REPORT OF THE PROGRESS IN BARBERRY ERADICATION TO DECEMBER 31, 1924

PROJECT REPORTS

RUST INVESTIGATIONS
(Dr. H. B. Humphrey, Pathologist in Charge)

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INTRODUCTION

The barberry eradication campaign, as a means of controlling stem-rust epidemics, was started by the Office of Cereal Investigations, Bureau of Plant Industry, United States Department of Agriculture, in 1918. It is conducted in cooperation with the following north-central, grain-growing States: Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin and Wyoming. By removing the barberries from this area it is hoped to eliminate entirely the small local epidemics which are directly traceable to common barberries, and to remove the many sources of inoculum of the large epidemics which frequently cause immense small-grain losses.

Similar barberry eradication campaigns have been carried on by many European countries in the last two hundred years. The most notable of these is the campaign begun in 1903 in Denmark where stem rust had previously done serious damage. Practically no stem-rust attacks have occurred in that country since the removal of the offending barberries. Eradication campaigns in other countries have not been entirely successful because careful surveys were not made and the laws were not rigidly enforced. but in many local areas beneficial results have followed immediately upon the removal of the common barberries.

ORGANIZATION

Some preliminary publicity and organization of the campaign was done in the spring of 1918, with a portion of the special appropriation for "Stimulating Agriculture." The first direct Federal appropriation, $150,000, became available July 1, 1918. A State leader was appointed to take charge of the work in each of the 13 States. The State leader's duties are to supervise the work in the State, following the general plans outlined by the Office of Cereal Investigations. He must make contacts with State officials who cooperate in the work, direct the various phases of the campaign within the State, hire field assistants, arrange for transportation of men and chemicals, plan and supervise the surveys, and compile reports of the work. Annual appropriations averaging $254,337.85 and totaling $1,780,715, have been made. State cooperation in cash and services equivalent to a total of about $464,000 has helped to make the work more effective.

PUBLICITY AND EDUCATION

Publicity has been carried on in each State under the direction of the State leader or a specially trained assistant, in cooperation with the Conference for the Prevention of Grain Rust. Besides an attempt to spread barberry eradication publicity generally throughout each State, efforts have been made to thoroughly familiarize every citizen of each county with the purpose of this campaign just previous to the original survey in that county. After the survey in a county is completed the public has been informed of the results.

Publicity through schools has been especially emphasized during 1924. The cooperation of Smith-Hughes instructors and city and county superintendents of schools has made it possible to train many of the school children to identify the common barberry and the stages of stem rust. Sixteen sets of a lantern-slide series, "Kill the Common Barberry," and a number of prints of the motion picture films "The Barbarous Barberry" and "The Battle Against Black Stem Rust" have been circulated so that people could learn to know the characteristics of the common barberry and see the damage that it does by spreading stem rust to small-grain crops. Demonstrations and portable window displays have been used in all of the States to emphasize the necessity of removing barberries. Circular letters have been sent to at least half of the rural property owners in many of the States. Numerous newspaper articles have been published in each State. These show the purpose and summarized results of barberry eradication and tell especially of the removal of large bushes and hedges which have been shown to have caused serious local stem-rust losses.

The Conference for the Prevention of Grain Rust, composed of representatives of agricultural and allied interests, has cooperated in every way to make the publicity campaign more effective. Over one million copies of the circular "Farmer Brown Beats the Rust" were distributed to the farmers of the small-grain growing States. Special statements to business men, charts ofor use in schools and window displays have been effectively distributed. During the past year the Conference has distributed thousands of samples of common barberry twigs for use in identifying the bush. The United States Department of Agriculture and the Conference for the Prevention of Grain Rust have distributed a total of approximately five million bulletins and circulars relating to the barberry eradication campaign.

State circulars and bulletins have received a very wide distribution within each of the States. The State leaders also have published reports and articles in cooperation with the State Experiment Stations, Extension Services, and allied Agricultural College departments.

SURVEYS

Original Survey

The original survey is the first complete survey of every city and village property and farm in a county. The thirteen States in the eradication area contain 976 counties. Original survey appears to be necessary in an area equivalent to about 895 counties. The original survey in cities and villages was largely completed in the first two years of the campaign. Rural survey was begun in 1919. In cities, survey was done on foot. Rural farm-to-farm survey made it necessary to procure other means of transportation so that every farm might be visited and the barberries economically found and eradicated. In order that tools and chemicals for eradication might be transported also, fifty-two light trucks were purchased. for use where there was a long seasonal period of survey. Additional cars were rented during the summer months when weather conditions and available trained field men made it possible economically to increase the field force. Rented automobiles also have been used in areas where the surveys are nearly completed.

Since April, 1918, practically all city and village properties and all rural properties in 786 counties have been covered by the original survey. The first survey has been completed in Indiana, Iowa, North Dakota, South Dakota, Wisconsin and Wyoming, and practically completed in Colorado, Minnesota and Nebraska. There still remain 59 counties to be surveyed in Illinois, 22 or more in Michigan, 20 in Ohio and 10 or more in Montana. To December 31, 1924, a total of 6,358,343 barberry bushes has been found on 68,465 properties. Of these, 63,026 properties have been entirely cleared of 5,458,159 bushes. During the year 1924, 295,814 bushes were found and 388,632 were destroyed.

Second Survey

Local stem-rust epidemics of 1922 and 1923 in counties which had been covered by an original survey, made it apparent that some barberries had been missed in some of the counties previously surveyed. Especially did the necessity of a second survey become apparent during 1923 when many local stem-rust epidemics were traced directly to the offending barberry bushes. With information gained in previous surveys, the methods of farm-to-farm survey during 1923 and 1924 have been made more efficient to prevent, as far as possible, any bushes being missed. On second survey it is hoped to get every bush previously missed. One of the problems of second survey has been the escaped bushes and seedlings not found on the original survey. The problem of seedlings must be contended with continually on second survey and resurveys. Revisits must be made to all properties where escaped bushes and fruiting bushes have been found. Areas of escaped bushes or areas in which it is probable that birds, other animals, or streams have spread the seeds must be gone over carefully so that all new seedlings and missed bushes are eradicated. If maps of these areas have been made they must be checked to make sure the outer boundaries of the areas are included. If no maps have been made this must be done. By this means the expense of subsequent resurveys is reduced to a minimum and little or no stem-rust inoculum is allowed to spread from these barberries to the small-grain crop. On the basis of bushes found on the second survey so far accomplished the original survey was about 92 per cent efficient. Many of the bushes found on second survey are bushes that were cut down but not killed by property owners in the beginning of the campaign. The locations of these cut bushes were not reported and the field men often were unable to find them. Sprouts appeared later and the bush again spread stem-rust inoculum.

In the equivalent of 60 counties, 4,841 bushes were found on 695 properties in second survey in 1924, and 5,023 bushes were destroyed on 699 properties. In addition, 8,703 seedlings were found and destroyed on 46 of these properties.

From the beginning of the second survey in 1922, to December 31, 1924, an area equivalent to over 111 counties has been covered by second survey. A total of 10,106 bushes was found on 1,003 properties. Of these, 10,086 bushes have been destroyed. All of the 9,579 seedlings found on 54 of these properties were destroyed.

The data on properties, bushes and seedlings for the second survey are included in the tables of data for the original survey as the bushes and seedlings found in new locations on second survey are new. Sprouting bushes and seedlings found in old locations are given under resurvey.

Barberry bushes usually sprout the year following digging and within two years after chemical treatment, where the chemicals have not destroyed all stems. This necessitates a revisit to every property upon which barberries have been previously found. Resurveys do not follow the original survey for at least two growing seasons, thus allowing time for any living roots to sprout and for scattered seeds to germinate. In many instances several resurveys are necessary. During the second surveys of 1923 and 1924 it was necessary to resurvey a large number of properties on which barberries had been previously located in many of the counties. Combining these two activities in this way in those counties, practically eliminates the expense of one resurvey. As a rule, resurvey will be combined with the second survey in those counties where a second survey is necessary.

From January 1 to December 31, 1924, a total of 21,852 sprouting bushes were found on 1,960 properties in the equivalent of 203 counties in which resurvey activities were carried on. Of these sprouting bushes 6,616 were dug and 15,234 were treated with chemicals, making a total of 21,850 sprouting bushes destroyed during the year. Many new seedlings were found on properties from which the fruiting bushes had been removed three or more years previously. A total of 188,612 seedlings was found and destroyed on 564 properties.

In the entire campaign, 273,619 sprouting bushes on 10,925 properties and 2,185,216 seedlings on 3,394 properties have been found. Of these, 272,593 sprouting bushes and 2,135,216 seedlings have been destroyed.

ERADICATION

Until the fall of 1922, barberry bushes were either dug or pulled with horses and tractors, and seedlings were pulled by hand or dug. Numerous sprouts developing indicated that pulling and digging were not effective methods of eradication in a majority of instances. Although digging is very effective in a loose sandy soil, it is almost impossible to remove barberries which are growing in rocky soil, near tree roots, or in rock crevices, without leaving some roots. As even small portions of roots may sprout, every remaining root fragment is a potential rust producer.

To increase the efficiency of eradication, experiments with chemicals were begun in the fall of 1921. Of over forty chemicals used experimentally, only crushed rock salt and kerosene are recommended since they are effective, cheap, and easy to obtain and apply. Sodium arsenite was used for several months during 1923 but its use was discontinued because of the danger to livestock. Kerosene is very effective. The disadvantages of its use are that it is hard to tell which ones of a group of bushes have been treated and that the treated bushes do not die immediately following treatment. It is not advisable to use kerosene when the bushes should be killed immediately as infected bushes can spread inoculum for a time after kerosene treatments. During 1924, 13,358 gallons of kerosene were used in barberry eradication. Practically all of this quantity was used in Ohio, Michigan and Nebraska. Barberry bushes die about two weeks after the application of salt. Salt is easily applied and can be conveniently transported in the Government-owned trucks. There is very little danger to livestock in the use of salt if the animals are not allowed to eat too freely of it. Poultry are very likely to be killed by eating salt. To prevent this it is advisable to cover the base of all treated bushes with dirt.

INVESTIGATIONS

Ecological Investigations

The relation of environment to the distribution of barberry bushes has been studied in the 13 States of the barberry eradication area, and in the New England States, New York, New Jersey and Pennsylvania. Particular attention has been given to areas of escaped barberries throughout these States. Colorimetric analyses of soils were made and data compiled on the several floristic and ecologic factors which characterize certain areas of escaped barberry bushes. The size and vigor of the bushes in the States bordering the Great Lakes and in northeastern Iowa indicates that the common barberry has reached its greatest development in those areas. The two chief factors limiting growth seem to be soil reaction and moisture. In the Great Plains portion of the eradication area the bushes do not attain the height of those in the Great Lakes region, as the climate is too dry. Observations indicate that while barberries are tolerant to acid soil conditions, escaped and native barberries are usually distributed only on limestone or neutral soils. A manuscript in preparation will summarize the results.

Study of Barberry Species and Hybrids

A Berberis garden has been established near Bell, Maryland, in cooperation with the Office of Horticultural Investigations, wherein all known foreign and native species and hybrids of Berberis are being assembled for description and classification. A sufficient number are being propagated so that the susceptibility of all of these species and hybrids can be determined at St. Paul, Minnesota, under controlled conditions. The literature has been searched, herbarium material examined, field observations made and greenhouse specimens studied for evidence of the susceptibility of various species. Some of this data has been summarized by E. C. Stakman and M. N. Levine, in "A Partial Report of the Susceptibility and Resistance of Berberis and Related Genera to Stem Rust." Cereal Courier 15: 278-287, September 30, 1923. L. W. Melander has added to this information in connection with the preparation of a master's thesis, "Studies of the relation of Berberis species to Puccinia graminis Pers.," unpublished Master's Thesis, University of Minnesota, June, 1924. Having once determined the susceptibility or immunity of all species and hybrids of Berberis, these important data can be used in regulating their transportation and sale. Native species of barberry also are being studied in their natural habitat and effective methods of eradication of susceptible species determined. A species which appears to be Berberis canadensis Miller was found along the Tippecanoe River in Carroll, White and Pulaski counties, Indiana. In 1924 a small area was found along Wild Cat River in Tippecanoe County, Indiana, and another area along the banks of Spring Lake near the Illinois River in Tazewell County, Illinois. Previously this species was not known to be growing in the eradication area. Its occurrence had been reported in the Appalachian region of Virginia, West Virginia, the Carolinas, and Georgia and in the Ozarks of Missouri. Berberis canadensis Miller is naturally susceptible and spreads stem rust to grains and grasses. In certain localities it is a great menace to small-grain growing and should be eradicated. Limited experiments show that bushes of this species may be eradicated by the application of salt or kerosene.

Effect of Chemicals on the Soil

Chemical studies and observations have been made of the soil-sterilizing effects of salt, kerosene, and sodium arsenite used in killing barberries. The results are summarized in Department publications, "Chemical Eradication of the Common Barberry," U. S. Dept. Agr. Circ. 332, by Noel F. Thompson (in press), and "Some Effects of Sodium Arsenite When Used to Kill Common Barberry," U. S. Dept. Agr. Bul. 1316, by E. R. Schulz and Noel F. Thompson (in press). In the treatment of barberries either 10 pounds of salt or a gallon of kerosene, applied to about one square foot area of soil, will kill all surface vegetation in that area. On fairly level land the sterile area ordinarily will not be larger than the area treated, that is, the sterile area resulting from the treatment will not be more than was previously occupied by the barberry. When salt is applied to barberries in the north-central part of the United States where the annual rainfall is 30 inches or more, the ground will be more or less covered by vegetation during the second summer after treatment and, by the third year, little difference between treated and untreated ground can be noticed. As a result of irrigation or cultivation, the time during which the ground remains sterile is lessened. In the more arid parts of the country sterility lasts longer. The soil will not remain sterile quite as long after a kerosene treatment as after salt. Soil treated with sodium arsenite shows rapid leaching where rainfall is abundant.

Relation of Seasonal Storage of Reserve Food to Successful Eradication

Investigations of the seasonal change of the storage products of barberries have been in progress since September, 1922. This work has been completed and a manuscript is being prepared for publication. The substances studied are sugar, starch, hemicellulose, nitrogen, ether extract, moisture and ash. The chemicals used in killing barberries are effective at practically any season of the year and there is no apparent correlation between the amount of the storage products present and the rapidity of killing the bush. There may be a relation between the storage products present and the success of digging. Additional investigations are in progress upon the effect of cutting off all stems of a barberry and keeping the crown in darkness and upon the action of salt in killing barberry bushes.

Stem-Rust Investigations

The barberry eradication field forces carry out a portion of the stem-rust studies in cooperation with epidemiology forces of the stem-rust project of the Office of Cereal Investigations. This work is conducted in the 13 eradication States and in other principal grain-growing States from the field headquarters at St. Paul, Minnesota. Special epidemiology field men cooperate with the State leaders and their assistants. These investigations include (1) overwintering studies, (2) the finding, tracing and mapping of local or more widespread epidemics and the determining of possible sources of inoculum, (3) the relation of weather conditions to the spread of rust, and (4) estimates of severity of epidemics and the losses produced.

SUMMARIZED RESULTS

Summary for 1924

During the calendar year 1924 approximately 124 counties were covered in original survey, approximately 60 counties were surveyed a second time, and the equivalent of 203 counties was covered in resurvey. Original bushes numbering 295,814 were found on 5,250 properties, and 388,632 bushes were destroyed on 6,335 properties. These totals include 4,841 bushes found on 695 properties in second survey. In resurvey, 21,852 sprouting bushes were found and 21,850 were eradicated. Seedlings numbering 847,771 were found in original survey, second survey and resurvey. A summary of the data is contained in tables 1, 2, 5, 6, 9, 10, 13 and 15.

Summary of Results for Seven Years

In the seven years of the campaign, from April 1, 1918, to December 31, 1924, the equivalent of approximately 796 counties has been covered in the original farm-to-farm survey. The original survey of practically all cities in the entire 13 States has been completed. Of the counties already covered by the original survey approximately 111 have been surveyed a second time. In continuing the resurvey it has been necessary to revisit the properties in approximately all counties covered by the original survey to June 30, 1923. Original bushes numbering 6,358,343 have been located on 68,465 properties. Of these, 5,813,192 bushes have been destroyed on 67,510 properties. In resurvey, 273,619 sprouting bushes were found on 10,925 properties and 272,593 sprouting bushes were destroyed from 10,902 properties. In all surveys, 4,607,142 seedlings were found, 4,548,-956 were destroyed. These numbers include 10,106 bushes and 9,579 seedlings found and 10,086 bushes and 9,579 seedlings destroyed on second survey. This makes a grand total of 11,239,104 bushes, sprouting bushes and seedlings found and 10,634,741 bushes, sprouting bushes and seedlings destroyed in all surveys in the entire campaign. These data are summarized in table 17.

ORIGINAL SURVEY, PROPERTIES, 1924

Table 1. Data showing, by States, the numbers of properties on which barberry bushes were found and destroyed in all surveys, and the numbers of properties upon which seedlings were found and destroyed in the original and second surveys, January 1 to December 31, 1924

State	Numbers of counties covered in original survey	Number of properties on which bushes were found				Total number of properties cleared of bushes			Number of properties on which seedlings were -			
		In cities and towns	In Country		Total in cities and country	Dug	Treated	Total	Found	Destroyed		
			Having escaped bushes	Total						Dug	Treated	Total
Colorado	0	1	2	9	10	1	7	8	0	0	0	0
Illinois	16.25	805	232	642	1447	1297	448	1745	59	46	13	59
Indiana	22.90	114	64	150	264	147	152	299	20	9	11	20
Iowa	7.00	51	77	207	258	103	159	262	13	4	9	13
Michigan	21.30	262	247	526	788	892	290	1182	151	143	8	151
Minnesota	0	33	38	137	170	56	114	170	20	5	15	20
Montana	7.01	16	6	21	37	22	15	37	1	1	0	1
Nebraska	0	28	23	78	106	33	75	108	7	2	5	7
North Dakota	4.00	11	0	23	34	7	27	34	0	0	0	0
Ohio	21.00	1061	157	593	1654	1671	221	1892	7	0	7	7
South Dakota	2.00	41	12	41	82	43	139	182	1	0	1	1
Wisconsin	22.00	176	128	224	400	259	157	416	42	21	13	34
Wyoming	0	0	0	0	0	0	0	0	0	0	0	0
Total	123.46	2599	986	2651	5250	4531	1804	6335	321	231	82	313

ORIGINAL SURVEY, BUSHES AND SEEDLINGS, 1924

Table 2. Data showing, by States, the numbers of barberry bushes found and destroyed in all surveys, and the numbers of seedlings found and destroyed in the original and second surveys, January 1 to December 31, 1924

State	Number of bushes found				Number of bushes destroyed			Number of seedlings			
		In Country							Destroyed		
	In cities and towns	Escaped	Total	Total	Dug	Treated	Total	Found	Dug	Treated	Total
Colorado	7	99	119	126	4	111	115	0	0	0	0
Illinois	5,709	77,861	85,455	91,164	16,295	81,364	97,659	12,120	8,728	3,392	12,120
Indiana	663	48,118	48,801	49,464	515	76,077	76,592	6,718	551	6,167	6,718
Iowa	471	2,921	4,369	4,840	2,279	3,292	5,571	634	144	490	634
Michigan	1,381	115,384	116,761	118,142	66,492	64,534	131,026	599,539	561,911	37,628	599,539
Minnesota	218	1,033	1,678	1,896	308	1,588	1,896	681	270	411	681
Montana	108	131	233	341	730	256	986	167	167	0	167
Nebraska	173	292	867	1,040	397	812	1,209	4,567	515	4,052	4,567
North Dakota	34	0	289	323	24	299	323	0	0	0	0
Ohio	7,114	8,364	11,611	18,725	13,838	8,790	22,628	19,765	0	19,765	19,765
South Dakota	529	2,064	2,286	2,815	1,039	6,783	7,822	70	0	70	70
Wisconsin	758	5,677	6,180	6,938	40,285	2,520	42,805	14,898	5,461	6,151	11,612
Wyoming	0	0	0	0	0	0	0	0	0	0	0
Total	17,165	261,944	278,649	295,814	142,206	246,426	388,632	659,159	577,747	78,126	655,873

ORIGINAL SURVEY, PROPERTIES, 1918 - 1924

Table 3. Data showing, by States, the numbers of properties upon which barberry bushes were found and destroyed in all surveys, and the numbers of properties upon which seedlings were found and destroyed in the original and second surveys, April 1, 1918, to December 31, 1924

State	Numbers of counties covered by original survey	Number of properties on which bushes were found			Total number of properties cleared of bushes			Number of properties on which seedlings were -			
		In cities and towns	In country Having escaped bushes	In country Total	Total in cities and country	Dug	Treated	Total	Found	Destroyed Dug	Destroyed Treated	Destroyed Total
Colorado	31.49	1,544	57	162	1,706	1,644	59	1,703	0	0	0	0
Illinois	43.25	9,787	971	2,436	12,223	11,095	1,082	12,177	121	82	39	121
Indiana	92.00	3,536	278	1,138	4,674	4,309	348	4,657	33	17	16	33
Iowa	99.00	7,009	677	2,553	9,562	8,966	595	9,561	39	23	16	39
Michigan	52.30	5,040	1,532	5,137	10,177	8,892	598	9,490	375	328	47	375
Minnesota	85.33	3,137	453	1,881	5,018	4,850	168	5,018	361	342	19	361
Montana	21.13	186	10	72	258	232	25	257	2	1	1	2
Nebraska	92.50	3,191	87	677	3,868	3,652	206	3,858	16	3	13	16
North Dakota	53.00	521	1	314	835	751	84	835	2	1	1	2
Ohio	68.00	7,412	319	2,048	9,460	9,042	328	9,370	21	12	9	21
South Dakota	69.00	486	108	549	1,035	793	242	1,035	88	81	7	88
Wisconsin	71.00	6,883	1,029	2,678	9,561	8,716	748	9,464	125	48	62	110
Wyoming	8.00	74	1	14	88	84	1	85	0	0	0	0
Total	786.00	48,806	5,523	19,659	68,465	63,026	4,484	67,510	1,183	938	230	1,168

ORIGINAL SURVEY, BUSHES AND SEEDLINGS, 1918 - 1924

Table 4. Data showing, by States, the numbers of barberry bushes found and destroyed in all surveys, and the numbers of seedlings found and destroyed in the original and second surveys, April 1, 1918, to December 31, 1924

State	Number of bushes found				Number of bushes destroyed			Number of seedlings			
		In country							Destroyed		
	In cities and towns	Escaped	Total	Total	Dug	Treated	Total	Found	Dug	Treated	Total
Colorado	19,593	2,645	4,757	24,350	23,833	505	24,338	0	0	0	0
Illinois	106,872	127,082	165,679	272,551	161,138	105,227	266,365	1,530,434	16,758	1,513,676	1,530,434
Indiana	77,220	102,724	117,560	194,780	97,524	96,356	193,880	6,962	747	6,215	6,962
Iowa	649,279	58,084	142,597	791,876	773,122	18,750	791,872	3,014	730	2,284	3,014
Michigan	53,827	343,633	412,987	466,814	365,132	78,441	443,573	780,792	710,338	70,454	780,792
Minnesota	592,361	81,177	191,863	784,224	780,204	4,020	784,224	20,278	19,553	725	20,278
Montana	6,884	879	3,308	10,192	9,542	639	10,181	812	167	645	812
Nebraska	73,081	5,683	21,192	94,273	90,450	3,787	94,237	6,735	915	5,820	6,735
North Dak.	14,401	150	7,744	22,145	19,561	2,584	22,145	156	150	6	156
Ohio	215,104	29,989	45,969	261,073	240,820	15,675	256,495	20,601	276	20,325	20,601
S. Dakota	23,654	20,727	35,486	59,140	48,650	10,490	59,140	17,258	16,579	679	17,258
Wisconsin	280,608	3,080,555	3,092,175	3,372,783	2,844,217	18,557	2,862,774	34,884	10,237	16,461	26,698
Wyoming	3,946	1	196	4,142	3,966	2	3,968	0	0	0	0
Total	2,116,830	3,853,329	4,241,513	6,358,343	5,458,159	355,033	5,813,192	2,421,926	776,450	1,637,290	2,413,740

SECOND SURVEY, PROPERTIES, 1924

Table 5. Data showing, by States, the numbers of properties upon which barberry bushes and seedlings were found and destroyed on second survey in the barberry eradication campaign from January 1, 1924, to December 31, 1924.

State	Numbers of counties surveyed	Number of properties on which bushes were found			Total number of properties cleared of bushes			Number of properties on which seedlings were -			
		In cities and towns	In country having escaped bushes	Total in country	Total in cities and country	Dug	Treated	Total	Found	Destroyed	
										Dug	Treated	Total
Colorado	3.69	0	1	3	3	0	3	3	0	0	0	0
Illinois	0	0	0	0	0	0	0	0	0	0	0	0
Indiana	.10	39	0	0	39	40	1	41	0	0	0	0
Iowa	4.00	9	39	74	83	24	59	83	9	1	8	9
Michigan	2.33	44	15	49	93	68	25	93	3	3	0	3
Minnesota	13.70	33	38	137	170	56	114	170	20	5	15	20
Montana	5.50	0	0	1	1	1	0	1	0	0	0	0
Nebraska	8.50	19	18	68	87	26	63	89	5	2	3	5
North Dakota	11.40	8	0	19	27	7	20	27	0	0	0	0
Ohio	2.00	18	0	7	25	24	1	25	0	0	0	0
South Dakota	5.78	21	0	16	37	8	29	37	0	0	0	0
Wisconsin	2.20	44	55	86	130	60	70	130	9	5	4	9
Wyoming	0	0	0	0	0	0	0	0	0	0	0	0
Total	59.20	235	166	460	695	314	385	699	46	16	30	46

SECOND SURVEY, BUSHES AND SEEDLINGS, 1924

Table 6. Data showing, by States, the numbers of barberry bushes and seedlings found and destroyed on second survey in the barberry eradication campaign from January 1, 1924, to December 31, 1924

State	Number of bushes found				Number of bushes destroyed			Number of seedlings			
	In cities and towns	In country		Total	Dug	Treated	Total	Found	Destroyed		
		Escaped	Total						Dug	Treated	Total
Colorado	0	1	3	3	0	3	3	0	0	0	0
Illinois	0	0	0	0	0	0	0	0	0	0	0
Indiana	145	0	0	145	150	1	151	0	0	0	0
Iowa	77	324	761	838	183	655	838	475	30	445	475
Michigan	91	82	170	261	204	57	261	40	40	0	40
Minnesota	217	450	1,057	1,274	267	1,007	1,274	681	270	411	681
Montana	0	0	1	1	1	0	1	0	0	0	0
Nebraska	146	248	659	805	417	564	981	567	515	52	567
North Dakota	28	0	263	291	24	267	291	0	0	0	0
Ohio	59	0	31	90	88	2	90	0	0	0	0
South Dakota	56	0	149	205	16	189	205	0	0	0	0
Wisconsin	183	652	745	928	150	778	928	6,940	3,640	3,300	6,940
Wyoming	0	0	0	0	0	0	0	0	0	0	0
Total	1,002	1,757	3,839	4,841	1,500	3,523	5,023	8,703	4,495	4,208	8,703

SECOND SURVEY, PROPERTIES, 1922- 1924

Table 7. Data showing, by States, the numbers of properties upon which barberry bushes and seedlings were found and destroyed on second survey in the barberry eradication campaign from January 1, 1922, to December 31, 1924

State	Numbers of counties surveyed	Number of properties on which bushes were found				Total number of properties cleared of bushes			Number of properties on which seedlings were -			
		In cities and towns	In country		Total in cities and country	Dug	Treated	Total	Found	Destroyed		
			Having escaped bushes	Total						Dug	Treated	Total
Colorado	15.69	0	15	27	27	3	24	27	0	0	0	0
Illinois	0	0	0	0	0	0	0	0	0	0	0	0
Indiana	4.10	66	2	20	86	68	18	86	0	0	0	0
Iowa	6.00	11	55	103	114	30	83	113	10	1	9	10
Michigan	2.33	44	15	49	93	68	25	93	3	3	0	3
Minnesota	29.95	50	46	200	250	127	123	250	21	6	15	21
Montana	5.50	0	0	1	1	1	0	1	0	0	0	0
Nebraska	14.00	45	25	116	161	46	113	159	9	2	7	9
North Dakota	20.40	10	0	50	60	11	49	60	1	0	1	1
Ohio	2.00	18	0	7	25	24	1	25	0	0	0	0
South Dakota	9.02	27	0	29	56	8	48	56	1	1	0	1
Wisconsin	2.20	44	55	86	130	60	70	130	9	5	4	9
Wyoming	0	0	0	0	0	0	0	0	0	0	0	0
Total	111.19	315	213	688	1,003	446	554	1,000	54	18	36	54

SECOND SURVEY, BUSHES AND SEEDLINGS, 1922 - 1924

Table 8. Data showing, by States, the numbers of barberry bushes and seedlings found and destroyed on second survey in the barberry eradication campaign from January 1, 1922, to December 31, 1924

State	Number of bushes found				Number of bushes destroyed			Number of seedlings			
	In cities and towns	In country		Total				Found	Destroyed		
		Escaped	Total		Dug	Treated	Total		Dug	Treated	Total
Colorado	0	43	75	75	6	69	75	0	0	0	0
Illinois	0	0	0	0	0	0	0	0	0	0	0
Indiana	197	15	85	282	212	70	282	0	0	0	0
Iowa	79	484	981	1,060	192	865	1,057	500	30	470	500
Michigan	91	82	170	261	204	57	261	40	40	0	40
Minnesota	318	77	2,441	2,759	1,472	1,287	2,759	711	300	411	711
Montana	0	0	1	1	1	0	1	0	0	0	0
Nebraska	468	342	1,679	2,147	543	1,587	2,130	985	515	470	985
North Dakota	64	0	1,354	1,418	59	1,359	1,418	3	0	3	3
Ohio	59	0	31	90	88	2	90	0	0	0	0
South Dakota	266	0	819	1,085	44	1,041	1,085	400	400	0	400
Wisconsin	183	652	745	928	150	778	928	6,940	3,640	3,300	6,940
Wyoming	0	0	0	0	0	0	0	0	0	0	0
Total	1,725	2,396	8,381	10,106	2,971	7,115	10,086	9,579	4,925	4,654	9,579

RESURVEY, PROPERTIES, 1924

Table 9. Data showing, by States, the numbers of properties upon which sprouting bushes and seedlings were found and destroyed on resurvey in the barberry eradication campaign from January 1 to December 31, 1924

State	Number of Properties on which sprouting bushes were found -				Total Number of Properties cleared of sprouting bushes:			Number of Properties on which Seedlings were -			
		In Country							Destroyed		
	In cities and towns	Having escaped bushes	Total	Total in cities and country	Dug	Treated	Total	Found	Dug	Treated	Total
Colorado	32	20	28	60	3	59	62	37	3	34	37
Illinois	96	64	169	265	122	143	265	62	59	3	62
Indiana	7	1	1	8	7	1	8	0	0	0	0
Iowa	41	75	258	299	121	179	300	61	42	19	61
Michigan	33	49	67	100	70	30	100	52	49	3	52
Minnesota	13	38	93	106	41	65	106	53	21	32	53
Montana	11	1	10	21	13	8	21	6	6	0	6
Nebraska	11	1	18	29	11	16	27	4	3	1	4
N. Dakota	28	0	35	63	13	50	63	0	0	0	0
Ohio	479	66	287	766	696	70	766	199	165	34	199
S. Dakota	29	14	48	77	8	69	77	34	2	32	34
Wisconsin	39	60	127	166	92	74	166	56	39	17	56
Wyoming	0	0	0	0	0	0	0	0	0	0	0
Total	819	389	1,141	1,960	1,197	764	1,961	564	389	175	564

Table 10. Data showing, by States, the numbers of sprouting bushes and seedlings found and destroyed on re-survey in barberry eradication campaign from January 1 to December 31, 1924

State	Number of sprouting bushes found				Number of sprouting bushes destroyed			Number of Seedlings			
	In cities and towns	In Country		Total	Dug	Treated	Total	Found	Destroyed		
		Escaped	Total						Dug	Treated	Total
Colorado	83	222	319	402	17	388	405	771	95	676	771
Illinois	923	765	3,339	4,253	1,027	3,226	4,253	34,913	33,158	1,755	34,913
Indiana	14	1	1	15	14	1	15	0	0	0	0
Iowa	197	990	3,024	3,221	626	2,593	3,219	3,503	2,459	1,044	3,503
Michigan	164	375	484	648	269	379	648	81,770	21,715	60,055	81,770
Minnesota	48	480	1,076	1,124	182	942	1,124	6,385	253	6,132	6,385
Montana	89	3	331	420	358	62	420	244	244	0	244
Nebraska	39	25	91	130	54	73	127	108	106	2	108
North Dakota	158	0	720	878	68	810	878	0	0	0	0
Ohio	2,226	974	1,893	4,119	3,025	1,094	4,119	50,813	10,393	40,420	50,813
South Dakota	270	63	233	503	10	493	503	937	224	713	937
Wisconsin	447	5,235	5,692	6,139	966	5,173	6,139	9,168	4,062	5,106	9,168
Wyoming	0	0	0	0	0	0	0	0	0	0	0
Total	4,658	9,133	17,194	21,852	6,616	15,234	21,850	188,612	72,709	115,903	188,612

RESURVEY, PROPERTIES, 1918 - 1924

Table 11. Data showing, by States, the numbers of properties upon which sprouting bushes and seedlings were found and destroyed on resurvey in the barberry eradication campaign from April 1, 1918, to December 31, 1924

State	Number of Properties on which Sprouting bushes were found			Total number of properties cleared of sprouting bushes				Number of properties on which seedlings were -			
		In country						Found	Destroyed		
	In cities and towns	Having escaped bushes	Total	Total in cities & country	Dug	Treated	Total		Dug	Treated	Total
Colorado	1,426	90	158	1,584	1,411	172	1,583	81	17	64	81
Indiana	328	264	564	892	388	504	892	236	188	48	236
Illinois	151	100	195	346	247	95	342	25	3	22	25
Iowa	279	202	702	981	570	411	981	138	87	51	138
Michigan	136	108	281	417	367	50	417	187	183	4	187
Minnesota	681	498	1,053	1,734	1,496	238	1,734	2,158	2,062	96	2,158
Montana	104	1	45	149	141	8	149	7	6	1	7
Nebraska	191	15	330	521	331	188	519	25	11	14	25
North Dakota	204	0	147	351	217	134	351	0	0	0	0
Ohio	1,045	137	617	1,662	1,567	95	1,662	303	257	46	303
South Dakota	339	33	325	664	510	154	664	65	23	42	65
Wisconsin	853	540	745	1,598	1,252	334	1,586	163	98	64	162
Wyoming	21	0	5	26	18	4	22	6	0	6	6
Total	5,758	1,988	5,167	10,925	8,515	2,387	10,902	3,394	2,935	458	3,393

RESURVEY, SPROUTING BUSHES AND SEEDLINGS, 1918 - 1924

Table 12. Data showing, by States, the numbers of sprouting bushes and seedlings found and destroyed on resurvey in the barberry eradication campaign from April 1, 1918, to December 31, 1924

State	Number of sprouting bushes found				Number of sprouting bushes destroyed			Number of seedlings			
	In cities and towns	In country		Total	Dug	Treated	Total	Found	Destroyed		
		Escaped	Total						Dug	Treated	Total
Colorado	3,780	1,870	2,920	6,700	5,136	1,563	6,699	2,502	707	1,795	2,502
Illinois	4,136	3,881	8,923	13,059	5,515	7,544	13,059	63,397	47,746	15,651	63,397
Indiana	1,481	16,640	17,993	19,474	17,446	1,723	19,169	3,262	255	3,007	3,262
Iowa	3,536	5,932	15,034	18,570	9,786	8,432	18,218	31,645	26,362	5,283	31,645
Michigan	511	1,142	2,357	2,868	2,206	662	2,868	607,161	547,076	60,085	607,161
Minnesota	13,790	14,763	33,354	47,144	39,954	7,190	47,144	24,939	2,389	22,550	24,939
Montana	3,454	3	1,609	5,063	5,001	62	5,063	889	244	645	889
Nebraska	5,972	82	9,519	15,491	12,386	3,102	15,488	2,630	954	1,676	2,630
North Dakota	336	0	834	1,170	172	998	1,170	0	0	0	0
Ohio	4,426	6,589	9,075	13,501	10,861	2,640	13,501	252,473	69,603	182,870	252,473
South Dakota	20,978	5,282	22,002	42,980	36,615	6,365	42,980	8,996	6,393	2,603	8,996
Wisconsin	11,030	72,782	76,190	87,220	19,007	67,906	86,913	1,187270	60,962	1,076,308	1,137,270
Wyoming	356	0	23	379	305	16	321	52	52	0	52
TOTAL	73,786	128,966	199,833	273,619	164,390	108,203	272,593	2185216	762,743	1,372,473	2,135,216

CHEMICAL TREATMENT, 1924

Table 13. Data showing, by States, the numbers of properties on which barberry bushes and sprouting barberry bushes were treated with chemicals; and the numbers of bushes, sprouting bushes and seedlings treated from January 1 to December 31, 1924

State	Number treated											
	With Salt			With Sodium Arsenite			With Kerosene			Total		
	Properties	Bushes	Seedlings	Properties	Bushes	Seedlings	Properties	Bushes	Seedlings	Properties	Bushes	Seedlings
Col.	66	499	676	0	0	0	0	0	0	66	499	676
Ill.	580	83,407	5,147	6	14	0	5	1,169	0	591	84,590	5,147
Ind.	153	76,078	6,167	0	0	0	0	0	0	153	76,078	6,167
Iowa	323	5,724	1,531	0	0	0	16	161	3	339	5,885	1,534
Mich.	189	4,008	55	0	0	0	131	60,905	97,628	320	64,913	97,683
Minn.	179	2,530	6,543	0	0	0	0	0	0	179	2,530	6,543
Mont.	23	318	0	0	0	0	0	0	0	23	318	0
Neb.	50	546	4,000	0	0	0	41	339	54	91	885	4,054
N. Dak.	77	1,109	0	0	0	0	0	0	0	77	1,109	0
Ohio	212	6,732	50,185	0	0	0	79	3,152	10,000	291	9,884	60,185
S. Dak.	201	7,266	767	0	0	0	7	10	16	208	7,276	783
Wisc.	231	7,693	11,257	0	0	0	0	0	0	231	7,693	11,257
Wyo.	0	0	0	0	0	0	0	0	0	0	0	0
Total	2,284	195,910	86,328	6	14	0	279	65,736	107,701	2,569	261,660	194,029

CHEMICAL TREATMENT, 1918 - 1924

Table 14. Data showing, by States, the numbers of properties on which barberry bushes and sprouting barberry bushes were treated with chemicals; and the numbers of bushes, sprouting bushes and seedlings treated from April 1, 1918, to December 31, 1924

State	Number treated											
	With Salt			With Sodium Arsenite			With Kerosene			Total		
	Properties	Bushes	Seedlings	Properties	Bushes	Seedlings	Properties	Bushes	Seedlings	Properties	Bushes	Seedlings
Colorado	231	2,068	1,795	0	0	0	0	0	0	231	2,068	1,795
Illinois	1,547	110,763	1,529,327	34	839	0	5	1,169	0	1,586	112,771	1,529,327
Indiana	443	98,079	9,222	0	0	0	0	0	0	443	98,079	9,222
Iowa	988	26,911	7,564	0	0	0	18	271	3	1,006	27,182	7,567
Michigan	278	9,604	3,000	239	3,594	29,911	131	60,905	97,628	648	79,103	130,539
Minnesota	379	11,100	23,143	25	85	102	2a	25a	30a	406	11,210	23,275
Montana	33	701	1,290	0	0	0	0	0	0	33	701	1,290
Nebraska	353	6,550	7,442	0	0	0	41	339	54	394	6,889	7,496
N. Dakota	197	3,515	6	21	67	0	0	0	0	218	3,582	6
Ohio	254	9,391	92,945	10	1,069	59,300	159	7,855	50,950	423	18,315	203,195
S. Dakota	389	16,845	3,266	0	0	0	7	10	16	396	16,855	3,282
Wisconsin	731	80,638	1,091,067	350	5,824	1,702	1b	1b	0	1,082	86,463	1,092,769
Wyoming	7	18	0	0	0	0	0	0	0	7	18	0
Total	5,830	376,183	2,770,067	679	16,478	91,015	364	70,575	148681	6,873	463,236	3,009,763

a. Killed with drip oil.
b. Killed with carbon bisulphide.

CHEMICALS, QUANTITIES USED, 1924

Table 15. Data showing, by States, the quantities of chemicals used in the barberry eradication campaign, January 1 to December 31, 1924

STATE	SALT (Tons)					SODIUM ARSENITE (Gallons)			KEROSENE (Gallons)		
	Furnished by					Furnished by			Furnished by		
	Property Owner	State Agency	Conference: P. G. Rust	U. S.D.A	Total	Conference: P. G. Rust	U.S.D.A.	Total	Owner	U.S.D.A.	Total
Colorado	0:	0:	0:	.780:	.780:	0:	0:	0:	0:	0:	0
Illinois	.650:	1.650:	0:	127.000:	129.300:	0:	27:	27:	0:	124:	124
Indiana	.728:	0:	0:	32.262:	32.990:	0:	0:	0:	0:	0:	0
Iowa	6.774:	0:	.483:	15.634:	22.891:	0:	0:	0:	224:	0:	224
Michigan	.030:	0:	1.491:	12.681:	14.202:	0:	0:	0:	0:	10,811:	10811
Minnesota	.300:	.833:	.721:	3.949:	5.803:	0:	0:	0:	0:	0:	0
Montana	.125:	0:	0:	1.808:	1.933:	0:	0:	0:	0:	0:	0
Nebraska	.005:	0:	.350:	7.772:	8.127:	0:	0:	0:	0:	446:	446
N. Dakota	3.660:	1.500:	0:	.800:	5.960:	0:	0:	0:	0:	0:	0
Ohio	.432:	24.491:	0:	1.909:	26.832:	0:	0:	0:	16:	1,722a:	1,738a
S. Dakota	10.425:	0:	0:	2.150:	12.575:	0:	0:	0:	0:	15:	15
Wisconsin	.085:	32.750:	0:	2.030:	34.865:	0:	0:	0:	0:	0:	0
Wyoming	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0
Total	23.214:	61.224:	3.045	208.775:	296.258:	0:	27:	27:	240:	13,118:	13,358

a. 1515 gallons kerosene furnished by the State included.

Table 16. Data Showing, by States, the quantities of chemicals used in the barberry eradication campaign April 1, 1918 to December 31, 1924

STATE	SALT (Tons)					SODIUM ARSENITE (Gallons)			KEROSENE (Gallons)		
	Furnished by					Furnished by			Furnished by		
	Property Owner	State Agency	Conference P. G. Rust	U.S.D.A.	Total	Conference P. G. Rust	U.S.D.A.	Total	Owner	U.S.D.A.	Total
Colorado	0:	0:	0:	3.640:	3.640:	0:	0:	0:	0:	0:	0
Illinois	.750:	50.650:	31.000:	226.000:	308.400:	0:	77:	77:	0:	124:	124
Indiana	.819:	0:	0:	53.332:	54.151:	0:	0:	0:	0:	0:	0
Iowa	38.283:	0:	19.898:	41.365:	99.546:	0:	0:	0:	382:	0:	382
Michigan	.030:	0:	8.491:	26.022:	34.543:	175.6:	129.3:	3 04.9:	0:	10,811:	10,811
Minnesota	.347:	.833:	9.211:	21.826:	32.217:	0:	23.2:	23.2:	0:	0a:	0a
Montana	.125:	0:	0:	3.758:	3.883:	0:	0:	0:	0:	0:	0
Nebraska	.018:	0:	8.550:	15.062:	23.630:	0:	0:	0:	0:	446:	446
N. Dakota	9.160:	5.000:	0:	4.300:	18.460:	0:	7:	7:	0:	0:	0
Chio	.668:	26.376:	0:	5.128:	32.172:	16.2:	30.1:	46.3:	230:	3,003c:	3,233c
S. Dakota	13.845:	0:	17.850:	2.150:	33.845:	0:	0:	0:	0:	15:	15
Wisconsin	.220:	56.650:	70.000:	24.950:	151.820:	408.0:	190.0:	598.0:	0:	0b:	0b
Wyoming	0:	0:	0:	.100:	.100:	0:	0:	0:	0:	0:	0
Total	64.265:	139.509:	165.000:	427.633:	796.407:	599.8:	456.6:	1,056.4:	612:	14,399:	15,011

a. 10 gallons drip oil used.
b. .3 gallon carbon bisulphide used.
c. 1919 gallons kerosene furnished by the State included.

GRAND SUMMARY, ORIGINAL BUSHES, SPROUTING BUSHES, AND SEEDLINGS, 1918 - 1924

Table 17. Data showing, by States, the numbers of bushes, sprouting bushes and seedlings found and destroyed in all surveys in the barberry eradication campaign, April 1, 1918 to December 31, 1924

State	Original bushes		Sprouting bushes		Seedlings	
	Found	Destroyed	Found	Destroyed	Found	Destroyed
Colorado	24,350	24,338	6,700	6,699	2,502	2,502
Illinois	272,551	266,365	13,059	13,059	1,593,831	1,593,831
Indiana	194,780	193,880	19,474	19,169	10,224	10,224
Iowa	791,876	791,872	18,570	18,218	34,659	34,659
Michigan	466,814	443,573	2,868	2,868	1,387,953	1,387,953
Minnesota	784,224	784,224	47,144	47,144	45,217	45,217
Montana	10,192	10,181	5,063	5,063	1,701	1,701
Nebraska	94,273	94,237	15,491	15,488	9,365	9,365
North Dakota	22,145	22,145	1,170	1,170	156	156
Ohio	261,073	256,495	13,501	13,501	273,074	273,074
South Dakota	59,140	59,140	42,980	42,980	26,254	26,254
Wisconsin	3,372,783	2,862,774	87,220	86,913	1,222,154	1,163,968
Wyoming	4,142	3,968	379	321	52	52
Total	6,358,343	5,813,192	273,619	272,593	4,607,142	4,548,956

Grand Total of bushes, sprouting bushes and seedlings, found - 11,239,104
Grand Total of bushes, sprouting bushes and seedlings, destroyed - 10,634,741