



Blind Seed Disease of Perennial Ryegrass

John R. Hardison

Agricultural Experiment Station
Oregon State College
Corvallis

Station Circular 177
January 1949

Blind Seed Disease of Perennial Ryegrass¹

by

JOHN R. HARDISON²

BLIND seed disease was positively identified by a scientist³ in New Zealand during the winter of 1943 on samples of Oregon-grown perennial ryegrass seed, confirming tentative identifications made by several American plant pathologists. Discovery that this disease existed in Oregon provided the first good explanation of the cause for the decrease in germination of perennial ryegrass seed since 1941. The disease has been associated with poor quality seed starting with the 1941 crop and must have been present somewhat earlier. During the past few years it has spread rapidly and now is one of the most serious diseases affecting forage crop grass seed production in Oregon.

Profitable production of perennial ryegrass as a seed crop in most sections of the Willamette Valley now depends on following the satisfactory control methods developed during the past five years. The control program is described in this paper.

Poor germination of perennial ryegrass has been recorded in New Zealand for 25 years. Blind seed disease has been known to be present in that country for over 16 years. Seed imported from New Zealand was planted in the Halsey-Harrisburg area of Oregon prior to 1941, and apparently this introduced seed started the infestation which has now been spread to most Willamette Valley counties. Wind-carried spores of the causal fungus and use of infected seed have spread the disease widely in most perennial ryegrass seed-growing counties.

Life Cycle of the Disease Fungus

The disease is caused by the fungus *Phiala temulenta*. It infects only the seed. As a result of this infection, seeds may be damaged so severely that they fail to germinate (Figure 1). Such seeds were described by New Zealand workers as "blind seeds," hence the name blind seed disease.

The life cycle of the blind seed disease fungus is illustrated by the diagram in Figure 3. Infected seeds reach the soil in the follow-

¹Cooperative investigations between the Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, and the Department of Botany and Plant Pathology, Oregon Agricultural Experiment Station.

²Associate Pathologist, Division of Forage Crops and Diseases, U. S. Department of Agriculture.

³Mr. E. O. C. Hyde, Seed Analyst, Palmerston North, New Zealand.

ing ways: shattering, planting diseased seed, feeding infected seed, harvesting operations, and natural seed dispersal in unharvested areas. These blind seeds remain dormant during the winter on or near the surface of the soil. In the spring, coincident with the flowering of the perennial ryegrass, small, stalked, cup-shaped spore producing organs (apothecia) arise from the overwintered blind seeds (Figure 2) and forcibly discharge the primary spores (ascospores). These spores are showered on the ryegrass flowers and infect the developing seed. Secondary spores (conidia) are produced in slimy masses on infected seeds. These spores can infect other developing seeds when spread from head to head by rain and insects. When infection is once started it may progress to the point of killing many

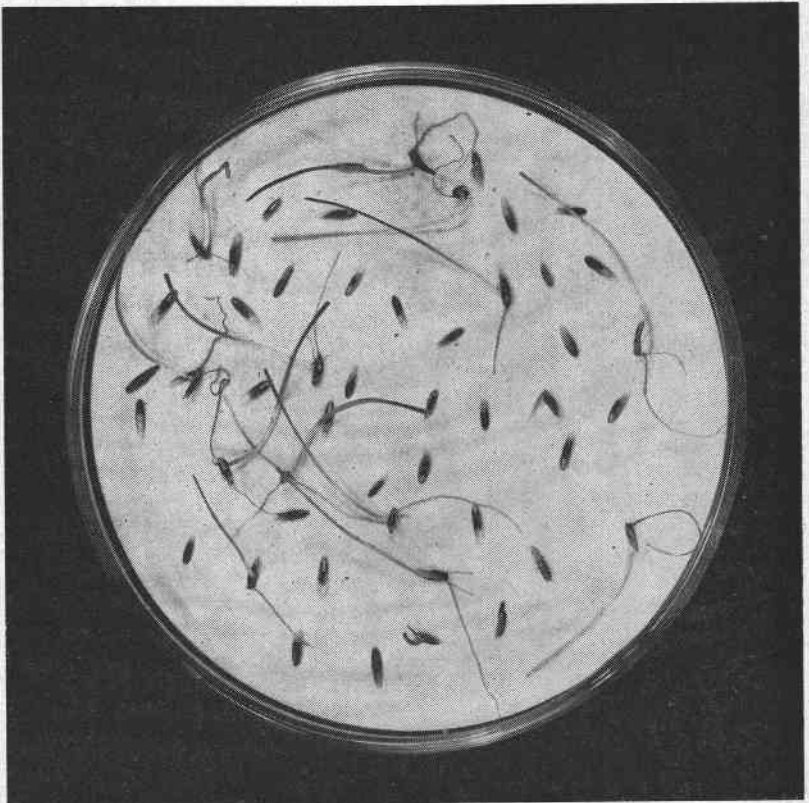


Figure 1. Blind seeds in germination test. (Sample is from a 1948, Linn County, heavily diseased crop that had an average of 27 per cent germination.)

of the ryegrass seeds. If badly infected seeds are overwintered at or near the surface of the soil, they will produce spore cups the following spring and repeat the cycle. The entire life cycle is confined to the seed; no other part of the plant is subject to attack.

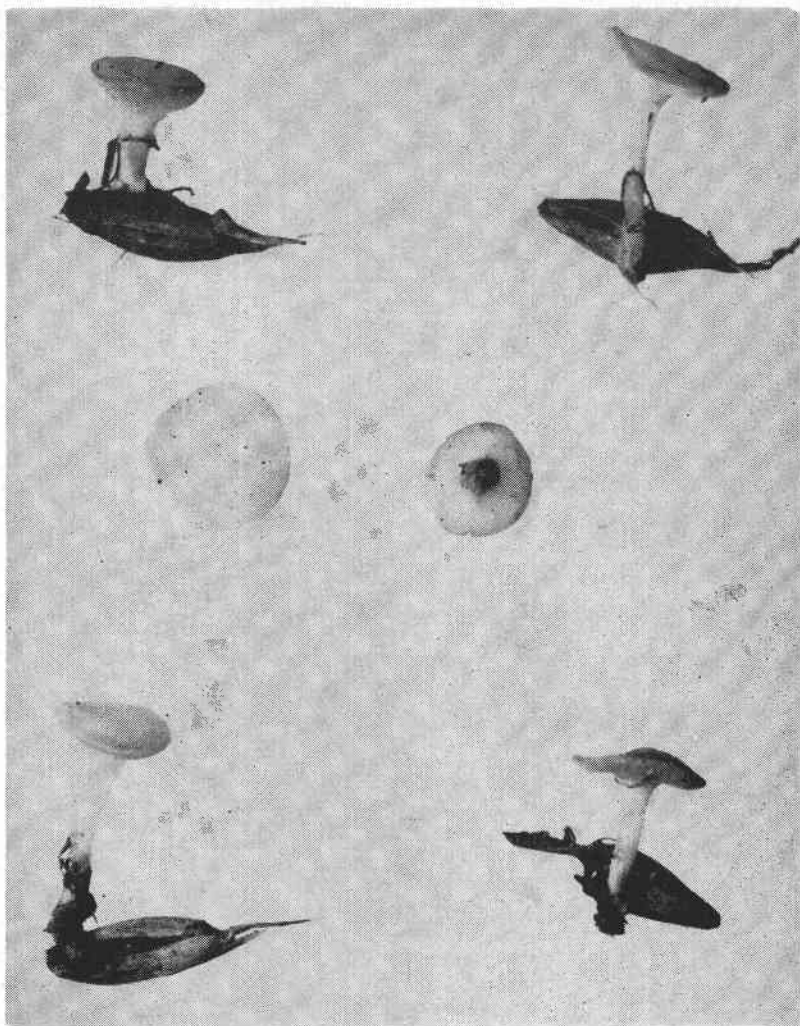


Figure 2. Spore cups of the fungus causing blind seed disease. Middle figure shows top and bottom view of the cup. (These cups are always attached to an old seed.)

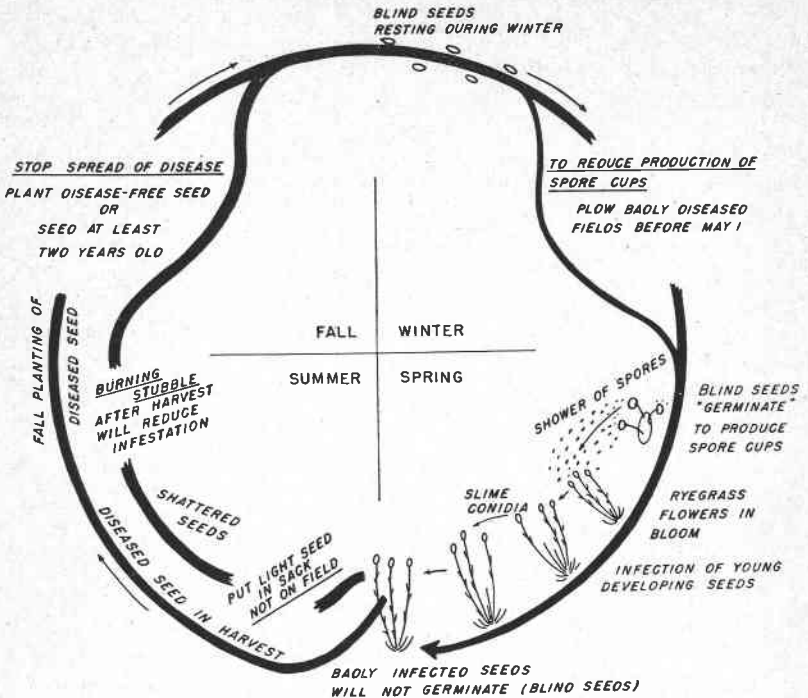


Figure 3. Life cycle of blind seed disease fungus. (Breaks in heavy black lines show where effective control measures may be applied.)

Factors Influencing Control

Individual growers cannot prevent spores being carried by wind from neighboring farms to their fields. Therefore, every infested field represents an important part of the total problem affecting perennial ryegrass. Whole-hearted cooperation of all growers is required in order that the control program can be effective.

No practical method is known for seed treatment of blind seed disease infested seed. No practical chemical treatment is known that will kill spore cups in a field without injuring the grass.

In considering measures to combat blind seed disease it is fundamental that only the seed is infected and only the infected seeds perpetuate the fungus. If all the seed from both harvested and unharvested areas could be removed every year and no infected seed planted, the disease probably could be completely eliminated in a few years.

Blind seed disease is difficult to control in seed production fields for two primary reasons. First, perennial ryegrass seed shatters badly and much diseased seed is lost before or during harvesting operations. Little improvement in the shattering problem is possible except by burning. Second, as combine harvesting is almost uniformly practiced in ryegrass seed harvesting, all straw and far too much light-weight is spread back on the field. In combine harvesting operations it is desirable to bring in all seed possible from the fields rather than to attempt partly to clean the seed while threshing as this results in much light seed being left on the ground. Light-weight seeds are the most likely to be diseased and consequently to increase the disease in the field. Other vulnerable points where the life cycle can be broken by control measures are illustrated in Figure 3.

Presence of the disease the first year or two in an infested field may not be detected unless the disease is severe, because the germination percentages may be fairly good. The disease, once in a field, generally continues to increase. It may appear to cause sudden, serious losses, when actually the disease was present for some time and passed unnoticed or the disease reports were ignored until it had built up to a heavy infection stage. For this reason, a field sometimes may make "blue-tag" (90 per cent) germination one year and drop to about 70 per cent germination the next year.

It should be emphasized that growers are faced with the problem of fighting a disease every year that will flare up in disastrous proportions if the program of inspection and recommendations for control are not continued, or if efforts of individual growers are relaxed. This has been well illustrated in Oregon. With excellent cooperation, growers controlled the disease in 1945 and 1946. Individual efforts were lax in 1947, and the majority of badly diseased fields were not plowed as recommended, resulting in a great increase in the disease. Growers were advised that the fairly good germinations of the 1947 crop were masking the real seriousness of the situation, and that intensive control efforts were necessary. Failure to recognize the seriousness of the disease situation and adverse weather conditions combined to prevent the plowing up of many badly diseased fields before May in 1948 for the second consecutive year. The disease increased greatly and losses were greater than for the 1943 crop. This was because the disease was so much more widespread at the beginning of 1947 than in 1943.

Cutting ryegrass for hay instead of seed is not recommended as a remedy for badly infested fields. The disease could be greatly reduced within a field if the crop was cut before any seed was formed, but the loss of a seed crop does not appear to be as practical as

burning after harvest or plowing. Also cutting badly diseased fields for hay allows the spores to be blown to neighboring fields, and evidence indicates that, on upland soils at least, many blind seeds produce spores cups the second spring after harvest.

Proper disposal of infected seed is of great importance. Diseased seed used for feed, used for pasture seeding, or indiscriminantly dumped can be a serious source of infection of seed fields. Therefore, diseased seed should be fed only if care is taken to prevent scattering of whole seeds. No other use of diseased seed can be recommended until it is 24 months old, and all screenings preferably should be burned.

Cool wet weather in May and June favors heavy infection by promoting maximum development of spore cups and also by prolonging the flowering period of the grass. This is particularly important on well drained soils which lose surface moisture rapidly, and of much less consequence to poorly drained soils which generally retain sufficient moisture to favor infection nearly every year. Excessive rainfall in the fall and spring favors the disease, in an indirect way, by preventing the necessary elimination of badly infested fields *which should be plowed before May 15.*

Objectives of the Control Program

The control program has two principal objectives. First, to detect and eliminate from production those fields that disease tests indicate will produce low quality and probably non-profitable seed crops, and second, to reduce the spread and extent of the disease. Both of these objectives can be largely accomplished by plowing up badly diseased fields.

In connection with blind seed disease control in Oregon, every sample of cleaned seed of perennial ryegrass entered for certification is examined for disease. From this, growers are advised through their County Agents of the amount of disease in their fields. Plowing is recommended for fields that appear too badly infested to produce a profitable crop of seed. Some fields are considered borderline cases, and positive predictions cannot be made. In such cases it would be preferable if the grower plowed up the field and thereby reduced the total amount of disease in the county rather than to gamble on a questionable crop.

Recommended Control Program

1. *Recommendations for planting new seed fields.*

A. **Plant Experiment Station approved, disease-free seed.**

The disease can be detected in seed samples. Seed of very high percentage germination cannot have much disease, but germination alone cannot be relied upon. Lists of approved planting stock seed lots have been issued to County Agricultural Agents starting with the 1944 crop.

B. **Plant 24-months-old seed.**

The blind seed disease fungus dies inside infected seeds after 24 months dry storage. For safe dates to plant aged, diseased seed, see Table 1.

C. **Plant seed at least $\frac{1}{2}$ inch deep.**

Evidence indicates that planting seed more than $\frac{1}{2}$ inch deep with complete soil coverage prevents emergence of fungus spore cups from the seed planted. Deeper plantings should be satisfactory in spring. Growers are advised to use their own judgment concerning deep fall planting because of possible damage to plants from soil heaving by frost.

D. **Prepare a good seed bed.**

Good seed bed preparation before seeding will allow the seed drill to penetrate to the proper depth and facilitate good coverage of the seed.

2. *Plow up badly diseased fields when notified.*

Examination of all certification samples of perennial ryegrass for blind seed disease is being continued. These examinations show which fields are badly diseased. Growers are advised that such fields should be plowed. Plowing should be done before May 15 to prevent emergence of spore cups and discharge of spores and subsequent spread of disease to neighboring fields. Do not again plant perennial ryegrass for two years on these fields.

3. *Save the light as well as heavy seed when combining.*

Because of the danger of increasing the disease, it is poor economy to attempt partly to "clean" the seed during harvesting operations. All diseased seed returned to the field aggravates the disease problem.

4. ***Burn, as a temporary remedy for diseased fields.***

Thorough burning of stubble and straw after harvest has given good control for one year. The disease will not be satisfactorily controlled, however, unless badly infested fields are thoroughly burned. The value of burning depends primarily on how much old seed is destroyed in a field.

5. ***Do not use diseased seed less than two years old for any purpose.***

Indiscriminate disposal of diseased seed in the seed producing areas by planting, feeding, or simply dumping represents a source of infection for seed fields.

6. ***Prevent heading of perennial ryegrass in pastures until after July.***

The disease will be perpetuated in pastures unless heading is prevented until after the regular seed harvest period.

7. ***Destroy all ryegrass screenings.***

Ryegrass screenings contain the light-weight seeds which are the ones most likely to be heavily diseased. Such screenings should preferably be burned. Feeding screenings to livestock is likely to spread the disease unless precautions are taken to prevent the scattering of whole seeds.

8. ***Beneficial farming practices.***

- A. **Clean plowing** is desirable to bury the blind seeds below the furrow slice.
- B. **Do not grow buckheat** or darnel (*Lolium temulentum*) as a companion crop with new plantings of perennial ryegrass. Buckheat is very susceptible and the large seeds will produce more spore cups than will perennial ryegrass seeds.
- C. **Good soil drainage** will reduce the disease, because development of spore cups is favored by wet soils.
- D. **Plow all perennial ryegrass** on a farm preferably at the same time so that no disease is carried over between crops. Small fields put together or farmed as one larger field would facilitate this practice.
- E. **Taking two seed crops and then plowing under the stand** is a system practiced by several growers who have been successful in reducing losses in the midst of severe disease infestations.

F. **Removal of straw after harvest** will allow the soil surface to dry more rapidly in spring and after showers, making conditions less favorable for spore cup production.

Summary

It is regrettable that any poor quality seed due to blind seed disease has been produced since 1944, because poor quality seed is definitely avoidable. Starting with the 1944 crop, growers have been provided with individual reports on all certification samples of perennial ryegrass, listing the amount of disease found in seed samples and recommendations for the next crop year. In the majority of cases, production of low germination seed could have been avoided if recommendations had been followed carefully. The control program was effective in 1945 and 1946. It will prove effective in 1949 and subsequent years if growers cooperate. The success of the control program rests primarily on the plowing up of badly diseased fields. Failing this, other control measures can be only partly effective.

Table 1. CHART SHOWING WHEN DISEASED SEED IS SAFE TO PLANT.

Year seed harvested	<i>Not safe to plant</i>	Safe to plant new fields
1946	Fall 1946 Spring 1947 Fall 1947	Spring 1948 Fall 1948 Or later
1947	Fall 1947 Spring 1948 Fall 1948	Spring 1949 Fall 1949 Or later
1948	Fall 1948 Spring 1949 Fall 1949	Spring 1950 Fall 1950 Or later
1949	Fall 1949 Spring 1950 Fall 1950	Spring 1951 Fall 1951 Or later
1950	Fall 1950 Spring 1951 Fall 1951	Spring 1952 Fall 1952 Or later
1951	Fall 1951 Spring 1952 Fall 1952	Spring 1953 Fall 1953 Or later
1952	Fall 1952 Spring 1953 Fall 1953	Spring 1954 Fall 1954 Or later
1953	Fall 1953 Spring 1954 Fall 1954	Spring 1955 Fall 1955 Or later
1954	Fall 1954 Spring 1955 Fall 1955	Spring 1956 Fall 1956 Or later
1955	Fall 1955 Spring 1956 Fall 1956	Spring 1957 Fall 1957 Or later