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## EC 128 Rev 1927 Reduce Stem-Rust Losses by Barberry Eradication

A. F. Thiel

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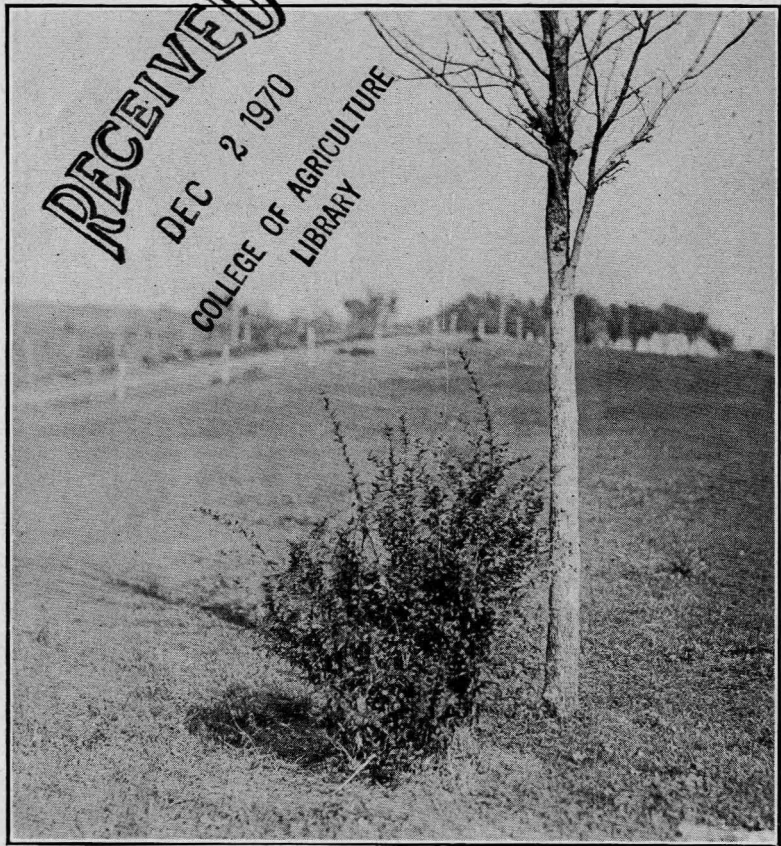
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July, 1927

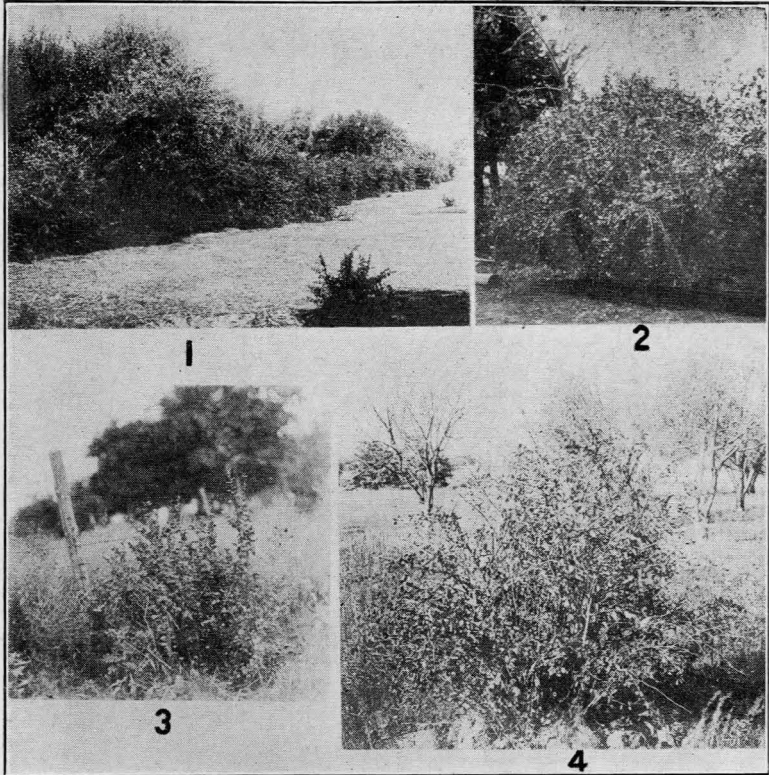
Extension Circular 1286 Revised -27

# Reduce Stem-Rust Losses by Barberry Eradication



An escaped common barberry bush. It spreads stem rust

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1. Part of a large common barberry hedge planted for a windbreak in an apple orchard. Farm of M. A. Harmer, Weeping Water, Cass County.
2. A common barberry bush found on the farm of Theodore Glesmann, Chalco, Sarpy County.
3. A common barberry bush planted along the fence on the farm of G. W. Beale, Carroll, Wayne County.
4. An escaped common barberry bush in an apple orchard. The planted bushes, from which the seed was scattered, were near the house, about  $\frac{1}{4}$  of a mile northwest. Farm of Paul Luebeke, Norfolk, Madison County.

## **Reduce Stem-Rust Losses by Barberry Eradication**

A. F. THIEL \*

The average annual-loss of all small grains due to stem rust in 13 principal grain-growing States of the Upper Mississippi Valley is estimated at slightly over \$60,000,000<sup>†</sup> for the ten-year period, 1917 to 1926. The average loss in dollars from this source for Nebraska alone is estimated at over \$2,900,000 annually for this period. One way to increase crop production is to reduce the great losses due to insect and fungous pests. Barberry eradication will eliminate all spore-material of stem rust which gets its start from the barberry in the spring. It is believed that this will materially decrease or eliminate the recurring losses due to stem-rust epidemics. The results already obtained in many of the States of the barberry eradication area indicate that, in localities where barberries have been completely eradicated, stem-rust losses have been reduced.

### **BARBERRY ERADICATION IN NEBRASKA**

The barberry eradication campaign in Nebraska was begun in the spring of 1918. At the same time similar campaigns were started in Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming. The demand for increased food-production during the late war and the enormous loss of wheat from stem rust in 1916, were chiefly responsible for the starting of the eradication campaign by the Office of Cereal Crops and Diseases of the United States Department of Agriculture, in cooperation with the Colleges of Agriculture, State Departments of Agriculture and other agencies in these 13 States.

### **PROGRESS OF BARBERRY ERADICATION**

Since April 1, 1918 every city, town, village and farm of the State has been surveyed for the common barberry. A second survey also was made in twenty-two of the eastern counties. The distribution and number of common barberries in each county is shown in Figures 1 and 2.

\* Associate Pathologist, Office of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, in charge of Barberry Eradication in Nebraska.

† Crop losses, official estimates of the Office of Mycology and Disease Survey, Bureau of Plant Industry, United States Department of Agriculture.

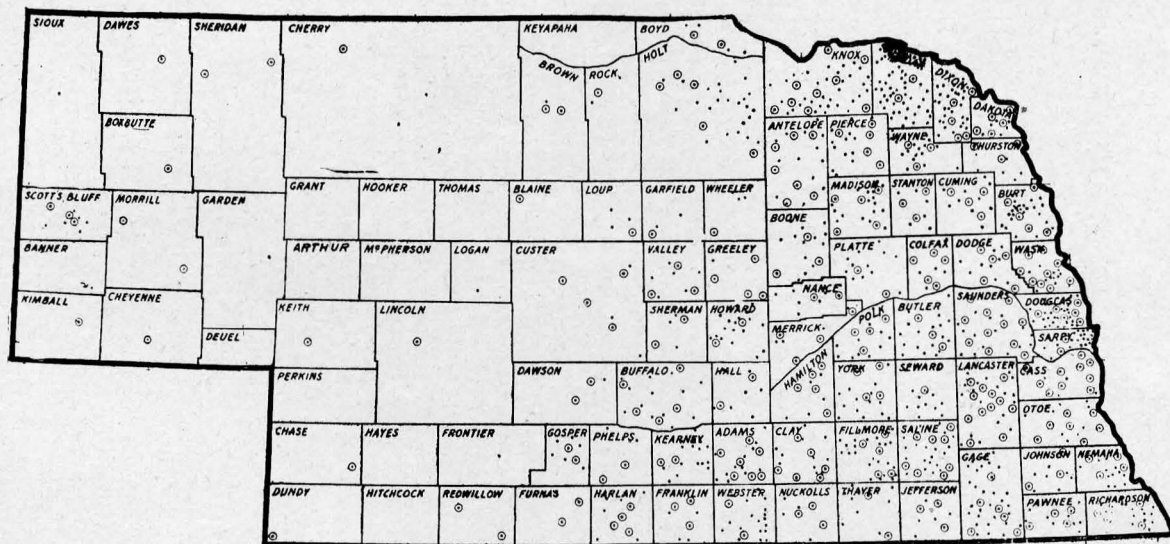


FIG. 1. Map of Nebraska showing the approximate location of properties on which barberries were found and destroyed, 1918-1926. Dots denote farms having barberry bushes. Circles with dots in them denote towns having barberry bushes.





Table 1

The number of barberry bushes and sprouting bushes found in cities and towns and on farms and all seedlings found in the 13 States of the eradication area from April 1, 1918 to December 31, 1926.

State	Number of bushes found		Number of sprouting bushes found		Number of seedlings found	Total found
	In cities and towns	On farms	In cities and towns	On farms		
Colorado ....	19,681	5,124	3,827	3,160	4,278	36,070
Illinois .....	113,381	257,056	4,816	16,626	2,140,409	2,532,288
Indiana .....	77,821	119,365	1,529	18,310	14,373	231,398
Iowa .....	651,077	153,085	4,009	23,942	173,959	1,006,072
Michigan ....	54,143	513,061	524	2,418	2,867,504	3,437,650
Minnesota ..	592,708	196,758	14,039	36,832	53,422	893,759
Montana ....	6,985	4,673	3,557	1,647	5,054	21,916
Nebraska ....	73,119	24,592	6,172	10,415	13,306	127,604
N. Dakota....	14,548	8,265	854	1,260	283	25,210
Ohio .....	219,624	111,844	5,666	12,276	705,203	1,054,613
S. Dakota....	23,746	36,806	20,980	22,045	26,791	130,368
Wisconsin ..	281,243	3,142,542	11,244	80,081	1,366,992	4,882,102
Wyoming ....	3,947	229	546	29	53	4,804
Total.....	2,132,023	4,573,400	77,763	229,041	7,371,627	14,383,854

**RELATION OF THE COMMON BARBERRY TO STEM RUST**

Stem rust attacks wheat, oats, barley, and rye. In addition to these cereal crops, there are about sixty different kinds of grasses which likewise are attacked. Stem rust is caused by a parasitic fungus or tiny, mold-like plant. It spends part of its existence on grain crops and grasses, and part on the leaves of the common barberry (Fig. 3). In the spring, usually about the middle of April in Nebraska, the black stem-rust spores which have overwintered on grain or grass stubble germinate and produce other small spores. These new spores are blown about by the wind. Those which fall on the leaves of the common barberry, germinate and enter the tissues of the leaves. They produce an infection called the cluster-cup or yellow-spore stage of the rust (Fig. 4, left). These cluster-cups are filled with thousands of spores which are likewise blown about by the wind. The cluster-cup spores which fall on grain plants germinate, if weather conditions are favorable, and infect the plant.

The rust infection, which has spread from barberries, usually appears on the grains or grasses about May 20 in this State. This early infection on the plants is the red-spore stage of the stem rust. Stem rust is usually found on the stems and sheaths of the grain plants, but it also occurs on the leaves and heads. It appears as elongated, reddish-brown pustules, (Fig. 4, right). The red spores from these pustules are blown about by the wind to other grain plants where, under favorable weather conditions, they germinate and in seven to ten days produce a new crop of spores. This process continues until the ripening of the grain or cool, fall weather make conditions unfavorable for the rust. Then the red spores are replaced by the black spores. The black spores are the winter spores and these remain dormant during the fall and winter on grass and grain stubble. The black spores cannot reinfect the grains or grasses but produce spores which can infect only the common barberry. If the barberry is eliminated, the life cycle of the rust is broken. Therefore, the eradication of the common barberry will prevent stem rust from getting a start from this source in the early spring in Nebraska.

**WILL BARBERRY ERADICATION ELIMINATE ALL STEM RUST?**

Investigations made by the United States Department of Agriculture show that the red spores of stem rust are able to live through the winter in the extreme southern and western parts of the United States. In those areas the rust is able to infect the new cereal and grass crops in the spring



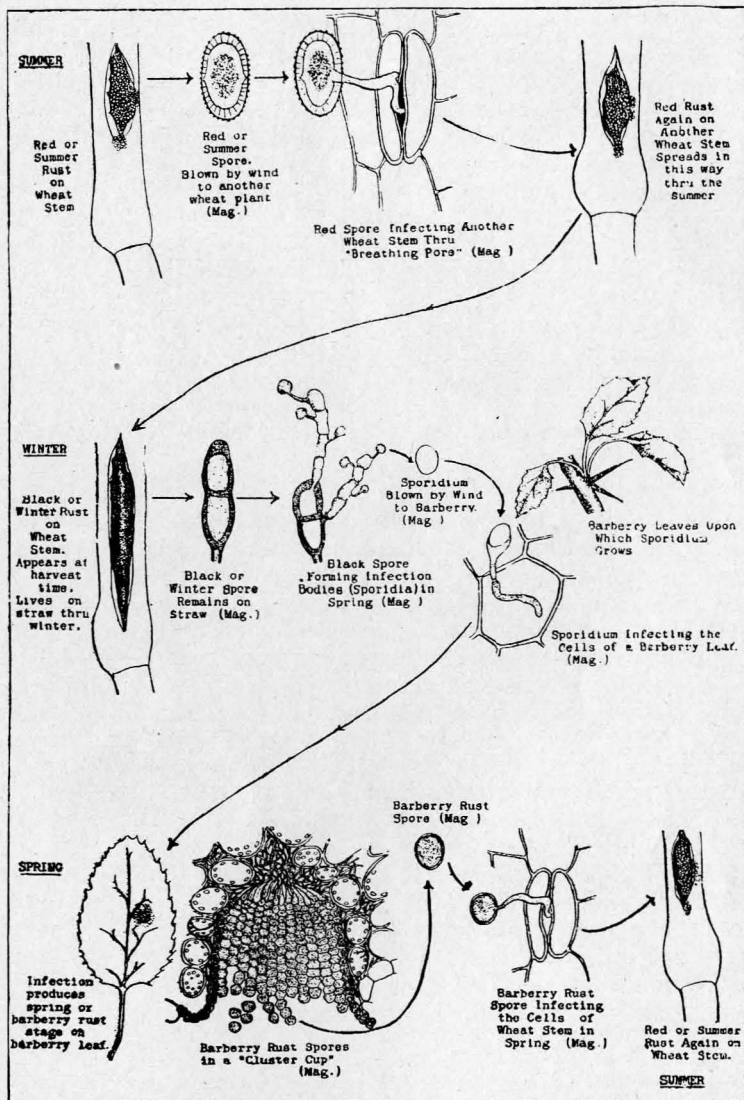


FIG. 3. Life story of stem rust of grain. Follow the arrows. (Mag.= magnified—as seen through the microscope).



TWIG FROM A COMMON BARBERRY BUSH (Actual Size)

Learn to know the common barberry by observing closely (1) the clustered leaves, either green or purple, with saw-tooth edges, (2) the thorns, usually three in number, below the leaf clusters, (3) the bunches of bright red, oval berries, (4) the grey, outer bark, and the bright yellow, inner bark.

The common barberry is a tall, erect shrub, usually four to eight feet in height. Originally it was introduced for ornamental purposes, but rapidly became naturalized and spread as birds scattered the seeds. Look for common barberry bushes wherever any bushes grow.

Reprint from Illinois Agricultural Experiment Circular 308, furnished by the Conference for the Prevention of Grain Rust.

without the aid of the common barberry. Experiments and observations made by the writer which have extended over a period of nine years show conclusively that stem rust does not overwinter in the red-spore stage in Nebraska. Many of the red spores perish early in the winter on account of the sudden changes of temperature. Those which survive germinate before the conditions are favorable for infections on grains or grasses.

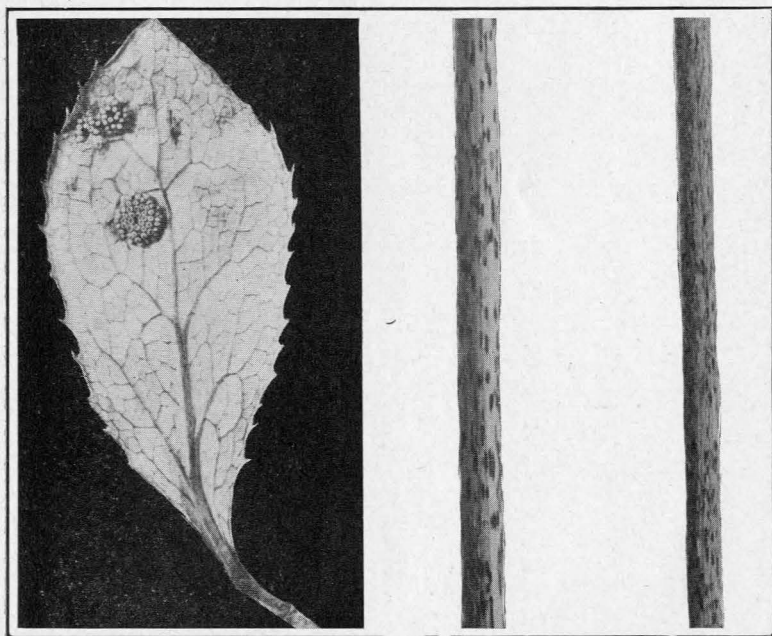


FIG. 4. (Left) Cluster-cup stage of stem rust on a leaf of the common barberry. (Right) Stems of wheat showing the elongated pustules of stem rust.

Barberry eradication may not eliminate all stem rust. Some of the rust which overwinters in the southern part of the United States may be carried northward by the wind and infect our grain crops. Observations made during the last six years show that some of the rust which develops in Nebraska comes from an outside source. The source of this rust material has not been determined. There are two sources from which stem rust arises in Nebraska. First, from cluster-cup spores from infected barberries, and, second, from stem-rust spores carried by the wind from rusted areas outside of the State.

The common barberry is the only plant known to harbor the spring stage of the stem rust. Its removal from Nebraska will eliminate one important and early source of stem-rust infection and severe stem-rust epidemics may no longer be possible.

#### HOW COMMON BARBERRIES SPREAD RUST

A typical case of the spread of stem rust from an infected common barberry is shown in Fig. 5. The first few pustules were found on wild barley near the two infected bushes on May 21, 1925. By May 25, a few pustules were found on winter wheat, a hundred feet north of the bushes. By June 24, the rust had spread over the entire forty-acre wheat field.

HAMILTON COUNTY, NEBRASKA

JUNE 24, 1925.

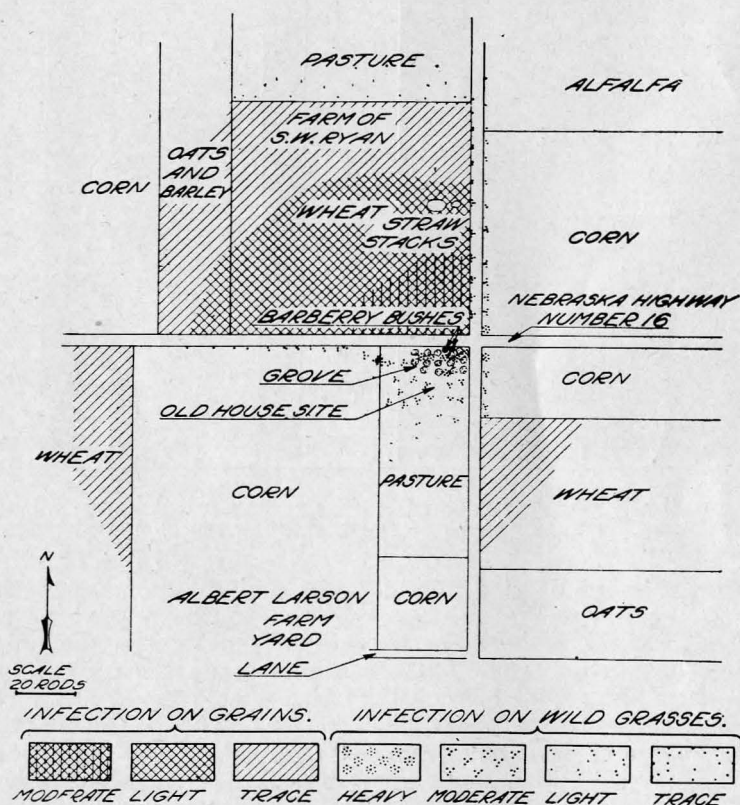


FIG. 5. Diagram showing the spread of stem rust from infected barberry bushes to winter wheat, Hamilton County, Nebraska. June 24, 1925.

The barley in the adjoining oat field also was rusted. The prevailing wind from May 20 to June 10 was from the south. This accounts for the heavier rust infection in the field toward the north. Stem rust was present in this field fifteen days before any stem rust was found which could not be traced directly to barberries.

During the past nine years, barberry infections were observed in 70 counties of the State. The weather conditions of each season are important factors in the spread of stem rust from barberries. Cool weather or hot, dry weather retard the germination of the spores. Hot, damp weather is ideal for their germination, and their reproduction under these conditions occurs every seven to ten days. Heavy dews furnish sufficient moisture for the germination of the spores. The general infection of barberries during the nine years shows clearly that they were a potential source of rust-infection material in every part of the State.

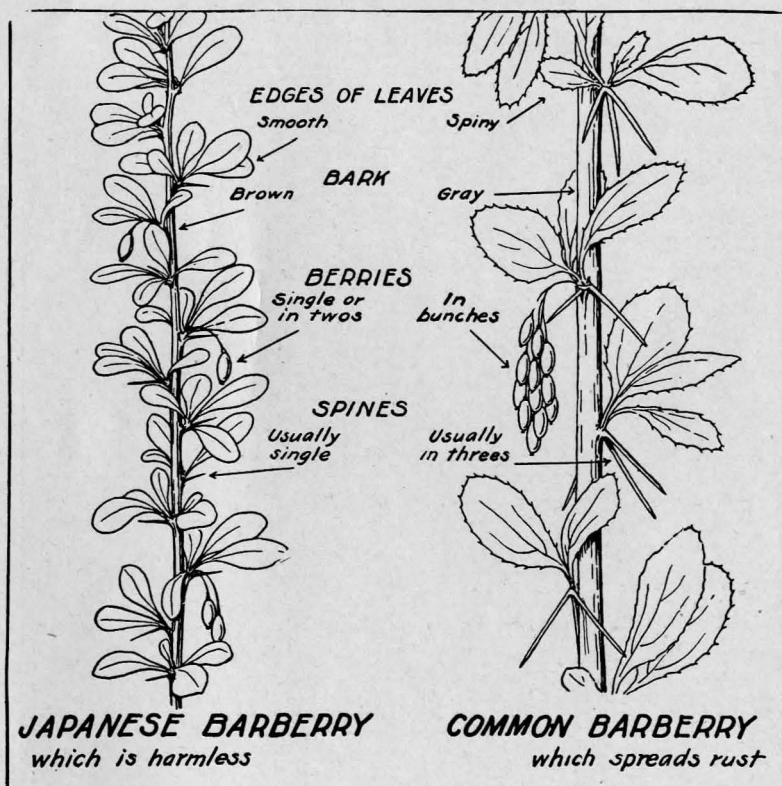


FIG. 6. Twigs of Japanese and common barberry showing the characteristic differences.



### THE COMMON BARBERRY AND JAPANESE BARBERRY CONTRASTED

The common barberry (*Berberis vulgaris* L.) including all green and purple varieties, usually grows to a height of 6 to 10 feet in Nebraska. Very old bushes sometimes attain a height of from 12 to 16 feet. The leaves have bristle-toothed edges. The yellow flowers and oblong red berries are borne in clusters like currants. The spines usually are in groups of threes or more. On young branches, the number of spines may vary from one to many (Fig. 6 and Plate 1).

The Japanese barberry (*Berberis thunbergii* DC.) does not spread stem rust and can be planted if desired. It is a beautiful bush (Fig. 7) which seldom grows more than 3 or 4 feet high in this State. The leaves are small and have smooth margins. As on the common barberry, the flowers of the Japanese barberry are yellow but the round red berries are borne singly or in small clusters of two, three or more. The spines generally occur singly or in twos (Fig. 6).

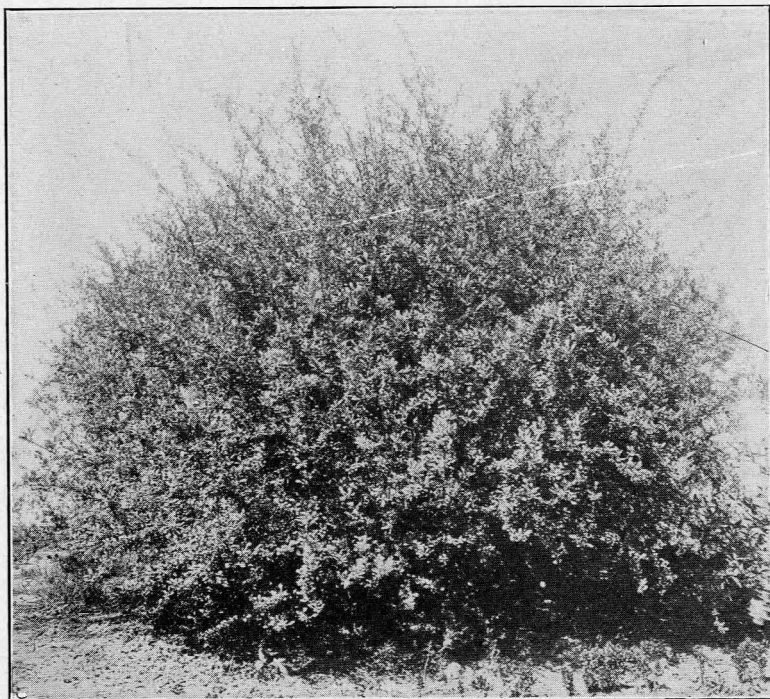


FIG. 7. A Japanese barberry bush. It does not spread stem rust.

PREVENT BARBERRIES FROM ESCAPING OR  
RUNNING "WILD"

The common barberry is not native to the United States. It was introduced from Europe by the early colonists. It was cultivated chiefly as an ornamental bush and for various drinks and jellies that were made from the berries (Fig. 8). In more recent years, it has become distributed over the whole country. Since nurserymen have learned about the harmful effects of the common barberry, they have cooperated by destroying their own bushes and in assisting in the destruction of the other bushes. The common barberry has escaped from cultivation in large numbers in all of the States of the eradication area. Various kinds of birds feed commonly on the berries and as a consequence seeds have become scattered in orchards, woodlots, brushy pastures, along fence rows, and on stream banks. In figure 9, and on the cover page are shown typical escaped common-barberry bushes. In the several Northern and Eastern States of the area over 4,000,000 escaped bushes have been found and destroyed. In addition more than 7,000,000 seedlings have been destroyed.

In Nebraska, 7,955 escaped bushes have been found on 151 properties. These escaped bushes were found in 38 of the eastern counties. The fact that escaped bushes and seedlings have been found in so many counties suggests what might happen in the future if barberries are not eradicated now. They would continue to spread and increase in such numbers that the production of grain crops would be seriously menaced by stem rust.

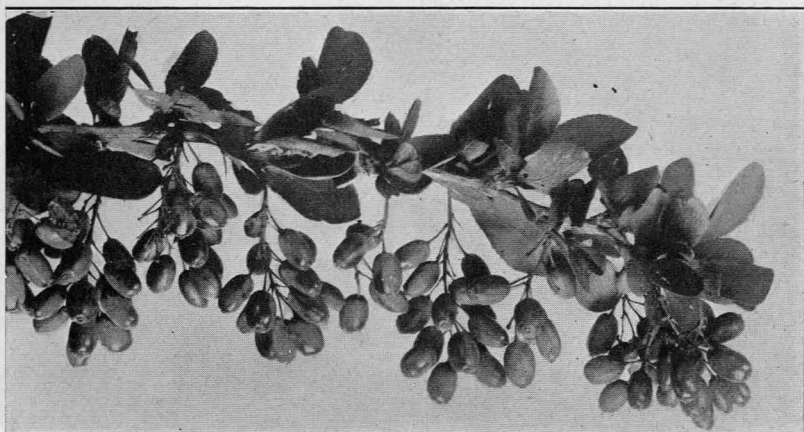


FIG. 8. A branch of the common barberry showing the clusters of berries.

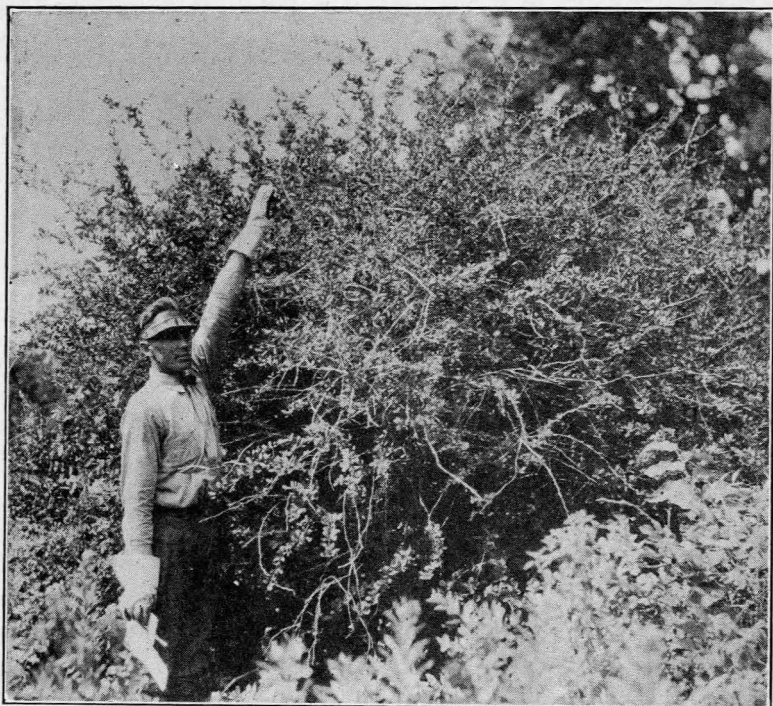


FIG. 9. A typical barberry bush which has escaped from cultivation through seeds scattered by birds. This bush was found along the Missouri River in northern Cedar County.

#### HOW TO DESTROY COMMON BARBERRIES

The best way to kill the common barberry is to treat it with either salt or kerosene. For bushes in which the clump of stems is approximately twelve inches in diameter at the soil surface, apply fifteen pounds of salt, or one gallon of kerosene. Proportionately more should be applied to larger and less to smaller bushes. Care must be taken to apply the chemicals around each shoot. The plants may be cut down before treatment, or they may be left standing. It is easier to find the place again when hunting for sprouts and seedlings if the bushes are left standing. These treatments are effective at any time of the year when the ground is not frozen. Farm animals, especially hogs and poultry, should not have access to salted bushes as too much salt may prove fatal to them. When livestock must be allowed access to salted bushes the salt should be covered with stones, brush, or dirt. As

salt and kerosene will kill nearby shrubbery as well as the treated barberry bushes, property owners should dig barberries which are within four or five feet of valuable shrubs or trees.

If barberries are dug, extreme care must be taken to get all of the roots. If even a small piece of root is left in the ground it may sprout. These sprouts will soon become bushes which will continue to spread stem rust.

#### HOW MUCH REMAINS TO BE DONE?

During the first few years of the Barberry Eradication Campaign, it was considered advisable to make a hurried survey of the State, in order to locate and destroy all of the large and conspicuous fruiting barberry bushes. This was done in order to eliminate the possibility of further barberry distribution through the scattering of seeds. The woodlots and fence rows were not sufficiently searched for barberries in this first survey.

In 1923, a more intensive survey was begun in order to locate and destroy the bushes missed on the first survey. Twenty-two counties have been covered in this intensive second survey. The remaining seventy-one counties must be similarly surveyed. Every foot of woods, whether planted or native, every fence row and stream bank must be searched for the common barberry. It is known that barberry seeds may lie dormant in the ground for seven years. This means that escaped areas, which have been surveyed, must be gone over several times in future years in order to find the new seedlings which may have come up from such seeds. In the early years of the campaign many barberry bushes were cut off, or dug by the owner. No record of these locations was sent to the officers in charge of barberry eradication. When bushes are cut off or poorly dug, they invariably sprout again. When the first survey was made, these sprouts were small and covered by weeds or by other vegetation. In many cases, they were missed by the field assistants. Since that time sufficient growth has been made so that they can easily be recognized. It is absolutely essential that every bush be found and destroyed. A single bush remaining in each county may be the source of local stem-rust epidemics. It also may be responsible for seeds being scattered, so that in time the barberries again would become widely distributed throughout the State.

An educational campaign is being carried on in the schools of the State, in order to acquaint the children and students with the characters of the common barberry and its menace in spreading stem rust. Boxes containing specimens of the



common barberry, the different spore stages of stem rust, and colored plates illustrating the life cycle of stem rust are available, and will be gladly sent to teachers requesting them. School children have reported the location of many barberry plantings as the direct result of this educational work. This cooperation is necessary for the complete success of the Barberry Eradication Campaign.

It is advisable to report the location of all barberry bushes to the Nebraska Agricultural Experiment Station at Lincoln, Nebraska, or to the United States Department of Agriculture, Washington, D. C. Even if the bushes are destroyed by the property owner, a report should be made. It is necessary to make resurveys to destroy sprouts or seedlings which may appear, and to locate escaped barberry bushes. Only through the cooperation of every citizen of the State can every barberry bush be found and its complete eradication be insured.