EXTENSION BULLETIN 260 JUNE 1944

BARBERRY ERADICATION

In Michigan

By J. H. Muncie and M. E. Turner

MICHIGAN STATE COLLEGE - EXTENSION SERVICE
EAST LANSING

Michigan State College and U. S. Department of Agriculture cooperating. R. J. Baldwin, Director, Extension Division. Printed and distributed under acts of Congress, May 8 and June 30, 1914.

Illustrations appearing in this bulletin are the property of the United States Department of Agriculture and are published with the permission of that agency.

Barberry Eradication in Michigan

By J. H. MUNCIE and M. E. TURNER***

INCREASED YIELDS AND IMPROVED QUALITY OF WHEAT, OATS, BARLEY and rye are benefits derived by Michigan small grain producers from the eradication of rust-susceptible barberry bushes. Prior to 1918 when the Barberry Eradication Project was started as a means of reducing yearly losses from stem rust, local epidemics of the disease were common, and often these local rust spreads merged to cause substantial regional crop damage. The barberry had become widely established in the state, and in some communities the plantings were so numerous that scarcely a grain field was beyond the reach of the early spread of the rust disease. The timeliness of the control program prevented further spread of this plant pest and contributed to the control of the greatest single hazard in the growing of small grains in Michigan. Progress that has been made can be maintained only through a continuous, concerted effort by interested agencies and individuals.

IMPORTANCE OF SMALL GRAINS IN MICHIGAN

Wheat, oats, barley and rye provide a substantial part of the farm income in Michigan and are fundamental in the economy of the state's agricultural industry. Cereals are basic to the products of flour and feed mills, bakeries, and malting plants. The important meat and dairy industries require quality feed grains to maintain high levels of production. Approximately 65 million bushels of wheat, oats, barley and rye, valued at 40 million dollars, are harvested annually. This represents between 20 and 25 percent of the total valuation of field and fruit crops grown in the state.

THE NATURE OF THE DISEASE

Stem rust is caused by a fungous plant that lives in the northern states on rust-susceptible barberry bushes and certain grains and grasses. The rust is spread between host plants by wind-borne spores. The fungus survives the winter in the black-spore stage on grain stubble, in straw piles, and on certain wild grasses. These spores cannot attack new crops of grains and grasses in the spring, but they infect susceptible barberry bushes, and the spring stage of the rust develops on the leaves. The rust spores from diseased

*Research Professor in Plant Pathology and Extension Associate Professor of Plant Pathology.
**Leader in charge of Barberry Eradication in Michigan, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

barberry leaves infect wild grasses and grain plants nearby, and the red or summer stage of the disease develops on these plants. Once this stage becomes established in grain fields, the rust spreads by means of wind-blown spores from plant to plant and from field to field over extensive areas. As the grain reaches maturity, the overwintering or black stage forms again on the ripened straw and grasses, thus completing the life cycle.

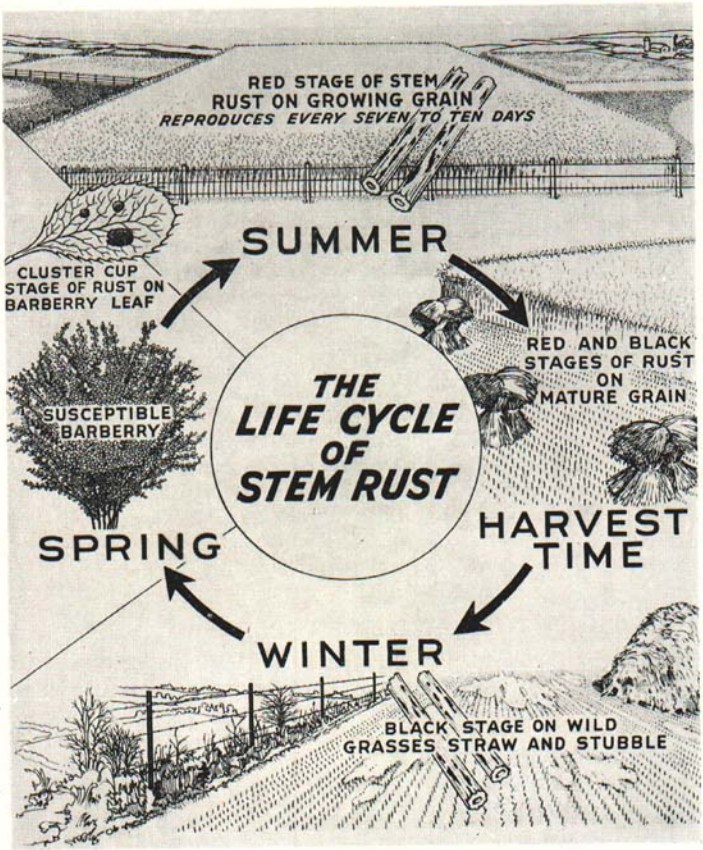

Fig. 1. Life cycle of stem rust of wheat, oats, barley and rye.

NEW RACES OF STEM RUST ARE PRODUCED ON THE BARBERRY

Just as there are many varieties of wheat, oats, barley and rye, there likewise are many varieties and races of the stem rust fungus. Certain varieties of grain are highly resistant to some of these rust races but very susceptible to others. New races are produced and old ones perpetuated on the leaves of barberry bushes. More than 200 different races of the rust fungus that may attack small grains have been identified. Most of these are of the wheat variety; however, there are at least 12 races that attack oats and 14 that may infect rye. Each is designated by number, and each may vary in its ability to attack the different varieties of small grain.

Plant breeders develop new varieties of grain by cross-breeding and by selecting carefully the desired types of plants. Considerable time, effort and skill are required to produce a new variety suitable for commercial use, and a continued effort along this line is necessary to improve further the quality, yield and disease resistance of all cereal crops. The problem of producing rust-resistant varieties of grain is complicated by the existence of so many different races of the rust fungus. The presence or absence of certain virulent races in different crop regions explains why the same variety of grain may appear resistant to stem rust in one region and entirely susceptible in

Fig. 2. Races of stem rust are produced by hybridization on the leaves of the barberry.

Fig. 3. Profit or loss—? The kernels on the left are from rust-free wheat plants.

another during the same year and under similar conditions favorable for rust development.

Progress has been made in the development of rust-resistant varieties. Although there are no known varieties of wheat, oats, barley or rye that are immune to all of the known races of the stem rust fungus, several varieties now in commercial production are highly resistant and have desirable agronomic characters. Additional varieties are being produced and will be distributed as seed becomes available in the future.

THE WEATHER AND STEM RUST

The kind of weather during a growing season greatly affects the development and spread of stem rust and the subsequent damage it causes to small grain crops. Infection takes place only when there is moisture present and the temperature is favorable for the germination of the spores. However, the disease cannot start either on the barberry or on grain crops and grasses unless the spores of the rust fungus are present.

The stem rust fungus is dependent upon the grain plant for its development; consequently, when the disease becomes severe, grain plants are robbed of food and lose water that would otherwise go to produce healthy and plump kernels. In fields where stem rust is heavy, often entire heads or parts of heads do not fill, and the kernels that are produced are shriveled and light in weight. Stem rust thus not only reduces yield but also affects the quality of the crop. Rusted grain that is badly shriveled often is not marketable and is suitable only as feed for livestock. Stem rust damages the crops after the major cost of production has been incurred.

SOURCES OF STEM RUST IN MICHIGAN

There are two sources of stem rust in Michigan: (1) the rust susceptible barberry bushes and (2) rust that is wind-blown into the state from infection centers in the states to the south.

Rust-infected barberry bushes are important early sources of stem rust

Fig. 4. Stem rust on barberry leaves.

infection in Michigan. The rust appears on the barberry during April and early May, and spreads from there to grains and grasses. The earliness of this initial infection permits the production of several crops of rust spores before the small grains mature. Every infected barberry thus becomes a focal point from which the rust is spread. After the initial infection takes place on the grains and grasses, the disease spreads independently of the barberry during the growing season from grain field to grain field throughout a community. If barberry bushes are numerous and well distributed through-

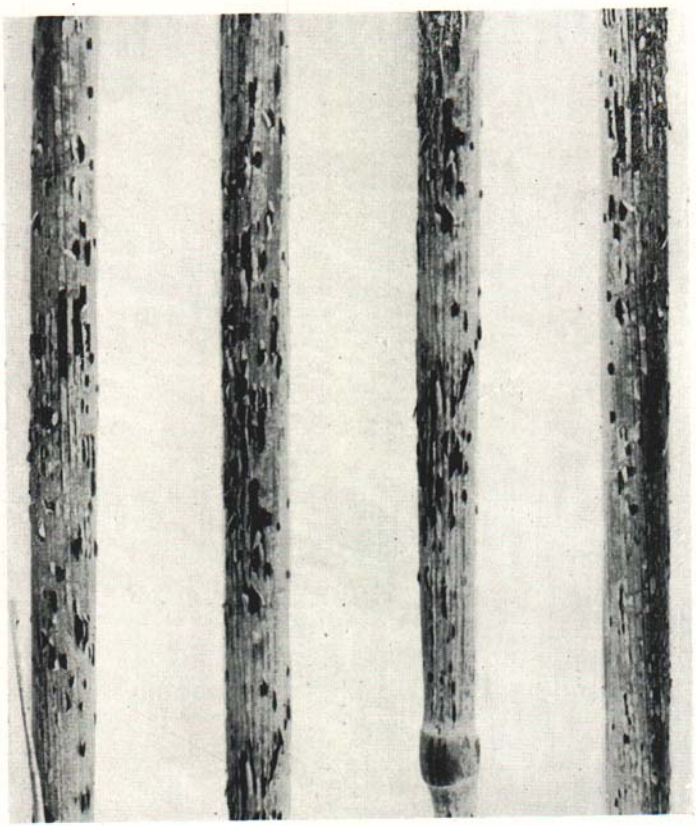

Fig. 5. Stem rust on wheat.

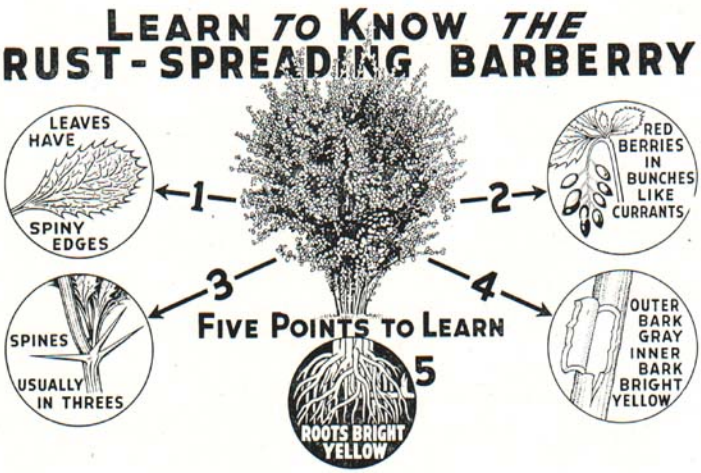

Fig. 6.

out a grain-producing area, many centers of infection that develop early in the spring may later merge and produce a widespread rust epidemic. The eradication of rust-susceptible barberry bushes eliminates the early spring stage in the life cycle of the fungus and prevents local outbreaks of the disease in important grain-producing counties.

There is another source of occasional stem rust epidemics in Michigan. Under favorable conditions, the rust fungus overwinters in the red stage on grains and grasses in northern Mexico and in Texas where the winters are mild. Crops mature early in the South, while farther north they ripen progressively later as the season advances. Some years when moisture, temperature, and crop conditions are favorable, rust increases on the grains in the South, resulting in the production of millions of spores. These spores are carried northward by the wind and infect the developing grain. Stem rust epidemics resulting from this source are infrequent in Michigan, but may occur any year, especially when crops are late.

RUST-SUSCEPTIBLE BARBERRY BUSHES ARE EASILY RECOGNIZED

The rust-susceptible barberry is a shrub that has a growing habit that resembles the lilac or honeysuckle. The leaves have fine, saw-toothed edges, grow in clusters on the stems, and may be either green or purple. Directly beneath each leaf cluster there are from three to five thorns. Mature bushes

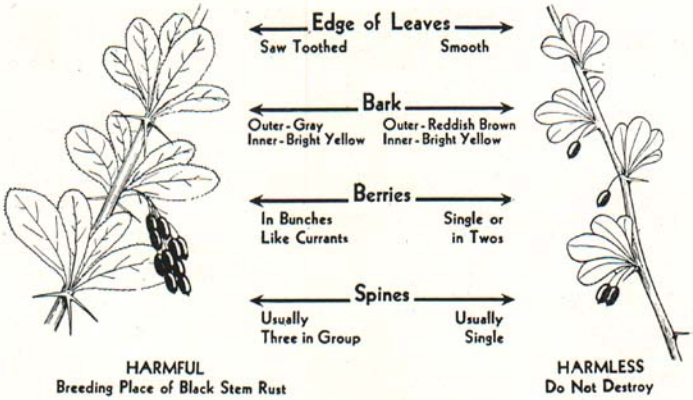

Fig. 7. By examining the leaves, thorns, berries and roots, one can easily distinguish barberry bushes from other shrubs.

have small yellow flowers in the spring, and in the fall oval red berries are produced in clusters like currants. The outer bark of the shrub is gray, and the inner bark and roots are bright yellow.

The Japanese barberry is grown widely in Michigan as an ornamental plant. This and a few other species of barberry bushes are immune to the stem rust fungus and thus can be propagated without restriction. The Japanese barberry is a low-spreading shrub, seldom more than 4 or 5 feet tall. The bark is reddish brown, and the small spines grow singly or in threes. The leaves have smooth edges, and the flowers and berries closely resemble those of the susceptible barberry except that they generally occur one or two in a place.

BARBERRY BUSHES ARE COMMON IN MICHIGAN

The susceptible barberry found in Michigan was brought into the state by early settlers, beginning about 1850, for hedge and ornamental use. From these and other plantings as late as 1918, the bushes became generally spread by birds and other agencies to orchards, woodlots, pastures and wooded ravines, and along stream banks and fence rows. In the course of the eradication work that has been done, more than six million barberry bushes have been destroyed on 17,165 properties scattered over the state. Bushes have been found in 82 of Michigan's 83 counties.

Seed of the barberry may lie dormant in the ground for 10 or more years; consequently, old established areas of infestation present a problem for several years following the first survey. Areas where there is an abundance of seed

in the soil must be reworked periodically, usually at five-year intervals, until there is no further evidence of regrowth. The reworking of territory is planned to prevent the production of fruit on new bushes after they develop from seed.

PROGRESS IN THE CONTROL OF STEM RUST

The comprehensive control program which includes barberry eradication and other control measures has been responsible for an appreciable reduction in annual stem rust losses. During the period 1916-29, annual losses in the 13 states originally included in the control area amounted to 47 million bushels of small grain, whereas for the 14-year period 1930-43, the annual loss approximated only 24 million bushels. In Michigan the results are even more significant. Statistics show that the annual loss due to stem rust in Michigan prior to 1928 exceeded 2,600,000 bushels of small grains. During the period since 1928, this loss has been less than 550,000 bushels each year.

SALT OR KEROSENE USED TO KILL BARBERRY BUSHES

Rust-susceptible barberry bushes have a spreading type of root system and a profuse development of underground stems that arise from the roots and from the crown. From these underground stems, shoots are produced that develop into new bushes. This characteristic of the barberry complicates its eradication and necessitates the use of methods that kill all the underground parts of the plant.

Fig. 8. Barberry regrowth in wooded pasture.

Common crushed rock salt applied at the rate of .10 pounds for each square foot of crown surface is recommended for killing barberry bushes. The salt is readily available, inexpensive, and is an effective herbicide. In yards or pastures where livestock or poultry might eat an excessive amount of the salt, kerosene can be used with equally effective results. An application of kerosene at the rate of one gallon for each square foot of crown surface is recommended.

Fig. 9. Status of survey in Michigan.

Salt or kerosene should not be used to treat bushes found in lawns or near valuable trees or shrubs. Digging is effective if all underground parts of the plant are removed. However, for large scale operations, this method is expensive and inefficient.

FARMERS SHOULD PRACTICE EVERY KNOWN METHOD OF CONTROL

The reduction of stem rust losses requires the application of all known preventive measures. Once the disease becomes established in a grain field, there is no practical control. The following approved practices are recommended to Michigan grain growers.

1. *Eradicate Rust-susceptible Bushes* — All rust-susceptible barberry bushes should be destroyed. A single barberry growing in a community may be responsible for considerable damage to grain crops, as well as the production of seed from which new bushes can grow. Every barberry bush is a potential source of races of the stem rust fungus, some of which may attack varieties of grain now resistant to the prevalent races.

2. *Use Approved Rust-resistant Varieties of Grain*—Plant breeders have made remarkable progress in the improvement of small grain varieties. By combining the desirable characters of parent stock, hybrids have been produced that have resistance to the common cereal diseases, improved agronomic qualities, high-yielding ability, and qualities that are acceptable to the milling industry. Improved varieties of wheat, oats, barley and rye recommended by Michigan State College should be grown if seed is available.

3. *Practice Approved Cultural Methods*—Spring crops should be sown early and, insofar as possible, farmers should grow only early-maturing varieties. Generally speaking, the earlier a grain field matures, the greater are its chances of escaping damage from stem rust. Winter crops should be sown according to the recommended seeding dates. Too early or too late seeding may increase losses from hessian fly, root rot, or winter injury.

THE PROBLEM IN MICHIGAN

Initial intensive survey and eradication work has been completed in 32,941 square miles in Michigan, and the remainder of the state comprising 24,540 square miles has been given a cursory coverage in order to eliminate obvious barberry plantings and to effect stem rust control over the entire state. The future program will include the reworking of 7,397 square miles where new bushes have developed from seed since the original intensive survey and a systematic survey of 12,385 square miles where only cursory work has been done. Of the total area of the state, 37,699 square miles are now on maintenance and will require no future organized work.

BARBERRY ERADICATION IN MICHIGAN IS A COOPERATIVE PROGRAM

Barberry eradication in Michigan is administered by the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, in cooperation with the State Department of Agriculture and Michigan State College.

Michigan State College and U. S. Department of Agriculture cooperating. R. J. Baldwin, Director Extension Service, Michigan State College, East Lansing. Printed and distributed under acts of Congress, May 8 and June 30, 1914.

10M