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Black Stem Rust and the Common Barberry in South Dakota

Raymond O. Bulger

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Black Stem Rust and the Common Barberry in South Dakota

Extension Service
South Dakota State College of Agriculture and Mechanic Arts
co-operating with the Office of Cereal Investigations
Bureau of Plant Industry
United States Department of Agriculture
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Stem Rust and the Common Barberry in South Dakota

RAYMOND O. BULGER

Agent, Office of Cereal Investigations, Bureau of Plant Industry, United States Department of Agriculture

STEM rust is one of the most dreaded as well as the most destructive diseases of the small-grain crops of South Dakota and the entire spring-wheat area. This rust attacks wheat, oats, barley, rye and about 60 cultivated and wild grasses.

Stem Rust Losses High

It is a well-known fact that tremendous losses have resulted from stem-rust epidemics. Official estimates of the Office of Plant Disease Survey of the United States Department of Agriculture place South Dakota's annual stem-rust losses for wheat, oats, barley, and rye in the period 1915 to 1924, inclusive, at 9,737,700 bushels. In the past, ravaging stem-rust epidemics, such as those of 1904 and 1916, have far exceeded this figure. The acreage, production, estimated stem-rust losses of these crops for the ten-year period, and the average annual losses are given in Table I.

TABLE I.—TOTAL WHEAT, OATS, BARLEY AND RYE ACREAGE, PRODUCTION IN BUSHELS, AND ESTIMATED STEM-RUST LOSSES IN BUSHELS FOR THE STATE OF SOUTH DAKOTA, IN THE TEN-YEAR PERIOD 1915 TO 1924, INCLUSIVE.

<table>
<thead>
<tr>
<th>CROP</th>
<th>Acreage</th>
<th>Production (bushels)</th>
<th>Estimated Stem-rust Losses (bushels)</th>
<th>Average Annual Losses (bushels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>31,681,000</td>
<td>381,905,000</td>
<td>68,344,000</td>
<td>6,534,400</td>
</tr>
<tr>
<td>Oats</td>
<td>21,949,000</td>
<td>722,976,000</td>
<td>25,639,000</td>
<td>2,563,900</td>
</tr>
<tr>
<td>Barley</td>
<td>9,966,000</td>
<td>235,909,000</td>
<td>3,022,000</td>
<td>302,200</td>
</tr>
<tr>
<td>Rye</td>
<td>3,360,000</td>
<td>53,194,000</td>
<td>372,000</td>
<td>37,200</td>
</tr>
<tr>
<td>Total</td>
<td>66,956,000</td>
<td>1,393,984,000</td>
<td>97,377,000</td>
<td>9,737,700</td>
</tr>
</tbody>
</table>

Reliable estimates placed the losses in Minnesota and the Dakotas caused by stem rust in 1904 at $20,000,000. In 1916, the production of wheat in Minnesota, Montana, and the Dakotas was reduced by the barberry eradication campaign in South Dakota is conducted jointly by the South Dakota State College of Agriculture, the South Dakota State Department of Agriculture, and the Office of Cereal Investigations of the Bureau of Plant Industry of the United States Department of Agriculture. The writer wishes to acknowledge the assistance given by C. Larsen, Dean of Agriculture, and other members of the agricultural staff of the South Dakota State College, in preparing this bulletin. Credit is also due to field men for collecting many of the data.
duced by about 200,000,000 bushels from that of the previous year. The wheat produced in those states during these epidemics was of very poor quality. In 1916, the average yield per acre of wheat in South Dakota was less than seven bushels for a ten-year average.

**Black Rust and Red Rust**

Stem rust is sometimes called black rust because of the black color of the long spots or pustules which appear on the stems of grain plants just prior to harvest time. The black pustules are only one stage of the stem-rust disease but, because they appear at harvest time, they are most easily noticed and the disease has long been called black rust. Stem rust also is called red rust from the brick-red spots produced on the leaves and sheaths of the grain plant in the spring and early summer. These red and black spots are different stages of stem rust.

The terms "black rust" and "red rust" may be misleading when applied to the disease known as stem rust. These common names are used because of the color of the spots produced by the rust on the leaves and stems of plants. These spots may become so numerous that the plant appears to be covered with what looks like the well-known iron rust. (Fig. 1.) For that reason, many people have confused grain rust with iron rust. On the contrary, stem rust is a liv-

![FIG. 1.—BLACK STEM RUST ON GRAIN](image)

Note the masses of dark colored spots on the leaves of the grain. These spots are filled with spores (seeds) of the rust plant. The spores are carried by the wind to other grain plants. See how the rust breaks the outer layer of the grain plant, allowing the water to escape.
ing plant called a fungus. This tiny mold-like plant grows into and takes food from its host, the small-grain plant. Thus stem rust is called a plant parasite. Each stem-rust plant is so small that it can be seen only with a microscope. It differs from the ordinary plants in not having definite roots, stems, and leaves. In place of roots, the rust plant has numerous minute colorless threads, which grow among the cells of the host plant. These threads send suckers into the cells of the grain plant, thus obtaining food by absorbing the juices. In this way, stem rust steals the food which normally would go to make up plump, heavy kernels. In addition, the outer layer of the stems and leaves of the grain plant are broken, allowing large quantities of water to escape (Fig. 1). As a result, badly rusted plants produce shrunken or shriveled kernels of light weight and poor quality.

Life Story of Stem Rust

Stem rust has four stages in its development (Fig. 3). Three of these stages are produced on grains and grasses and the other on the harmful barberry. The red or summer stage appears on grains and grasses in South Dakota usually in the latter part of June. This stage of stem rust appears as brick-red spots or pustules on the leaves and stems (Fig. 1). An examination with the microscope will show that these spots are filled with numerous spores of the tiny rust plant. When these spores are distributed by the wind to other fields of grain, a new infection of stem rust is produced, if conditions are favorable for growth.

This disease develops so rapidly that in 7 to 10 days rust pustules appear on the stems and leaves of the newly-infected plants. The spores from these new pustules again may infect other grain plants. This process of spreading may be repeated over and over again as long as the grain remains green and weather conditions are favorable. In this manner, a small area infected with the red stage of black stem rust may help to start an epidemic. This repeating red, or summer stage, is the most destructive because of the rapidity with which the disease spreads.

When the grain begins to ripen, red spores are no longer produced, but in their place thick-walled, black spores are formed. This is the resting or black-spore stage in which the rust plant survives the winter. The black spores can live through severe winters, but numerous experiments show that the thin-walled red spores seldom, if ever, live through the winter and early spring months as far north as South Dakota, even under the most favorable conditions. Consequently, if the stem-rust plant survives the northern winters it must depend on the black spores.

Millions of black spores live through the winter on the stubble and straw of grains and grasses. In the spring, these spores germinate and produce the white or colorless stage of stem rust. The very tiny colorless spores of this stage, called sporidia, are blown about
by the wind. If any of these sporidia fall on grains or grasses they are unable to produce rust and soon die. Those sporidia which fall on the leaves of harmful barberry bushes germinate and may produce yellow or orange patches in which appear clusters of cups. This is called the cluster-cup stage (Fig. 2), and is the only stage on the barberry.

![Image of black stem rust on the barberry](image)

**FIG. 2.—BLACK STEM RUST ON THE BARBERRY**

*Note the cup-like spots on the leaves and fruit. These spots are filled with spores which, when blown to grain plants, start stem rust on the grain every spring.*

These cluster cups contain thousands of spores which are blown from the barberry by the wind. When these yellow spores alight on the leaves and stems of nearby grains and grasses, they produce the red rust stage. This again is the summer or repeating stage and completes the life story of the rust.

Thus there are the following four stages in the life of the rust plant: (1) the black or resting stage which lives over winter but which can produce only sporidia; (2) the colorless or sporidia stage,
FIG. 3.—LIFE STORY OF THE STEM RUST PLANT

This sketch shows how the rust plant lives from year to year. Follow the arrows. (Courtesy of A. F. Thiel, State Leader, Barberry Eradication, Nebraska.)
the spores of which can infect only the harmful barberry; (3) the spring or cluster-cup stage on the common barberry, the spores of which do not infect other barberries but do produce stem rust on grains and grasses; and (4) the red or summer stage on grains and grasses, which spreads from one grain field to another, but cannot infect the barberry.

**Weather and Stem Rust**

Although the weather does not cause stem rust, it is an important factor in every stage of the development of the disease. Stem rust is caused by a parasitic plant. The spores of the rust are, in a sense, its seeds. Abundant moisture and warm weather hasten development of the parasite. It is for this reason that in a season favorable to the spread of stem rust, a rust epidemic may destroy the small-grain crops in a relatively short time. In other years, stem-rust spores are able to develop only slowly and not enough rust is produced before harvest to materially damage the crop. Rust spores may be present in great number, but without favorable conditions they cannot bring about infection. Weather conditions cannot be controlled, but the barberry bush, which is necessary to the completion of the life cycle of stem rust, except in the extreme south, can and should be destroyed.

**The Common Barberry as a Menace**

From an early date, the common barberry has been convicted of spreading stem rust. About 1660, the people of Rouen, France, were so thoroughly convinced that the barberry caused their wheat to rust that they passed a law condemning the bush and causing its removal. Prior to the American Revolution, Massachusetts, Connecticut and Rhode Island passed laws requiring the destruction of common barberries. These people did not know the scientific facts regarding the relation of the stem rust to the barberry, but they did know from observation that small grains growing near barberry bushes became heavily rusted. In 1818, Schoeler, a German scientist, succeeded in infecting rye with rust spores from the leaves of the common barberry. This was the first proof of the relation of the barberry to the development of stem rust. His experiments were not accepted until 1865, when De Bary, another German scientist, further demonstrated the relationship. De Bary produced infection on barberry leaves with the sporidia produced by black rust spores that had lived over the winter. This infection resulted in the development of cluster-cup spores on the barberry leaves. With these cluster cup spores, he produced rust infection on wheat. He also discovered that when the sporidia were sown on grains or grasses they died. These experiments have since been repeated and confirmed by many rust specialists throughout the world, thus dismissing any doubt as to the part the common barberry plays in the perpetuation of black stem rust in northern climates.
Since 1865, common barberries have become rare in the grain-growing areas of England, much of Germany, Belgium, Holland, France, Spain, Italy, Austria, Czechoslovakia and Hungary. In these areas, stem rust no longer causes severe damage to grain crops. Where barberries have been allowed to remain, stem rust still is destructive.

![Diagram](image)

**FIG. 4.—SPREAD OF RUST FROM ONE SMALL BARBERRY**

This map shows how a small escaped barberry bush on the NW 1/4 section 29, Rutland township, Lake County, S. Dak., was responsible for a heavy infection of black stem rust on barley. The intensity of the dots represents the severity of the rust.

As barberries were introduced and became numerous in the midwestern wheat-growing areas of the United States, it was evident that they were the source of many local stem-rust outbreaks. These local epidemics have been noted in all of the principal small-grain states.

**Stem Rust and Barberries in South Dakota**

Many instances of the spread of black stem rust from common barberries to grains and grasses have been found and recorded in South Dakota. A small infected barberry bush may spread enough stem rust to cause serious damage (Fig. 4). Barberry bushes have been located by tracing the increasing severity of the stem-rust at-

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tack directly to them. Many of the best examples of the spread of rust from barberries are those which have been noted year after year by farmers living near the offending bushes. In South Dakota, one of the most outstanding examples of the relation of stem rust to barberries was noted near Lake Preston on the Evergreen Farms. In 1884, about 1,000 common barberry bushes were planted there, nearly all of which grew and fruited. The seeds were carried by birds and other animals to surrounding groves. Many escaped bushes grew from the seeds. In 1904, farmers of the community gathered and cut down these bushes, because they were convinced that these barberries were responsible for the severe stem-rust losses. The cut-off bushes soon sprouted and by 1917 stem rust again was found to be severe on the near-by grain fields. So evident was the relation between this barberry hedge and stem rust on the near-by grain fields that 27 farmers of the vicinity drew up and signed the following statement:

"Since the common barberry harbors the black stem rust of the wheat in the early spring and thereby starts an early and serious infection of rust, particularly because of the barberries on two farms south of town, which are known as the Evergreen farms, where for many years early and serious stem-rust infection has been noted, and is due to the presence of the barberries, we, the undersigned, believe that in order to protect the wheat crop of South Dakota from the rust infection caused by the common barberry there should be a special barberry law in South Dakota making it a crime to propagate, grow, or have growing on any public premises any of the common rust-susceptible varieties of barberry."

Other similar examples have been found in South Dakota (Fig. 5). Undoubtedly every planting of common barberries in the State has been a factor in the spread of stem rust.

HARMFUL AND HARMLESS BARBERRIES

The Common Barberry

The common or European barberry is an ornamental shrub, introduced from Europe. It is believed to have originated in the mountains of Central Asia where it still grows in its original wild condition. The earliest records of it trace back to about 650 B.C., when it was listed as a medicinal plant. Like many other plants of medicinal value, it was carried by man as civilization advanced. The barberry was one of the first shrubs introduced into the United States. It became well established in New England by the end of the seventeenth century and was carried westward by those who settled in the new areas. Records of many of the older plantings of barberry in South Dakota show that they were planted about the
STEM RUST AND THE COMMON BARBERRY

Time that the State was admitted to the Union. Later, many more thousands of barberry bushes were planted in the State. In 1919, a State law was passed prohibiting the sale of harmful bushes and providing for their eradication.

FIG. 5.—SPREAD OF RUST FROM A HEDGE OF BARBERRIES

This map shows how black stem rust spread from a hedge of barberries in 1920 on section 27, Sisseton township, Roberts County, S. Dak. The density of the shading is in proportion to the amount of stem rust in surrounding fields.

The common barberry (Berberis vulgaris L) is susceptible to black stem rust. It is a tall, erect shrub commonly about four to six feet high in South Dakota, but may grow to a height of 12 or more feet (Fig. 6). The bark is gray and furrowed. The roots and the wood beneath the bark are bright yellow. The leaves occur in clusters, are green or purple in color, and have bristle-toothed edges. Spines, usually in threes or more, are produced at the base of each cluster of leaves, although only one or two spines sometimes occur.
The red, oblong berries are produced in currant-like bunches (Fig. 7). The bright yellow flowers of this barberry usually appear in May in South Dakota.

**Other Barberries**

There are many other species and varieties of barberries. Not all of these are harmful. The Japanese barberry (*Berberis thunbergii* D C) which is not susceptible to stem rust, is a low, gracefully spreading bush (Fig. 6) seldom more than four or five feet tall. The smooth bark is reddish in color.

In contrast to the common barberry, the Japanese barberry has small leaves with smooth edges. The thorns usually are single but sometimes occur in twos or threes. The yellow flowers and the oval red berries grow singly or in small bunches of two or three, like gooseberries. The Japanese barberry is easily distinguished from the harmful barberry (Fig. 7). Because the Japanese barberry does not harbor stem rust it may be used in landscape gardening.

A closely related shrub, (*Mahonia repens*), is found native to the Black Hills of South Dakota. It is a low, spreading plant, seldom over ten inches high. Stem rust never has been known to occur on this plant.

Barberries which are crosses between the common barberry and other barberries may be found rusted. These plants, called hybrids, are harmful and should be destroyed. Hybrid barberries which do not rust may produce seed from which susceptible plants may grow. Many hybrid bushes are growing in South Dakota. These should be eradicated.

![FIG. 6.—HARMFUL AND HARMLESS BARBERRIES](image)

The common barberry (left) helps to spread stem rust. It should be destroyed. Note the tall erect habit of growth. The Japanese barberry (right) is harmless. It may be grown. Note its low, graceful habit of growth.
In spite of the fact that European countries had declared the common barberry a menace and were destroying it, the United States made no real cooperative effort to eradicate the bush until 1918. Because of the increasing frequency and destructiveness of stem-rust epidemics throughout the northern wheat-growing states, some means of controlling stem rust seemed imperative, if the growing of small grain, especially spring wheat, was to be continued. Many people in the United States had long recognized the possibility of controlling stem rust by the removal of the common barberry. Scientists, who had given the problem careful study, were convinced that the barberry played an important part in the spread of stem rust, and that the eradication of this bush would lessen materially the ravages of the disease. In the spring of 1918, the United States Department of Agriculture and 13 of the north-central, wheat-growing states began...
cooperation in a movement to eradicate all harmful barberries within those states. This area extends from Ohio to Montana and includes the states of Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin and Wyoming.

**BARBERRY ERADICATION IN SOUTH DAKOTA**

The eradication of the common barberry in South Dakota was started by the United States Department of Agriculture in April, 1918, in cooperation with the State College of Agriculture. A great deal of indirect aid has been given the campaign each year by the South Dakota Agricultural College. In 1923 and in 1925 State appropriations, supplementing the Federal appropriations, greatly aided the surveys. At the beginning of the campaign, it was thought that there were only a few barberries in the State, and that eradication would take only a short time. A preliminary survey of the larger cities was made in order to estimate the number of bushes. Surprising results were obtained. Sioux Falls alone had over 5,000 harmful barberries. Bushes were found in cities and towns in all parts of the State.

In 1919 the real task of systematically surveying for barberries was started. Nearly all the towns in the State were covered, and a rural farm-to-farm survey was begun in Lake County. The results of this county survey indicated the necessity of a farm-to-farm survey of the entire State. The barberry eradication law, making it a legal offense to grow harmful barberries, was passed in February, 1919. This law empowered the State entomologist to remove or order removed any and all harmful barberries from any property in the State.

**FIG. 8.—BARBERRY HEDGE IN WESTERN SOUTH DAKOTA**

This hedge of barberries was found in Fall River County. Similar hedges have been found in many other South Dakota counties.
Where Barberries Are Found

Barberries in South Dakota usually are found growing in yards, orchards, windbreaks, woodlots, cemeteries, parks, and other places where shrubbery is planted. However, they may be found also in out-of-the-way places, such as old cellar holes, between two closely situated buildings, in pastures, and along fence rows and streams, many rods from a house or grove. In such cases, the bushes have escaped from cultivation by means of seeds which have been scattered by birds, rodents, water, winds, and other agencies to distances of four or five miles from the fruiting bushes. In this manner, a few fruiting barberry bushes may be responsible for a large number of escaped bushes in a short time.

First Survey for Barberries

The preliminary surveys of 1918 and 1919 showed the necessity of a systematic rural and city survey for barberries over the entire State. This survey consisted of a property-by-property survey of the cities and towns, and a farm-to-farm survey in the country. An educational and publicity campaign was begun simultaneously with this survey. In this, the relation of the barberry to black stem rust was explained, and cooperation in finding and destroying these bushes was solicited.

In the first survey, completed in 1924, almost all of the large plantings of barberries in the State were found and destroyed. This removed the principal sources of stem-rust infection and a majority of the older, seed-bearing bushes were destroyed.

Difficulties of Survey

The experiences of the first few years of the survey showed that all properties on which barberries were found needed one or more re-inspections. These resurveys were necessary to insure the destruction of sprouts and seedling bushes. As a rule, a resurvey follows the first survey by about two years. Subsequent resurveys are necessary until the property is known to be cleared of all barberry bushes.

One of the most difficult problems of survey is the finding and removal of barberry bushes which have grown from scattered seeds. This problem is especially difficult because barberry seeds may be scattered over several miles in any direction from the original hedge. Often these seeds fail to germinate for three, four, or more years. After germination several years must pass before the barberry seedlings are of sufficient size to be easily found. Eradication is further complicated by the occurrence of barberry seedlings in inaccessible places. Seeds may be distributed in swamps, lowlands, rocky ledges, river lowlands, and in dense underbrush.

In Moody County, South Dakota, barberry seeds were scattered by birds and other animals from the fruiting bushes to 11 near-by
farms (Fig. 9). In Kingsbury County, barberry seedlings have been found distributed several miles in each direction from one hedge. New seedlings have been found on these farms every year for seven years since the fruiting bushes were destroyed. Over 100 similar instances of the spread of barberry bushes have been noted in South Dakota. More than 45,000 escaped barberry bushes and seedlings have been found and destroyed in this State.

**Chemical Eradication of Barberries**

Because of the difficulty in completely destroying barberry bushes, experiments were made by the United States Department of Agriculture\(^3\) to find a cheap and efficient method of killing barberries.

\(^3\)Thompson, Noel F., Chemical Eradication of the Common Barberry. Dept. Circ. 332, Dec., 1924.
Nearly 40 chemicals were used in these experiments. Crushed rock salt and kerosene are recommended. Salt is the more convenient to handle and is very effective. To kill a barberry with a diameter of 12 inches at the base, apply 10 to 15 pounds of crushed rock salt over the crown. The quantity of salt may be increased or decreased according to the size of the bush. The salt must cover completely the crown of the bush to insure its death. Kerosene is a much slower though equally effective killing agent. One gallon is required to kill a bush with a crown diameter of 12 inches. An advantage of kerosene treatments is that they are not molested by poultry or livestock, as often happens to salt treatments. The knowledge of these chemicals as killing agents has greatly reduced the time and money necessary to insure the complete destruction of barberry bushes.

Second Survey

As soon as the first survey had been made and the large harmful barberry hedges removed from the principal grain-growing areas of the State, a second survey was started in these areas. The second
survey is a thorough property-to-property and, where necessary, foot-by-foot survey of each city and rural property in the State. A second survey became necessary for several reasons: (1) Many barberry bushes cut off or improperly dug by property owners as a result of early publicity were missed on the first survey because of the inability of the field men to find them. After a few years the sprouts from the roots of these bushes became a menace to the small-grain crops. (2) Some escaped barberry bushes and seedlings could not be found on the first survey because they were so small. In the meantime some seedlings developed from seeds. These became large enough to spread stem rust. (3) Some bushes planted or growing wild in unusual places were not found on the first survey. A thorough second survey will find and eradicate the majority of these bushes and seedlings. It is necessary that the second survey be conducted before the sprouts and small bushes become large enough to bear seeds.

Second survey has been completed in about 19 counties in the eastern portion of the State (Fig. 11). A total of 2,216 barberry bushes and seedlings has been found on this survey. It has been possible to combine the resurvey and second survey activities in many counties. Second survey probably will be necessary in every county in which any large numbers of barberry bushes were found on first survey. The second survey already accomplished shows that many barberries were overlooked in the first survey (Fig. 11).

Results of Barberry Eradication

The results, in numbers of barberries found by counties in South Dakota, have far exceeded the expectations of those responsible for the campaign (Fig. 12). Over 125,000 bushes, sprouting bushes, and seedlings have been found on 1,212 properties in the State since the campaign was started. This number includes 59,811 bushes of which 20,878 were escaped bushes, 42,989 sprouting bushes, and 26,608 seedlings. Most of these were found in the eastern and southeastern part of the State. Some bushes were found in every county east of the Missouri river. Over 20,000 bushes and seedlings have been found in Minnehaha and Moody counties alone. Nearly 10,000 bushes and seedlings have been recorded for Kingsbury County. West of the Missouri river, the numbers of barberry bushes found were not great, but their general distribution was such that sources of stem-rust infection were distributed in general over the entire State. In Fall River County, over 2,700 barberry bushes and seedlings have been found. Some of these were spreading stem rust to cereals and grasses when found. In areas near these barberry bushes, stem-rust attacks were more severe than in other sections of the Black Hills region.

Some states of the barberry-eradication area have far exceeded South Dakota in numbers of barberry bushes found. Table II shows,
by states, the numbers of barberry bushes, sprouting bushes, and seedlings found in each state of the barberry eradication area. This table also gives the totals for each state and the grand totals for the 13 states.

**SOUTH DAKOTA**

![](image)

**FARMS HAVING BARBERRY BUSHES**
**TOWNS HAVING BARBERRY BUSHES**

**EXTENT OF SECOND SURVEY**

**FIG. 11.—SECOND SURVEY FOR BARBERRIES**

The areas covered by second survey to December 31, 1925, are indicated by the cross hatching. The dots represent the properties on which barberries were found on this survey. More second survey is necessary.

**TABLE II.—NUMBERS OF BARBERRY BUSHES, SPROUTING BUSHES, AND SEEDLINGS, BY STATES FOR THE PERIOD FROM APRIL 1, 1918, TO DECEMBER 31, 1925.**

<table>
<thead>
<tr>
<th>STATE</th>
<th>Bushes</th>
<th>Sprouting Bushes</th>
<th>Seedlings</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado</td>
<td>24,434</td>
<td>6,882</td>
<td>3,456</td>
<td>34,772</td>
</tr>
<tr>
<td>Illinois</td>
<td>328,956</td>
<td>15,151</td>
<td>1,741,538</td>
<td>2,085,645</td>
</tr>
<tr>
<td>Indiana</td>
<td>196,355</td>
<td>19,585</td>
<td>12,106</td>
<td>328,086</td>
</tr>
<tr>
<td>Iowa</td>
<td>793,847</td>
<td>21,636</td>
<td>49,564</td>
<td>865,047</td>
</tr>
<tr>
<td>Michigan</td>
<td>481,700</td>
<td>2,904</td>
<td>1,544,273</td>
<td>2,028,777</td>
</tr>
<tr>
<td>Minnesota</td>
<td>785,956</td>
<td>49,388</td>
<td>48,326</td>
<td>883,680</td>
</tr>
<tr>
<td>Montana</td>
<td>11,293</td>
<td>5,171</td>
<td>4,771</td>
<td>21,235</td>
</tr>
<tr>
<td>Nebraska</td>
<td>86,516</td>
<td>15,846</td>
<td>11,973</td>
<td>123,235</td>
</tr>
<tr>
<td>North Dakota</td>
<td>22,414</td>
<td>1,684</td>
<td>157</td>
<td>24,255</td>
</tr>
<tr>
<td>Ohio</td>
<td>292,142</td>
<td>17,942</td>
<td>530,836</td>
<td>840,920</td>
</tr>
<tr>
<td>South Dakota</td>
<td>59,811</td>
<td>42,989</td>
<td>26,908</td>
<td>129,408</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>3,404,253</td>
<td>90,902</td>
<td>1,335,367</td>
<td>4,830,522</td>
</tr>
<tr>
<td>Wyoming</td>
<td>4,176</td>
<td>575</td>
<td>53</td>
<td>4,804</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,500,893</td>
<td>290,655</td>
<td>5,308,938</td>
<td>12,100,486</td>
</tr>
</tbody>
</table>


Although fewer bushes have been found in South Dakota than in some of the states of the barberry eradication area, there is no state in which barberry eradication is of more importance. Fall-sown grains in the winter-grain states allow an earlier harvest and this tends to minimize stem-rust losses. In the great spring-grain area of North Dakota, Minnesota and South Dakota, harvests are later, and the rust started by the barberry bushes has a longer time in which to reproduce itself and to destroy these crops.

**Will Barberry Eradication Curb Stem Rust?**

The harmful barberry is the only plant known to spread the spring stage of black stem rust. The removal of all common barberries from the barberry eradication area will eliminate the most important source of stem rust infection. Investigations made by the United States Department of Agriculture show that red spores of stem rust commonly do not live over winter in the barberry eradication area. This means that stem rust either must start its growth on the barberry every spring in this area, or be blown into the State from outside sources. However, rust from outside sources usually arrives too late to cause much damage. Investigations have shown that the earliest and most severe epidemics of stem rust in South Dakota have been traceable to local barberries. The complete eradication of barberries in several communities in South Dakota has resulted in a most noticeable decrease in the amount of stem rust in each of these localities.

Definite control of stem rust in these 13 states cannot be expected until all of the barberry bushes in the entire area are found and destroyed. This is a tremendous task. The rust problem is one of long standing. Stem-rust control cannot be expected in a period of a few years. Time and continuous effort are necessary.

It is of the utmost importance that every person in South Dakota be able to recognize the common barberry. It is also his duty to report the location of all harmful barberries to the State College of Agriculture or the United States Department of Agriculture. Thorough eradication is essential to the success of the campaign. It can be accomplished only through the cooperation of the citizens of the State.

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Note—Aid in securing cuts was received from the United States Department of Agriculture and the Conference for the Prevention of Grain Rust, Minneapolis.
SUMMARY

Stem rust has caused enormous losses to the growers of small grain in the United States. South Dakota alone, from 1915 to 1924, inclusive, suffered a loss amounting to over 97,377,000 bushels of wheat, oats, barley and rye.

Stem rust is caused by a tiny plant parasite that grows on, and takes food from, its hosts, the small-grain plants.

The common barberry spreads stem rust during the spring and summer. The purpose of the barberry eradication campaign is to reduce stem-rust losses in the 13 north-central states by locating and destroying every common barberry plant in those states. These states cooperate with the United States Department of Agriculture in this project. Each of the states has a law requiring the destruction of all harmful barberry bushes.

Difficult problems have been encountered in the barberry eradication campaign. Because digging or cutting down the bushes usually does not kill them, chemicals are used as killing agents. Of these, crushed rock salt is the most satisfactory, cheapest, and most easily obtained. Barberries escape from cultivation by means of seeds scattered from fruiting bushes. Barberry seeds may lie dormant for several years in South Dakota before germinating. For this reason it is a difficult task to insure that every property is cleared of barberry bushes.

Frequent resurveys are necessary for a number of years after all the fruiting bushes have been found and destroyed. Not all bushes and seedlings can be found by a single survey. A second survey is necessary in all sections of the State where numerous barberries have been found.

The Japanese barberry does not rust and should not be destroyed. It is a beautiful bush of graceful, spreading habit and may be planted wherever desirable.

Several publications by the United State Department of Agriculture are available for distribution in South Dakota. If barberry bushes are found and severe local outbreaks of stem rust occur in your community, please report them. These reports and requests for publications should be addressed to South Dakota State College, Brookings.
FIG. 12.—NUMBERS OF BARBERSIES IN SOUTH DAKOTA
Map showing the number of barberries found by counties in South Dakota from 1918 to 1925. Upper figures bushes, lower figures seedlings.
FIG. 13.—PROPERTIES HAVING BARBERRY BUSHES IN SOUTH DAKOTA

The single dots on this map represent farms on which barberries were found. The dots surrounded by a circle represent cities or towns in which barberries were found. These barberries were destroyed from 1918 to 1925. Undoubtedly barberries will be found on more properties in South Dakota before the work is completed.