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## 8. Weeds that Challenge Iowa Crops

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WHEN IOWA PRAIRIES WERE UNFENCED, WEEDS WERE OF little importance. Grazing cattle, free to roam at will, could choose good grazing country and leave untouched areas of less inviting plants. As land passed into private hands and fences were built, however, cattle were less free to move about. Poisonous and harmful plants became a problem. In 1884, for instance, Dr. Bessey, professor of botany at Iowa State College, reported that "rattle box" was common in western Iowa as a cause of death among horses. Porcupine grass, the fruit of which became buried in sheep's wool and cattle hair, had become a serious concern.

When farmers shifted from grazing cattle to growing crops, trouble was caused by more than only poisonous plants. In a wheat field, any kind of plant other than wheat is unwanted. Such plants, which do not fit into the economics of a country, we call weeds.

At the same time that the farmer became particular as to which plants should grow in a given field, he introduced new varieties of weeds by importing seed. As early as 1888, Byron Halsted, successor to Professor Bessey, listed 297 species of weeds and noted that the large majority had been introduced to the state. Undoubtedly most of these came to Iowa from Europe by way of the eastern states. Iowa State College's plant collection had 1,484 species in 1929, of which 263 had come into the state from elsewhere. Most of them, 210, or 80 per cent, had come from Europe. The bulk of human immigrants also came from there, of course. Sources of the other weed species were: Asia 11, Tropical America 11, Mexico 1, Eastern United States 3, Southern United States 9, Western United States 18. Of the primary noxious weeds, not a single one is native to Iowa and only one, horse nettle, is native to the United States.

The most important way in which the pioneer introduced weeds was through having weed seeds mixed with crop seeds. In several clover patches on the State Farm in 1891 L. H. Pammel, professor of botany, found oxeye daisy, rib grass, hawkweed, Canada thistle, dodder. Horse nettle already had been reported from Taylor, Ringgold, and Greene counties.

Professor Pammel, R. E. Buchanan, and Charlotte M. King provided evidence in 1907 that agricultural seeds were an important medium for the distribution of weed seeds. One hundred and thirty samples of red clover seed were examined for impurities and adulteration. The average per cent of impurities ranged from 1.93 to 33.2, and only two samples consisted of pure seed.

It was clear very early that the best way to get rid of weeds in Iowa was by making sure the seeds one planted were free of weed seeds. From 1892 to 1906 the Department of Botany at Iowa State College, under the leadership of Professor Pammel, tested a small number of seed samples each year for farmers and seedsmen. From 1906 to 1932 a small seed laboratory was maintained by the Department of Botany, where from one thousand to two thousand samples of seed were tested annually. Prior to the establishment of a small laboratory by the State Department of Agriculture in 1922, the seed samples collected by seed inspectors under the provisions of the Iowa Seed Law passed in 1908 were tested in the Botany laboratory. In 1914 the Farm Crops Department of Iowa State College, under the leadership of H. D. Hughes, established a small laboratory to test corn for moisture and germination, and later undertook the testing of grass and clover seeds. These two laboratories tested from three thousand to four thousand samples per year.

In 1932 the two small college laboratories were combined into one. This was designated the Iowa State College Seed Laboratory under the sponsorship of the Agricultural Extension Service, the Agricultural Experiment Station, and the Divisions of Agriculture and Science. This laboratory was placed under the direction of R. H. Porter. Research, teaching, and service phases of seed work were co-ordinated into the one unit. These phases increased rapidly until by 1940 more than forty thousand samples of seed per year were received and analyzed. The laboratory now is one of the best equipped stations in the United States. Extensive research has been undertaken there, and three college courses and one annual short course for the training of seed analysts have been developed.

Since 1940 the demands for seed testing have been so great that

assistance has been given by the college laboratory to teachers of vocational agriculture for the establishment of seed-testing facilities. Private laboratories also established indicate a growing appreciation of the need for seed testing. Thousands of samples of oats, soybeans, and clovers now are tested each year in Iowa by local testing stations. This relieves the central laboratory and brings the value of testing closer to the farmer.

The State Department of Agriculture in Des Moines has also maintained its seed laboratory since 1922, primarily for the purpose of checking the labeling of seed offered for sale in Iowa. Tests for farmers and seedsmen also are made there.

For a time, while people were learning the seriousness of weeds, only voluntary inspection of seeds for weeds was accomplished. Farmers wanted assurance before they bought from seed companies that the seeds were reasonably free of weeds. This became more important, of course, as farmers produced less and less of their own seed. In 1846 nearly every farmer saved a part of his harvest to provide seeds for the following year. Today probably less than half the Iowa farmers raise their own clover seed, for example. Every time a new variety is introduced, such as oats, the weed situation is improved for a while at least, since farmers must buy their seed from those who produce certified seed.

#### SEED AND WEED LAWS

The first seed law, demanded by farmers and agricultural leaders, was passed by the Iowa Legislature in 1907. It required that seed offered for sale be labeled. It listed those species of weeds that were considered noxious. It did not regulate the sale of seed by one farmer to another. Later the law was revised to the extent that sale of seed containing seeds of quack grass or Canada thistle in excess of ninety per pound of crop seed by any citizen of the state was unlawful. The first law and its subsequent revisions helped to improve the quality of seed sold in Iowa, but it did not go far enough, in that seeds of noxious weeds still could be distributed in crop seed.

In 1940 the Secretary of Agriculture and the head of the college seed laboratory organized the Iowa Seed and Weed Council, which recommended the repeal of the old seed law and enactment of a new law. The Legislature in 1941 heeded both recommendations, and it became necessary for farmers to test seed before sale and to furnish information to the purchaser showing percentage germination and hard seeds, percentage of secondary noxious weed seeds, and freedom from primary noxious weed seeds. The law made it illegal for anyone

to sell seed containing seeds of primary noxious weeds or seed containing more than 3 per cent total weed seeds. Another important provision was that if a seed inspector found primary noxious weed seeds in a lot offered for sale or found the seed mislabeled, he could issue a stop-sale order. This law marks a real advance in seed legislation, and the State Department of Agriculture through its seed laboratory and its system of inspection has raised the quality of seed sold in the state to a high degree.

One important feature of the present Iowa Seed Law is that it classifies noxious weeds into primary and secondary. Though not a single primary noxious weed is a native in the state and only horse nettle is a native in the United States, all are perennials with creeping roots or stems which crowd out crop plants under ordinary methods of tillage. The spread of these weeds is shown in Table 7. Records are from specimens deposited in the herbarium of Iowa State College.

TABLE 7  
SPREAD OF WEEDS IN IOWA

Weed	County and Time of First Recorded Collection	Counties Now Reporting Weed
Quack grass . . . . .	Story, 1871	82
Canada thistle . . . . .	Howard, 1892	99
Perennial sow thistle . . . . .	Polk, 1895	18
Leafy spurge . . . . .	Story, 1907	27
Russian knapweed . . . . .	Sioux, 1932	17
Buckhorn . . . . .	Story, 1890	99
Horse nettle . . . . .	Story, 1891	94
Perennial pepper grass . . . . .	Carroll, 1920	30
European bindweed . . . . .	Fayette, 1892	92

For a long time a farmer's weeds were considered his own business. If he were wise, he would destroy them. If not, it was his own hard luck. But eventually Iowans came to believe that, since weeds spread from one farm to another, weeds on one farm were the concern of that farmer's neighbors and of the community. So laws were passed concerning some of the more serious weeds.

The first weed law in Iowa was passed in 1870. It placed the responsibility for weed control on the road supervisors. This law accomplished little, because a supervisor either hesitated to enforce a law among his neighbors or he had so many noxious weeds on his own farm that he had no influence. In later years the law underwent several changes. The first change provided for a trustee to serve as township

weed commissioner, but, since he had to be elected by the other two, it was usually difficult to obtain willingness for one to serve. A second change placed the responsibility for weed control on the county board of supervisors and required that the board appoint one trustee from each township as weed commissioner. This change was not too successful, because the commissioners were usually farmers and they were hesitant about enforcing a law on their neighbors. A third modification made in 1934 permits the county board of supervisors to appoint a county weed commissioner who is authorized to enforce the weed law in his county. The counties with a county commissioner have made the greatest progress in the development of a weed control program, but too often they have been limited by funds.

The present law is weak, in that weed control work must be financed from the county general fund, which too often is inadequate. A special levy for weed control work is needed, as well as state or district commissioners with power to enforce the provisions of the weed law in each county. One of the valuable provisions in the law is that land owners or tenants or both can be required to adopt a long-time program of control on large areas infested with primary noxious weeds. It was possible to include this provision in the law because of the important demonstrations by the Agricultural Extension Service of Iowa State College which had shown that cropping systems could be employed to eradicate large areas of weeds and bring in a fair return. Subsequent tests by the Agricultural Experiment Station corroborated these findings and provided additional information on cultural practices which have further aided in effective weed control.

#### DESTROYING WEEDS

Weeds became established, of course, despite the growing use of seed testing. The first method developed for destroying them was that of cultivation, by which weeds were pulled up or plowed under. Then farmers found they could destroy some weeds by planting crops which would smother them. Most recent of all destruction methods has been the development of sprays and weed-killers which destroy the weeds without injuring crops, and the introduction of chemicals that temporarily prevent plant growth.

From 1890 to 1914 Prof. L. H. Pammel was exceptionally active in his efforts to acquaint the people of Iowa with the losses caused by weeds, the danger of allowing noxious weeds to become established, and the importance of destroying weeds by good cultural practices. He invited people to send weeds to him for identification, provided in-

struction for students interested in weeds, and published bulletins and books to acquaint farmers with weeds and their habits. His book, *Weed Flora of Iowa*, published in 1913, was widely used in later years by county agents, farmers, and teachers of agriculture. From 1914 to 1918 farm help was insufficient to do the necessary farm work and destroy patches of bad weeds. The net result was a marked increase in the areas infested with such perennials as quack grass, Canada thistle, and horse nettle. Annual weeds also gained the upper hand. By 1920 weeds had become recognized as a serious farm problem.

In 1921 R. H. Porter, the representative of the Department of Botany, initiated a project which linked weed identification and control with the Agricultural Extension Service. The educational program consisted of weed identification meetings and method demonstrations for the control of quack grass and Canada thistle.

This type of program was continued until 1927, when a new method of weed control was introduced into the United States—the use of sodium chlorate. Porter, who had returned to Iowa after four years' absence, began field tests with chlorates on quack grass, Canada thistle, and horse nettle. Other chemicals to kill weeds were introduced and demonstrations for the control of small patches of perennial noxious weeds were conducted in practically every county of the state.

Porter also introduced demonstrations of cropping systems for the control of large areas of perennial weeds, and planned programs of weed control on a county-wide basis. Control of perennial weeds by cropping systems became urgent by 1930 because areas of 40 to 160 acres of tillable land had become infested with such weeds as quack grass, Canada thistle, European bindweed, and horse nettle. It became necessary to develop methods of eradication which provided a reasonable crop return at the same time. The methods employed included (1) use of such smother crops as alfalfa, sorghum, and sudan grass; (2) summer fallow in combination with fall seeding of rye or wheat for two or three seasons; (3) surface cultivation between rows of drilled sorghum, corn, or soybeans; and (4) a combination of these methods. Records of the cost of cultivation and crop returns showed definitely that by adopting a cropping system a farmer could eradicate bad weeds and realize a fair financial return from the land. These practical demonstrations became common throughout the state and remain one of the important features of weed control in Iowa. Since 1940 E. P. Sylwester has been in charge of the Extension work in weed control.

These tillage control methods made it possible to interest county

farm bureaus and county supervisors in weed control programs. Meetings were held with county boards of supervisors, weed commissioners, and farmers, and definite plans were made, not only to show farmers how to destroy weeds, but to require them to do so when persuasion failed.

#### WEED RESEARCH

Prior to 1927 research in weeds in Iowa was largely confined to a study of the vitality of buried seeds, the detection of weed seeds in crop seed, and surveys for new weeds or new areas of noxious weeds. In 1929, when the extension botanist was holding a district weed conference with the county agents in northwest Iowa, a petition was drawn up and sent to the Agricultural Experiment Station requesting that experiments for the control of European bindweed be undertaken. A. L. Bakke was detailed to set up a field laboratory at Hawarden in Sioux County. Experiments with herbicides, summer fallow, and smother crops were initiated on areas infested with European bindweed and leafy spurge.

A regional weed committee was formed in 1935, with representatives from Minnesota, Nebraska, South Dakota, Wisconsin, and Iowa. The committee called on Congress to appropriate funds for weed research, especially for the control of European bindweed. Congress responded and has maintained an appropriation annually for weed research. A portion of the funds has been continuously allocated to Iowa, making it possible to expand field work which has moved to the State Hospital Farm at Cherokee. Eighty acres, practically solid with bindweed, were turned over to the Experiment Station and the United States Department of Agriculture for experimentation.

The life history of the plant, along with its environmental reactions, had been worked out at Hawarden. By sowing winter rye or millet in fields infested with bindweed, researchers found that spraying with sodium chlorate or Atlacide could be done more effectively. For large areas the use of soybeans drilled solid proved to be an effective eradication procedure. Cultivations made every ten to fourteen days proved as effective in reducing the stored food material in the roots of the European bindweed as cultivations made twice a week. Considerable attention also has been given to means of eradicating Canada thistle, horse nettle, and annual weeds. The results of the experimental work at Hawarden and Cherokee have greatly aided the Extension program in weed control by supplying information on the use of herbicides and smother crops.

Seasons since 1943 have seen considerable interest in the experi-

mental work on selective sprays—sprays that will kill the weeds in a crop but will not materially affect the crop itself. Sinox will kill mustard and many other annual weeds in oats, peas, and flax. A mixture of sodium chlorate and Santobrite effectively cleans up weeds along fence rows and ditch banks. Furnace oil at the rate of one hundred gallons per acre has proven to be a good spray to kill annuals in carrots.

It was found in 1944 that a growth-promoting compound, 2,4-D, could be used as a weed eradicator. A .1 per cent solution was sufficient to kill dandelions without hurting bluegrass. A research committee of weed control workers in thirteen North Central states set up in 1945 a number of uniform experiments to test these 2,4-D compounds.

It is evident that 2,4-D is still in the experimental stage. It has been found to be toxic to young onions, carrots, peas, tomatoes, poison ivy, but members of the grass family are generally resistant. It has been possible to control annuals in oats by using a dilute application of one of the commercial forms. Canada thistle is resistant, but in the case of the European bindweed the results look promising. At any rate, such weeds as dandelion, plantain, and many weeds of lawn and turf are on their way out.

Weeds that are easily killed by 2,4-D are the mustards, buckhorn, burdock, ground ivy, mallow, pepper grass, ragweed, pigweed, marsh elder, shepherd's purse. In addition to Canada thistle, weeds that are resistant are the following: barnyard grass, buffalo bur, crabgrass, corn cockle, dock, mullein, night-blooming catchfly, Russian thistle, squirrel tail grass, yarrow.

The 2,4-D compounds act slowly; in some cases no action is noticed for several days. The susceptible plant will then twist and turn and after two to three weeks will be dead. The material is noncorrosive, nonirritating to the skin, and is not inflammable. The United States Department of Agriculture fed one-fifth of an ounce of 2,4-D to a cow for two months with no apparent ill effects.

The agricultural engineers of Iowa State College also have made an important contribution to weed control by developing improved machines. They have shown that disc harrows, spring tooth harrows, rotary hoes, and weeders may be used most effectively in tillage to control weeds.

Marked advances in our knowledge of weeds and in methods of control have been made within the past two decades, and it is probable that within another ten years Iowa will have its worst weeds well under control.