fungus as Chupp reports on cabbage.

Phoma lingam (Tode) Desm. *Black leg* (See CABBAGE and TURNIP also)

Cunningham, G. H. New Zealand Dept. Agr. Bul. 133. 1927.

SWEET ALYSSUM (*Alyssum* spp.)

Phoma lingam (Tode) Desm. *Black leg* (See CABBAGE)

SWEET CORN (See CORN)

SWEET CLOVER (*Melilotus alba*)

Mosaic (Virus)

Dickson, B. T. McDonald College Tech. Bul. 2: 85-86. 1922.

SWEET PEA (*Lathyrus odoratus*)

Bacillus lathyri Manns & Taub. *Streak* (See ALFALFA)

Bacterium pisi (Sack.) EFS. *Bacterial blight of peas* (See PEA)

Glomerella rufomaculans (Berk.) Sp. & v. Schrenk. *Bitter rot*

Taubenhaus, J. J. Del. Agr. Exp. Sta. Bul. 106: 1-93. 1914. The fungus attacks the pods universally and overwinters upon them. It is inferred that the disease is seed-borne, but final proof seems lacking.

SWEET WILLIAM (*Dianthus barbatus*)

Puccinia dianthi DC. *Rust*

Cooke, M. C. Fungoid Pests of Cultivated Plants, 34. 1906. Plants grown from Japanese seed developed this rust in England.

TEASEL (*Dipsacus fullonum*)

Tylenchus dipsaci Kuehn. *Stem nematode*

Kuehn, J. Zeitschr. Wiss. Zool. *9:* 129-132. 1858.

TEOSINTE (*Euchlaena mexicana*)

(See *Sclerospora graminicola* under MILLET)

Tick Trefoil *(Desmodium; Meibomia)*

Bacterium vignae Gard. & Kend. *Bacterial spot of cowpea* (See cowpea)

Timothy *(Phleum pratense)*

Colletotrichum graminicolum (Ces.) Wils. *Anthracnose* (See wheat)

Ustilago striaeformis (Westd.) Niessl. *Leaf smut*

Osner, G. A. N. Y. (Cornell) Agr. Exp. Sta. Bul. 381: 189-230. 1916. Modified hot-water treatment effective.

Tobacco *(Nicotiana* spp.)

Bacterium angulatum Fromme & Murray. *Angular leaf-spot*

Fromme, F. D., & T. J. Murray. Jour. Ag. Res. *16:* 219-228. 1919.
———— Va. Poly. Inst. Ext. Bul. 62. 1920.
———— & S. A. Wingard. Va. Agr. Exp. Sta. Tech. Bul. 25. 1922.

Bacterium melleum Johns. *Bacterial leaf-spot*

Johnson, J. Jour. Agr. Res. *23:* 481-494. 1923.
———— Wis. Agr. Exp. Sta. Bul. 373: 5-16. 1925.

Bacterium tabacum Wolf. *Wild-fire*

Clinton, G. P., & F. McCormick. Conn. Agr. Exp. Sta. Bul. 203: 67-81. 1921.
Fromme, F. D. Va. Poly. Inst. Ext. Bul. 62. 1920.
Johnson, J., C. M. Slagg, & H. F. Murwin. Phytopath. *14:* 175-180. 1924.
Wolf, F. A. No. Car. Agr. Exp. Sta. Bul. 246: 13, 18. 1922.
Natural infection occurs also on tomato, *Petunia hybrida, Phytolacca decandra, Solanum melongena,* and *Vigna sinensis.* Artificial infection occurred on a wide range of plants, embracing 21 different families. Seed transmission proved only with tobacco.

Peronospora hyoscyami de Bary. *Blue mold; downy mildew*

Angell, H. R. Jour. Council Sci. & Ind. Res. Australia (Reprint p. 1-5). 1929. Diseased seedlings appear only in certain lots of seed, but actual proof of seed carriage not fully demonstrated.

Phytomonas polycolor Clara. *Philippine bacterial leaf-spot*

Clara, F. M. Phytopath. *20:* 691-706. 1930. Infection from seed reduced by disinfection in silver nitrate (1-1000) for 10-15 minutes.

Ring spot (Virus)

Valleau, W. D. Plant Dis. Rep. *14:* 113. 1920.
Evidence that this disease is seed-borne in a small percentage of cases on Turkish tobacco.

Tomato *(Lycopersicum esculentum)*

Aplanobacter michiganense EFS. *Bacterial canker* or *Grand Rapids disease*

Bryan, Mary K. U. S. D. A. Circ. 29. 1928.
———— Jour. Agr. Res. *41:* 825-851. 1930. The causal bacteria are disseminated on and in the seed. Absolutely clean seed can be obtained only by selection from disease-free fields. Surface infection is eliminated by disinfection with organic mercury dusts and is to be recommended when the seed is not known to be absolutely disease-free.

Bacillus lathyri Manns & Taub. (?) *Winter blight, stripe, streak*

Berkeley, G. H. Ontario Dept. Agr. Ann. Rept. Veg. Growers' Assoc. *25:* 52-59. 1930. Demonstrated streak as seed-borne.

Dickson, B. T. Science *62:* 398. 1925.

Doolittle, S. P., & H. L. Blood. Phytopath. *20:* 134. 1930.

Orton, C. R. Proc. Am. Seed Trade Assoc. *40:* 74-82. 1922.

Paine, S. G., & W. F. Bewley. Ann. Appl. Biol. *6:* 183-202. 1919.

Vanterpool, T. C. Phytopath. *16:* 311-331. 1926.

Considerable confusion still exists regarding the nature of the destructive tomato diseases which have been variously designated under the common names appearing above. The disease in England was attributed by Paine and Bewley to *B. lathyri.* In North America various workers have reproduced certain types of the disease by virus mixtures with potato virus. There are at least three distinct types of this disease which have been confused in the literature and by the various workers. The type of this disease occurring in Pennsylvania was proved to be seed-borne by Orton in 1917 and thereafter. At least one type of the disease has become almost world-wide in distribution during recent years. See reference by Orton. One type of the disease is infrequently seen in epiphytotic conditions in the field. Most frequently these maladies are restricted to glass-house tomatoes. Some of the literature appears to be confused with Grand Rapids disease.

Bacterium leguminiperdum v. Oven (See BEANS)

**Bacterium lycopersici* Burgw. *Blossom end-rot bacteriosis*

Burgwitz, G. K. Morbi Plant. (Leningrad) *13:* 128-130. 1924. The relation of this disease to the blossom end rot occurring in No. America is uncertain.

Bacterium exitiosum Gard. & Kend. = *B. vesicatorium*

Bacterium vesicatorium Doidge. *Canker*

Doidge, Ethel. Jour. Dept. Agr. Union So. Africa *1:* 718-721. 1920.

———— Ann. Appl. Biol. *7:* 407-430. 1921.

Gardner, M. W., & J. B. Kendrick. Jour. Agr. Res. *21:* 123-156. 1921.

The disease has been recorded upon many varieties of tomatoes. The pathogen also attacks *Capsicum annuum, Datura stramonium, Hyoscyamus niger, H. aureus, Lycium* spp., *Nicotiana rustica, Physalis minima, Solanum dulcamara, S. nigrum, S. rostratum* and *S. tuberosum.* It is seed-borne on tomato and pepper and probably on some of its other hosts.

Cladosporium fulvum Cooke. *Leaf mold*

Gardner, Max W. Indiana Acad. Sci. *1924:* 311. 1925.

———— Jour. Agr. Res. *31:* 536-538. 1925.

Colletotrichum phomoides (Sacc.) Chester. *Anthracnose*

Harvey, F. L. Maine State Coll. Ann. Rept. *1893:* part II, 152.

Pritchard, F. J. The Canning Trade *46:* 33-34. 1923.

Fusarium lycopersici Sacc. *Wilt*

Clinton, G. P. Conn. Agr. Exp. Sta. Rept. *1903:* part 4, 279-370.

Edgerton, C. W., & C. C. Moreland. La. Agr. Exp. Sta. Bul. 174: 54. 1920.

Elliott, J. A., & R. A. Crawford. Phytopath. *12:* 428-434. 1922.

Macrosporium solani E. & M. *Early blight*

Massee, I. Bul. Agr. Intel. & Plant Dis. *5:* 1518-1519. 1914.

Roy. Bot. Gard. Kew Bul. Miscell. Inf. 4: 145-146. 1914.

Nematospora lycopersici Schneid.

Schneider, A. Phytopath. *6:* 395-399. 1916. Seed infection occurs but seed transmission not proved, although probable.

Phoma destructiva Plow. *Fruit rot*

Link, G. K. K., & F. C. Meier. U. S. Dept. Agr. Cir. 219: 1-5. 1922. (See PEPPER also.)

Phytophthora omnivora de Bary. *Brown rot; "buckeye" rot*

Bancroft, C. K. Jour. Bd. Agr. (London) *16:* 1012. 1910. Claims that the hyphae penetrate endosperm and embryo of seed and that such infested seeds germinate and always produce infected fruits.

Rhizopus nigricans Ehr. *Seedling blight*

Chen. C. C. Md. Agr. Exp. Sta. Bul. 240: 104. 1920.

Trailing Wild Bean *(Strophostyles helvola)*

Bacterium phaseoli EFS. *Bacterial blight of bean* (See bean)

Trifolium pratense = red clover

Turnip *(Brassica rapa)*

Alternaria sp. *Seed fungus* (See swedes)

Bacterium campestre (Pamm.) EFS. *Black rot* (See cabbage)

Mycosphaerella brassicicola (Fr.) Lindau. *Ring spot* (See broccoli)

Infects yellow but not white varieties of turnips.

Phoma lingam (Tode) Desm. *Black leg* (See cabbage also.)

Cunningham, G. H. New Zeal. Dept. Agr. Bul. 133. 1927. Destructive also on swedes in New Zealand. Pathogen is present in seedcoats, from which it spreads to developing cotyledons, where infection results and fruit bodies form. Seed disinfection for 1 hour in 0.25 percent chlor-phenol mercury at 46°C. was completely effective without causing material damage to seed.

Velvet Bean *(Stizolobium deeringeanum)*

Bacterium phaseoli EFS. *Bean blight* (See bean)

Bacterium vignae Gard. & Kend. *Bacterial spot* (See cowpea)

Vetch *(Vicia* spp.)

Bacterium vignae Gard. & Kend. (See cowpea)

Protocoronospora nigricans A. K. & Edg. *False anthracnose*

Wolf, F. A. Jour. Elisha Mitchell Soc. *36:* 72-84. 1920. Attacks *Vicia sativa, V. villosa, V. angustifolia, & V. dasycarpa.*

Vicia = vetch

Violet *(Viola* spp.)

Urocystis violae (Sow.) F. von Wald. *Smut*

Pape, H. Centralb. f. Bakt. Parasit. u. Inf. II: *65:* 301-307. 1925.

Walnut *(Juglans* spp.)

Bacterium juglandis (Pierce) EFS. *Bacteriosis* (See black walnut)

Watermelon *(Citrullus vulgaris)*

Alternaria cucurbitae Let. *Leaf blight*

Munn, M. T. Proc. Assoc. Off. Seed Analysts *12-13:* 57-59. 1921.

Colletotrichum lagenarium (Pass.) Ellis & Hals. (See cucumber)

Fusarium niveum EFS. *Fusarium wilt*

Fulton, H. R. No. Car. Agr. Exp. Sta. Rien. Rept. *1913-14:* 48-51. 1914. Spores carried externally. Seed disinfection effective with mercury compounds.

Western Rye Grass *(Agropyron tenerum)*

Ustilago bullata Berk. *Loose smut*

Fraser, W. P., & G. A. Scott. Phytopath. *16:* 473-477. 1926. Reported as *U. bromivora.* Controlled by formaldehyde seed treatment.

Muraschinsky, K. E. p. 4 Omsk. 1926. [See Biol. Abs. *2:* (404) 1928.] Believed to have been introduced into Russia from North America.

Wheat *(Triticum aestivum)*

Acrostalagmus sp. Isolated from seed but only slightly pathogenic to seedlings

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 12-13, 21. 1924.

Alternaria sp. Relation to field symptoms undetermined; a very common fungus on wheat seed

Bolley, H. L. Ann. Rept. No. Dakota Agr. Exp. Sta. *22:* 3-40. 1912.

———— No. Dak. Agr. Exp. Sta. Bul. 107: 1-94. 1913.

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 1-71. 1924. Finds *Alternaria* generally pathogenic to wheat seedlings.

Stakman, Louise J. Univ. of Minn. Studies in Biol. Sci. No. 4: 139-161. 1923.

Wollenweber, H. W. Jour. Agr. Res. *2:* 251-285. 1914.

**Alternaria tenuis* Nees. *Black point;* see also CLADOSPORIUM HERBARUM and BRACHYSPORIUM sp.

Peyronel, B. Boll. R. Staz. Pot. Veg. (Roma) *6* (1): 10-25. 1926. Isolated *A. tenuis* frequently from black pointed seeds and occasionally *Cladosporium herbarum.* He concludes that the latter organism is not always the cause of "black point". Comparison of *A. tenuis* with *Alternaria* sp. as listed above should be made.

Aspergillus niger van Tieg. Relation to field symptoms undetermined; caused a root disease of seedlings in greenhouse at Minnesota.

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 45. 1924.

Bacterium atrofaciens McCul. *Basal glume-rot*

McCulloch, Lucia. Jour. Agr. Res. *18:* 543-552. 1920. Infection of kernels proved, but it is not yet demonstrated that infected kernels produce infected plants though the distribution of the disease indicates such manner of infection.

Bacterium cerealinum (Gentner) Elliott. *Bacteriosis* (See BARLEY)

Bacterium translucens var. *undulosum* Sm., Jones & Reddy. *Black chaff*

Braun, H. Jour. Agr. Res. *19:* 363-392. 1920.

Reddy, C. S., J. Godkin, and A. G. Johnson. Jour. Agr. Res. *28:* 1039-1040. 1924.

Smith, E. F. Jour. Agr. Res. *10:* 51-53. 1917.

Smith, E. F., L. R. Jones, & C. S. Reddy. Science *50:* 48. 1919.

Bacterium tritici (Hutch.) Elliott. *Punjab* or *Tandu disease*

Carne, W. M. Jour. Dept. Agric. West. Austr. *3* (ser. 2): 508-512. 1926.

Fahmy, T. E., & T. E. Mikhail. Agric. Jour. Egypt. New Ann. ser. 1923. *1:* 64-72. 1925.

Hutchinson, C. M. Mem. Dept. Agric. India Bact. ser. *1:* 169-175. 1917. Eelworms thought by Fahmy and Carne to be associated with the bacteria and responsible for their introduction into the host plant.

Brachysporium sp. *Black point*

Henry, A. W. Phytopath. *13:* 49. 1923. See *Helminthosporium M.*
———— Minn. Agr. Exp. Sta. Tech. Bul. 22: 36-37. 1924. The relations of *Brachysporium* to *Helminthosporium M.* in this case are not yet understood.

Calonectria graminicola (Berk. & Br.) Wr. = *Fusarium nivale*

Cephalosporium sp. Isolated from wheat seed at Minn. Exp. Sta. but pathogenicity not yet established

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 12. 1924.

Cephalothecium roseum Corda. *Pink mold*

Bolley, H. L. Ann. Rept. No. Dak. Agr. Exp. Sta. *22:* 3-40. 1912. Isolated from wheat seed at North Dakota and Minnesota stations but apparently not pathogenic to wheat seedling in Minnesota tests.

Chaetomium sp.

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 21. 1924. Isolated from wheat seeds at Minn. Exp. Sta. but pathogenicity not yet established. In one trial it did not prove to be pathogenic.

Cladosporium gramineum Corda.

Board of Agric. & Fisheries, London, Leaflet 289: 1-2. 1915. Reduces germination. Recommends seed testing and rejection of poor seed.
Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 12, 30. 1924. Isolated from wheat seed but did not prove pathogenic in two tests.

Cladosporium herbarum (Pers.) Link = *Mycosphaerella tulasnei. Black point* (See RYE)

Claviceps purpurea (Fries) Tul. *Ergot* (See RYE)

Colletotrichum graminicolum (Ces.) Wilson. *Anthracnose*

Bolley, H. L. Ann. Rept. No. Dak. Agr. Exp. Sta. *22:* 3-40. 1912.
———— No. Dak. Agr. Exp. Sta. Bul. 107: 1-94. 1913.
Selby, A. D., & T. F. Manns. Ohio Agr. Exp. Sta. Bul. 203. 1909.

Dilophospora alopecuri Fries. *Dilophospora disease*

Atanasoff, D. Phytopath. *15:* 11-40. 1925. Carried with the seed in the galls, which also bear *Tylenchus tritici* (Stein.) Bast. These galls may be removed by the saturated salt solution method. Also attacks rye.

Epicoccum sp.

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 21. 1924. Isolated from wheat seed at Minn. Agr. Exp. Sta. but not apparently pathogenic to seedlings in two trials.

Fusarium avenaceum (Fr.) Sacc. = *F. subulatum*

Fusarium culmorum (W. G. Sm.) Sacc. A scab and seedling blight fungus frequently confused in the early literature with the conidial stage of *Gibberella saubinetii*

Stakman, Louise J. Univ. of Minn. Studies Biol. Sci. No. 4: 139-161. 1923.
Wollenweber, H. W. Jour. Agr. Res. *2:* 251-285. 1914.

Fusarium graminearum Schwabe = *Gibberella saubinetii*

Fusarium herbarum (Corda) Fries. Isolated from wheat seed in Germany but relation to field symptoms not determined so far as compiler knows

Wollenweber, H. W. Jour. Agr. Res. *2:* 251-285. 1914.

Fusarium metachroum App. & Wollenw. = *F. herbarum*

Fusarium moniliforme Sheldon. *Root rot*

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 28-33. 1924. The fungus is common on corn in the United States.
Sherbakoff, C. D. Phytopath. *12:* 19. 1922.

Fusarium nivale Ces. *Foot rot* and *seedling blight*, especially of *rye*

Atanasoff, D. Jour. Agr. Res. *20:* 1-32. 1920. Reports the disease in U. S. A.
Schaffnit, E. Landw. Jahrb. *43:* 521-648. 1913.
Perfect stage is *Calonectria graminicola.*

**Fusarium subulatum* App. & Wollenw. Isolated from wheat seed in Germany, where it is said to cause head-blighting and seedling blight

Naumov, N. A. Minn. Zeml. (Russia) Trudy Biûro Mykol. i. Fitopat. Uchen. Kom. No. 12. 1-216. 1916.
Wollenweber, H. W. Jour. Agr. Res. *2:* 251-285. 1914.

Fusarium spp. *Root rots* and *seedling blights*

Bolley, H. L. Ann. Rept. No. Dak. Agr. Exp. Sta. *22:* 3-40. 1912.
Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 21, 33. 1924.
Hoffer, G. N. Proc. Ind. Acad. Sci. *1913:* 97-98. 1914.
Stakman, Louise J. Univ. of Minn. Studies Bot. Sci. No. 4: 139-161. 1923.
It seems probable that most of these reports refer to species listed above.

Gibberella saubinetii (Mont.) Sacc. *Seedling blight, scab*

Atanasoff, D. Jour. Agr. Res. *20:* 1-32. 1920.
Selby, A. D., & T. F. Manns. Ohio Agr. Exp. Sta. Bul. 203, 212-236. 1909.
A common and widely distributed disease of cereals in North America. (See also BARLEY, CORN, and RYE.)

Helminthosporium sativum P. K. & B. *Black point* and *foot rot*

Evans, N. S. Phytopath. *12:* 34. 1922.
Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 33-36. 1924.
Stakman, Louise J. Minn. Agr. Exp. Sta. Bul. 191: 1-18. 1920.
Weniger, Wanda. Phytopath. *13:* 48-49. 1923.

Helminthosporium M. Root rot and *black point* (See *Brachysporium)*

Henry, A. W. Minn. Agric. Exp. Sta. Tech. Bul. 22: 36-42. 1924. Isolated four strains of this species which differ morphologically and physiologically.

Helminthosporium N. Root rot and *black point*

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 34-36. 1924. Similar to *Podosporiella verticillata* in conidial features.

**Langloisula* sp.

Wollenweber, H. W. Jour. Agr. Res. *2:* 252. 1914. Associated with carmine red spots on wheat seeds in Germany.

**Leptosphaeria* sp.

Wollenweber, H. W. Jour. Agr. Res. *2:* 252. 1914. Isolated from seed in Germany but field symptoms not established.

Macrosporium spp. Isolated from seed but field symptoms not established

Bolley, H. L. Ann. Rept. No. Dak. Agr. Exp. Sta. *22:* 3-40. 1912.
———— No. Dak. Agr. Exp. Sta. Bul. 107: 1-94. 1913.
Hoffer, G. N. Proc. Ind. Acad. Sci. *1913:* 97-98. 1914.

**Melanospora* sp.

Wollenweber, H. W. Jour. Agr. Res. *2:* 252. 1914. Isolated from seed in Germany but field symptoms not established.

Ophiobolus cariceti (Berk & Br.) Sacc. = *O. graminis* Sacc. *Take-all.*

Brittlebank, C. C. Jour. Dept. Agr. Victoria *19:* 447. 1921. The perithecia may be carried on bits of straw with the seed. Only indirect evidence that this fungus is carried with the seed.

Penicillium sp.

Henry, A. W. Minn. Agric. Exp. Sta. Tech. Bul. 22: 12, 21. 1924. Isolated from seed wheat but only in one of four tests did it prove pathogenic.

Podosporiella verticillata O'Gara

O'Gara, P. J. Phytopath. *5:* 323-326. 1915. Not considered parasitic but seriously impairs the germinating kernels.

Puccinia graminis Pers. *Stem rust*

Pritchard, F. J. Phytopath. *1:* 150-154. 1911. Mycelium from pericarp penetrates various parts of the seedling. Others dispute seed transmission of stem rust.

**Ramularia* sp.

Wollenweber, H. W. Jour. Agr. Res. *2:* 252. 1914. Isolated from seed in Germany but field symptoms not established.

Sclerospora macrospora Sacc. *Downy mildew*

Peglion, V. Abstract in Centralbl. f. Bakt. *26:* 108. 1910. Mycelium infects young ovaries and develops within pericarp. Infection of seedlings results from planting seed which is apparently healthy.

Seed fungus (See RYE GRASS)

Septoria nodorum Berk. *Glume spot*

Rosen, H. R. Ark. Agr. Exp. Sta. Bul. 175. 1921. Rosen has not demonstrated the seed dissemination of this disease but from the sticky character of the exuding cirrus of spores it appears very probable that they are carried on the seed.

**Spicaria* sp.

Wollenweber, H. W. Jour. Agr. Res. *2:* 252. 1914. Isolated from seed in Germany but field symptoms not established.

Stemphylium parasiticum (Thum.) Elliot

Henry, A. W. Phytopath. *13:* 49. 1923. Apparently the same as *Macrosporium parasiticum*, and according to Miyabe, *Pleospora herbarum* is the perfect stage.
———— Minn. Agr. Exp. Sta. Tech. Bul. 22: 43. 1924.

Tilletia laevis Kuehn. *Smooth-spored bunt* or *stinking smut*

Kuehn, J. Hedwigia *2:* 5. 1858.

Tilletia tritici (Bjerk) Wint. *Rough-spored bunt* or *stinking smut*

Gleichen. Auserlesene mikrosk. Entdeckungen p. 46. 1781.
McAlpine, D. The Smuts of Australia, 70-85. 1910.
Schulthess. Abhandl. Naturf. Gesell. Zürich. *1:* 498-506. 1761.
Tessier, H. A. Paris. 1783.
Gleichen was apparently the first to show experimentally that bunt is carried on the seed and that moisture is essential to infection. The species with which he worked is doubtful, though *T. tritici* is probably the most common European bunt. This species is much more inclined to live over winter in the soil in the United States than the preceding, to which it is closely related. Schulthess was apparently the first to test the effect of copper sulphate on wheat for smut control in 1761, and Tessier in 1783 and 1786 found copper sulphate to be effective in controlling bunt.

Torula sp.

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 12, 20. 1924.
Isolated from seed but not pathogenic to wheat seedlings in two tests.

Trichoderma sp.

Henry, A. W. Minn. Agr. Exp. Sta. Tech. Bul. 22: 13, 31, 45. 1924.
Two species isolated from seed, one of which proved slightly parasitic on seedlings.

**Trichothecium* sp.

Wollenweber, H. W. Jour. Agr. Res. *2:* 252. 1914.
Isolated from seed in Germany but field symptoms not established.

Tylenchus tritici (Stein.) Bast. *Nematode disease*

Byars, L. P. U. S. D. A. Farmers' Bul. 1041: 1-10. 1919.
Fromme, F. D. Va. Agr. Exp. Sta. Bul. 222. 1919. Not intraseminal but occurs in galls which replace the seed.

Urocystis tritici Koern. *Flag smut*

Brittlebank, C. C. Jour. Dept. Agr. Victoria *19:* 447. 1921.
Hori, S. Bul. Imp. Cent. Agr. Exp. Sta. *1:* 163-176. 1907.
McAlpine, D. The Smuts of Australia, 88-102. 1910.
This smut acts much like *T. tritici* in its persistence in the soil, especially on straw and other plant debris.

Ustilago tritici (Pers.) Rostr. *Loose smut*

Barrus, M. F. Proc. Ind. Acad. Sci. *1908:* 113-122. 1909.
Brefeld, O., & R. Falck. Unters. Gesam. Geb. Mykol. No. 13. 1905.
Hecke, L. Zeitschr. f. Landwirtsch. Versuch. Oesterr. *7:* 59-64. 1904.
Maddox, F. Dept. of Agr. Tasmania. 1895.
———— Notes and Results of Agricultural Experiments. Launceston, Tasmania, 1897.
Maddox was the first to demonstrate floral infection by the smut fungi.

**Verticillium* sp.

Wollenweber, H. W. Jour. Agr. Res. *2:* 252. 1914. Isolated from seed in Germany but field symptoms not established.

Wheat Grass *(Agropyron Smithii & Apropyrum* spp.)

Aplanobacter agropyri O'Gara

O'Gara, P. J. Phytopath. *6:* 341. 1916.

White Cedar = arbor vitae

White Clover *(Trifolium repens)*

Bacterium trifoliorum Jones, Will., Wolf, & McCull. (See alsike clover)

**Sclerotinia* sp. resembling *S. trifoliorum* but with smaller apothecia

Alcock, N. L., & M. S. Martin. Trans. & Proc. Bot. Soc. Edinburgh *30:* 13-18. 1928. Infects seed and mycelium develops under seedcoat. First detected in shipments of seed from New Zealand to Scotland.

Sphaerulina trifolii Rostr. *Sphaerulina leaf-spot* (See red clover)

Wild Cucumber *(Micrampeltis lobata)*

Mosaic (Virus)

Doolittle, S. P., & W. W. Gilbert. Phytopath. *9:* 326. 1919.
———— Phytopath. *11:* 47. 1921.
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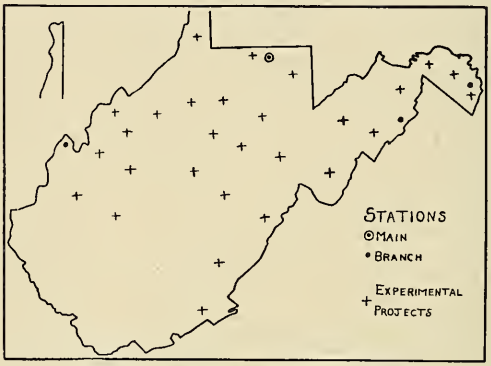
Wild Rye *(Elymus* spp.) (See grasses)

AGRICULTURAL EXPERIMENT STATION



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