A SURVEY OF THE HISTORY, DEVELOPMENT & PRESENT INTERNATIONAL STATUS OF SEED POTATO CERTIFICATION

THESIS FOR THE DEGREE OF M. S.

Donald Zabriskie Terhune

1930

Title Seed potato certification

Farm Crops

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A Thesis Prepared by
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in partial fulfillment
of the requirements for
the Degree of
Master of Science
Department of Farm Crops.

MICHIGAN STATE COLLEGE OF AGRICULTURE AND APPLIED SCIENCE.
1 9 3 0

ACKNOWLEDGMENT

The writer is indebted to Prof. Henry C. Moore under whose direction this survey was conducted and recorded; and to Prof. C. R. Megee for his suggestions and encouragement.

He wishes further to express his appreciation of the cooperation that he has received from the certification authorities of the various states, and of other countries; from the Bureau of Plant Industry of the United States Department of Agriculture; from the Certification Committee of the Potato Association of America; from several members of the Faculty of the Michigan State College in the translation of his foreign material; and from many other sources. It is only through their cooperation that this thesis has been possible.

CONTENTS

Contents. (Continued)

CONTENTS. (continued)

A SURVEY OF THE HISTORY, DEVELOPMENT AND PRESENT INTERNATIONAL STATUS OF SEED POTATO CERTIFICATION.

I FOREWORD.

The movement toward government-regulated seed potato certification has been a definite one, though the system is still comparatively young. Its development in the United States has been so rapid that few of those actually engaged in the conduct of the work have had time to keep in close contact with the fast-shifting stage of events. Many now find it difficult to place within their immediate grasp the broader significance of the movement, or the facts appertaining to its development, as these have spread beyond their own local horizons.

It is the purpose of the writer, in compiling this thesis, to collect and review material on the history, development, present extent and status of organized systems of seed potato certification throughout the world. Stress will be laid on the situation in America, showing the trend and effect of the movement here.

Obviously, the field of this survey is a broad one, as it deals with material that is widely-scattered, much of it fragmentary or obscure. The data presented have

been drawn from all the materials that were available on this subject.

II INTRODUCTION

It seems well at the start to make clear what the writer has in mind when he refers to "seed potato certification".

In general terms, seed potato certification is the recording of inspected seed potato stock, by a recognized state or national agency, as being from vigorous plants, and conforming to certain standards of freedom from disease and varietal mixture. The term "certified seed" as hereafter used, will refer only to seed that has been passed on and approved, both in the field and after harvest, by or under the direction of authorized representatives of recognized public agencies. It will bear no inferred reference to some seed which has been classed as certified by individuals or privately-controlled agencies.

Through the study of the history of the movement for seed potato certification, a clearer conception of its real purposes can be obtained. The same paramount principles before mentioned in defining certification are

in common use by practically all of the authorized certifying agencies. There is, however, a wide divergence in the actual organization standards and conduct of the work. In this thesis, it is hoped to bring together much of the information now available in this field, to the end that all agencies concerned may be able to refer to this compilation in working toward the solution of their common problems. For those states and countries yet unorganized for seed potato certification, this treatise may serve as a basis from which to build up a satisfactory plan. For students, it should furnish a general source of information, covering briefly the whole seed potato certification field.

The material for this thesis has been obtained through conferences and through correspondence with:- Secretaries of Seed and Crop Improvement Associations; College Extension workers in Farm Crops; Horticulture and Plant pathology, and Experiment Station workers in both this and foreign countries; State and National Secretaries, Ministers and Commissioners of Agriculture; Specialists of the Bureau of Plant Industry of the U. S. Department of Agriculture; State Seed Inspectors; Managers of State Potato Growers Cooperatives, and others engaged or interested in some phases of the seed potato industry. Published or stenciled pamphlets, circulars, bulletins and other printed materials from many sources have been freely quoted.

III HISTORY AND DEVELOPMENT

1. The Need for Certification

Our present cultivated potato (Solanum tuberosum) was apparently first introduced into Europe shortly after the Spanish Conquest of Peru (about 1550), and was first brought to North America (1) by Irish immigrants to New Hampshire in 1718. By the later half of the 18th Century, it was extensively cultivated throughout the temperate regions of Europe and America.

In common with most newly-introduced crops, the early plantings of the potato were fairly-widely scattered in regions where its pests were almost unknown. Until the crop became commercially established and intensively grown, the seed problem did not seem serious.

The matter of climatic adaptation soon presented itself and it was recognized that in order to produce seed of a satisfactory vigor the proper environment was necessary. Many of the sections of the world into which the potato had been introduced did not offer such an ideal climate for the new crop. In these situations, high temperatures maintained during all or a part of the growing season seriously hampered the reproductive value of the tubers. The work of such investigators as Bushnell (2) has proven

that unfavorably high summer temperatures do not cause the degeneration of potato seed stock directly. The so-called "running out" of the potato is due entirely to the presence of the virus or degenerative diseases. Hot weather favors their development.

Growers complain-

This explains why the potato cannot be expected to successfully reproduce itself in some countries, and in certain sections of many other countries. Growers in many of the southern, central and western states of our own country can produce good crops of table-stock, but they must rely on northern growers for their seed. Before the advent of seed potato certification, it was extremely difficult for these seed-buying growers to obtain stock of known and standard quality. Large losses annually could be traced to poor and diseased seed. Mr. H. R. Talmadge (3) of the Long Island Potato Exchange estimated that the growers of Suffolk County, N. Y. lost $300,000 in 1913 because of poor seed. The mixture of varieties and degenerative diseases were the common troubles experienced. Markets for table stock were even then asking for better uniformity in quality, and this required the use of uniform seed stock by the growers. These growers desired seed potatoes in carload lots, of a single variety, true to name

and free from disease; but such stock was not available.

From the Extension Workers-

State extension and experiment station workers were confronted with these same problems. As expressed by Dr. Mel T. Cook (4) of New Jersey -"During the past five years there has been an increasing number of complaints concerning the character of the seed which we have been using. These complaints involve two points: purity and freedom from disease. Mixed seed hampers the industry in many ways, and is frequently the cause of greater losses than the northern grower can appreciate. It is also true that virus diseases are responsible for heavy losses, and that the seed coming to use is very badly infected."

Economics Involved-

Competition for sales was keen and it often forced the seed grower to extremes in keeping down his cost of production and hence his prices. Still, in 1913, we find the growers of not only Long Island and New Jersey but also those of Virginia (5), North Carolina and Florida evincing a willingness to pay from 25 cents to $1.00 a barrel more for seed stock that was known to be true to type. Higher prices at that time did not insure high quality from year to year. Much of the "seed-stock" on the market was hardly better than ordinary table stock.

The fault was not all with the seed growers. Many northern farmers were then producing high-grade seed potatoes. Others would have been glad to supply such an article if the prices received would warrant the trouble involved in producing and marketing them. The system of classification and distribution then in effect did not afford the grower sufficient means of convincing the purchasers of the superior value of his stock.

Low Yields-

There was also the matter of low yields. Our average production in the United States was as low as 82.5 bu. an acre back in 1898-1902, and for 1909-1913 it was only 97.3 bu. For this last period, Canada had an average of 161.2 bu. to the acre, and practically every European potato producing country but Italy had a yield about double that of our own. This advantage was due in part to the more favorable climates of these other countries, but it is nevertheless true that the use of a higher quality of seed over a period of years will invariably tend to raise the average yield.

Dr. William Stuart (6) of the U. S. D. A. had this point in mind when he stated that if the Southern trucking sections of the Atlantic seaboard could be planted with high-grade seed in 1915, the crop, under normal seasonal conditions, would be increased at least 25 per cent. The

only additional cost to the grower would be a reasonable advance in the purchase price of the seed and the extra cost of harvesting and marketing a larger crop. Even up in 1923 (after we had benefitted by ten years of certification) Dr. Stuart (7) stated that if in any given year it were possible to plant the entire potato acreage of the United States with first-class seed stock, the total production would be increased 10 to 25 per cent. Based on the average production from 1918 to 1922, this increase would have represented from 39 to 79½ million bushels, or an increase in money value of $40,333,000 to $106,333,000.

The need-

In view of the facts that have been presented, it is quite evident that there was a real need for a reorganization of the seed potato industry, from both the viewpoint of the producer and of the planter of seed stock. Official regulations were important in setting up a reliable means of determining disease freedom, varietal purity and productiveness. It fell the lot of the potato specialists of the United States Department of Agriculture to start the work toward the solution of these pertinent problems.

2. The Origin and Progress of Certification.

a. In America

(1) The United States

If we go back twenty years to 1910 and review

the knowledge of potato diseases then available, we will find that very little was known of our present degenerative diseases, and much confusion existed. Dr. Erwin Smith(8) had described the Fusarium wilt, and German writers were publishing on "Blatt-rollkrankheit". Tobacco mosaic was pretty well understood, but no virus diseases of the potato had been much studied.

The Work of Dr. Orton-

The late Dr. W. A. Orton, who at that time headed the plant pathology work for the Bureau of Plant Industry of the U. S. Department of Agriculture, might properly be termed "the Father of Seed Potato Certification in the United States". Through his official duties Dr. Orton came in close contact with the needs of the seed potato industry in this country. The work already done by the Germans attracted his attention, and in April 1911 he went to Europe remaining there until November of that year. Most of his time while there was spent in acquiring an understanding of their point of view, and in comparing the field symptoms of potato diseases in Europe with those in America.

Here, in Dr. Orton's own words, are the results of this trip which led up to the start of our present potato certification system - " The following year, 1912, I spent in field work in the United States and was able to make differential diagnosis of a number of troubles that had

The Late Dr. W. A. Orton

"The Father of Seed Potato Certification in the United States"

been confused and to point out some undescribed potato diseases. In the U. S. Department of Agriculture Bul. 64, "Potato Wilt, Leaf-Roll and Related Diseases", I described Verticilluim wilt as distinct from Fusarium Wilt, and potato leaf-roll as a non-fungus trouble. Potato mosaic was described for the first time, and curly-dwarf, which has later been sub-divided into a number of virus troubles. My manuscript also contained a chapter on streak disease, but this looked so much like a bacterial trouble that I finally with-held it and did not publish it until 1920 (Phytopathology, Vol. 10, No. 2).

"Later workers, particularly Schultz, have completed these investigations until we now have more than a dozen virus diseases of the potato and a number of special pathological pictures due to combinations of two or more.

"While the true virus character of these potato diseases and their transmission by insects was not understood in 1911, the relation of their spread through infected seed had become evident to observers, and I found in practice in Germany a system of "Anerkennung" (recognition). This was a somewhat informal arrangement by which potato fields were examined by plant pathologists and a statement of disease freedom given to the intending purchaser. It served as a starting point for the American system of seed certification, which has grown to be much more highly-organized and practiced on a vastly larger scale than anything in Europe."

Dr. Orton (9) presented a paper on his revised classification of virus diseases of the potato at the meeting of the American Phytopathological Society in Cleveland on December 31, 1912.

Wisconsin the pioneer-

The first definite step toward the adaptation of a seed potato certification system in this country was taken by Wisconsin. The Wisconsin Potato Growers Association, under the leadership of Prof. J. G. Milward, had already taken an advanced position in the development of a pure stock of seed potatoes. Early in 1913, an informal conference with Dr. Orton was held in the office of Dean Russell of the College of Agriculture, Prof. Milward and Prof. L. R. Jones being among those present. The certification idea of Dr. Orton fitted in well with the program that had already been started, and it was promptly adopted.

This first Seed Potato Certification Service in the United States was thus organized by the Horticultural Department of the University of Wisconsin. About forty growers applied for inspection in the summer of 1913, and that fall certificates were issued on about 30,000 bushels of seed.

Dr. Orton's Plan-

At the fifth annual meeting of the American Phytopathological Society, held in Atlanta, Georgia, December 30,1913

to January 2, 1914, in conjunction with the American Association for the Advancement of Science, Dr. Orton (10) first brought his ideas on certification into a definite expressed plan through a paper called "Inspection and Certification of Potato Seed Stock". His presentation follows-

"A system of official inspection and certification is proposed to be established in each of the seed-growing states to provide a means for securing better quality in seed potatoes, with particular reference to freedom from disease, varietal purity and vigor. This inspection, which would be voluntary and at the request of the grower, would be accomplished through a State agency such as the Experiment Station and protected by suitable legislation penalizing misuse of certificates. The grower should pay the cost of inspection.

"The certificates would be based on field inspections of the grower's crop supplemented by a field test to be carried out in the home state and duplicated in the State where the seed will be sold. Two field visits would be required: the first at blooming time, the second just before the foliage dies in the fall, and in certain cases a third inspection of the stored tubers should be made just prior to shipment.

"The requirements for certification would be: uniformity to type, freedom from mixture of other varieties exceeding 1 per cent, uniform size, not over 5 per cent of the tubers shipped weighing less than 2 ounces or over 5 ounces, and freedom from dangerous diseases.

"The presence of the following diseases should disqualify for certification: powdery scab, wart, eel worm, Fusarium wilt, southern brown rot and leaf roll. Other diseases should receive special consideration as follows:

"Oospora scab No potatoes should be included which have any deep scab nor over one-fourth of the surface covered with scabs, nor may the grower deliver stock on which slight scabs occur on more than 10 (?) per cent of the tubers.

"The presence of Rhizoctonia sclerotia shall be indicated on the certificate and the grower should not include heavily covered tubers in certified stock.

"Silver Scurf if found, shall be mentioned in the certificate.

"If more than one-half of 1 per cent of blackleg occurs in the field, the inspector shall exclude the stock from certification.

"The presence of Phytophthora in the field shall be reported in the certificate and the purchaser may require a third examination of the stored potatoes prior to shipment.

"Freedom from any Fusarium dry rot or other types of storage rots cannot be guaranteed except after a special third inspection.

"If over 2 per cent of distinct curly dwarf is present and if over 5 per cent of hills with weak or poorly developed foliage occurs, or if among the sample hills harvested over 5 per cent yields less than 1 pound of marketable tubers, certification shall be refused for the entire stock."

The Potato Association of America.

At the first meeting of the then-called National Potato Association of America (11) held at Cornell University, February 10-11, 1914, this organization went on record as sponsoring a system of certification. This was stated in Article 2 of the original Constitution of the Association which read - "To encourage a system of pure seed certification through field inspection of the growing crop." In Section 8 of the By-Laws, under Committees, the first of ten standing committees listed was -"Seed Improvement and Certification".

This Committee has continued to function as an integral part of the Association's activity ever since that time. It has collected and disseminated information relative to certification, recommended changes in the rules and regulations whenever they were thought advisable, and has strived to bring about a closer cooperation and coordination between all of the agencies interested in the production of better certified potato seed. Practically all of the information immediately available on the progress of certification in America now comes from the annual printed reports of this "Seed Certification Committee".

The Chairmen of this Committee since its appointment in 1915 have been - M. F. Barrus (1915-19), A. G. Tolaas (1919-23), H. O. Werner (1923-24) and Wm. H. Martin (1924-).

In connection with this first meeting of the Potato Association of America, Dr. Orton (12) read a paper

on "Improvement of Potato Seed Stocks Through Official Inspection and Certification." This report was in substance practically the same one that he had given the previous month at the Atlanta, Georgia meeting.

The Pot to Study Trip of 1914.

The next step to arouse the interest of American potato workers in the movement was taken in the summer of 1914, when the Bureau of Plant Industry of the U. S. D. A., (13) brought to this country as its guest, the leading German authority on pot to diseases, Dr. Otto Appel. A very extensive series of visits to the principal potato states was arranged and, from July 27th to October 2nd, Dr. Appel and Dr. Orton visited New Jersey, Maine, Vermont, New York, Michigan, Wisconsin, Minnesota, Nebraska, Colorado, Utah, Idaho, and the Pacific Coast States. They were accompanied throughout the trip by Dr. W.M. Stuart, Horticulturist of the U. S. D. A., who has since that time carried much of the responsibility for the potato improvement work in this country. Dr. H. T. Gussow of Canada and Dr. Johanna Westerdijk of Holland were also present for portions of the trip. In each state, these authorities were met by groups of potato growers, headed by their station pathologists, breeders, horticulturists and agronomists. They were then taken on an automobile tour of the principal potato districts. Particular attention was paid to the newer virus disease troubles, disseminated through seed tubers and to other seed improvement problems, such as loss of

varietal vigor, influence of environment, quarantine laws and regulations, legal regulation of the seed trade, certification standards, methods of field inspection, standards and grades of seed potatoes, the encouragement of commercial production of pure seed stock, the best sources of seed supply, hill and tuber-unit selection, the classification and nomenclature of potato varieties, the standards for commercial varieties, and potato breeding principles and methods. The result of this continued interchange of ideas, between our American growers and specialists and the German visitor, was a much better understanding of not only the obscure potato diseases, but of the problems of seed growing in general, and a stimulating time to continued research in plant pathology.

Philadelphia Conference-

The first official conference on potato certification (14) was held in Philadelphia, Pennsylvania on December 28, 1914, the day preceeding the sixth meeting of the American Phytopathological Society. This conference on state standards for Potato Seed Inspection and Certification was called by the Bureau of Plant Industry of the U. S. D. A., all of the states and foreign countries were invited to send representatives. Thirty-six delegates from twelve states- Ohio, Pennsylvania, Minnesota, Michigan, New York, New Jersey, Connecticut, Kansas, Maryland, West Virginia, Louisiana and Wisconsin and from three foreign countries Canada, Ireland and Germany, as well as the scientists of the U. S. D. A. attended this meeting. Dr. Orton brought forward an outline of a proposed standard for seed certification which he had developed. This was virtually the same as the one already outlined at the Atlanta, Georgia and the Potato Association of America meetings.

The object of the conference, as then stated by Dr. Orton himself, was based on the assumption of the forthcoming organization within the various states of a seed potato inspection service. To quote Dr. Orton - " It presupposes a movement for the betterment of the potato industry, through the improvement of seed potatoes, through the development of specialized growers of seed potatoes, and through an organization created to control diseases and to reduce varietal mixture, to improve varietal types, to be

stimulated by the inspection service organized by the state for the purpose of inspecting seed potatoes and granting certificates to such as may be found worthy of such certification through their varietal purity and freedom from disease."

With Prof. A. D. Selby of Ohio as chairman and Dr. Orton leading the discussion, the conference afforded an excellent opportunity for the exchange of ideas on the following topics:-

1. Standards of varietal purity and freedom from disease.
2. Organization.
3. Methods of Inspection.
4. Legislation.

A great many constructive suggestions were furnished by Dr. William Stuart of the U. S. D. A. and by Prof. L. R. Jones of Wisconsin. Dr. Otto Appel of Germany contributed much of value through his explanations of the work as carried on in his home country. The general result of this conference was the stimulation of interest in the formulation of efficient systems of seed potato inspection and certification in the various states.

Report of the Certification Committee-

The first recorded report of the Seed Certification Committee of the Potato Association of America (15) was

given by its chairman, Dr. M. F. Barrus, at the third meeting in Washington, D. C., November 13-14, 1916. This was a very comprehensive paper which considered the organization, standards and progress of the work up to that date. Dr. Barrus concluded his report with a set of recommendations which he called - "Qualifying conditions for a Certification Service". This was a summary of the opinions evolved from the Philadelphia Conference of 1914, as they had been sorted and evaluated by the Committee. The suggestions of the Committee for the continuation and extension of the work may be outlined as follows:-

General-

1. That seed potatoes be planted in regions suitable for their production.

2. That only varieties adapted to the region be grown for certification.

3. That only one late and one early variety be grown by each association, and that only one variety shall be grown by an individual.

4. That local seed improvement be encouraged through the formation of local associations.

5. That special care be taken in selecting the original seed for certification.

6. That improvement be secured and continued by hill selection and by the maintainance of a seed plot on each farm.

Horticultural Standards-

1. Varietal classification - group name, except some well marked varieties.
2. Conformity to type to be stressed.
3. Purity of seed stock - 5% foreign mixture allowed.
4. Size - 2-10 oz. for early and 2-12 oz. for late varieties.
5. General appearance - reasonably uniform, smooth and free from blemishes.
6. Good cultural methods - excessive weeds or insect injury may reject.
7. Satisfactory yield - for the variety and season.

Pathological Standards-

1. Freedom from wart and powdery scab.
2. Practical freedom from black leg, wilt and serious Rhizoctonia.
3. Practical freedom from leaf roll, curly dwarf, mosaic and other weaknesses.
4. Tolerance of 5% weak hills, to be removed before harvest.
5. Freedom from serious infection other diseases.
6. Tubers should show little blemish from scab, Rhizoctonia or other diseases.

Inspections-

Three to be made-

1. About blooming time.
2. Before harvest.
3. After Harvest.

Organization-

To suit conditions within the state concerned.

Financial Support-

Service should be self-supporting, through entrance fees, prices on certificates and on tags.

Marketing-

1. Sacks should be of uniform size.
2. Shipping inspection should be made.
3. Tags should be attached at this inspection.

Guarantee-

Tag statement should give confidence to customer but not bind the certifying organization to a guarantee.

Further Suggestions-

In its 1917 report (16) the certification committee made some additional suggestions as follows:-

1. That exceptional care be taken to recognize the presence of mixtures, degenerate hills and virus diseases.

2. That frequent timely inspections be made for the recognition of diseases and mixtures.

3. That certified seed be marked so that the planter can determine its source.

4. That varieties be sold into only those localities to which they are adapted.

5. That every effort be made by certifying organizations to locate complaints, determine causes and make adjustments.

Emergency Inspections-

As an emergency war measure (16), inspections were made in 1917 in the states of Colorado, Indiana, Maine, Michigan, Minnesota, New Hampshire, Vermont, Wisconsin and New York by the U. S. Department of Agriculture, Cooperating in each case with the State College. Some independent work was done by the New York State Food Commission, and in all nearly 2,000,000 bushels of seed were inspected and registered in this manner. This work was approved by the Certification Committee, but the seed registered should not be confused with

certified seed, as much of it passed only bin inspection and none of it met the certified requirements.

The Progress of Certification-

In the meantime, the actual organization and development of state systems of certification had been proceeding rapidly following Wisconsin's 1913 venture. Idaho, Maine and Vermont started to certify in 1914; New York and Maryland in 1915, and Colorado in 1917. Ohio started the work in 1918; California, Minnesota, Nebraska, New Jersey and North Dakota in 1919; Michigan, Oregon and Wyoming in 1920; Montana, New Hampshire, Pennsylvania and Washington in 1921; and Kentucky, South Dakota and Utah in 1922. Thus in 1922, twenty-three states were certifying seed potatoes. This is the largest number of states that have ever been active in the work in the United States. Utah discontinued the service in 1924 because of unfavorable soil and climatic factors. Only 2,300 bushels of seed were certified by this state in her two years of inspections. Since that time, only twenty-two states have carried on the work. Further details of the advance of certification in each of these states are given in Tables I to VI which follow this section of history.

Grading Receives Attention-

The outstanding development of the start of the second ten years of potato certification in this country, in

the year 1923, was the increased attention given to seed grading. This work had been stimulated by the establishment of the U. S. Standard Grades in 1917, but in 1921 (17) only six of the certifying states had grading inspections. It was encouraging to note in the surveys of 1922 (18) and 1923 (19) that practically all of the states required a grading inspection in which the minimum standards conformed with the U. S. No. 1 Grade. Extensive tests on certified seed were being carried on cooperatively in many of the seed-consuming states by the certification authorities.

Less attention was paid to production problems in 1924, and more attention was given to effective standards, advertising and distribution. The most notable advances recorded by the certification committee (20) were:-

1. Increased number of field inspections.
2. Improved grading of certified stock.
3. More rigid control of virus diseases because of a better knowledge of symptoms and control.
4. Increased use of seed trial plats to check the effectiveness of field inspections.
5. Great increase in the volume of certified seed produced.

Raising Standards for Certification-

At the twelfth annual meeting of the Potato Association of America, held December 29-31, 1925, at Kansas City, Missouri, the Seed Certification Committee (21)

made a strong plea for more efficient inspections and higher uniform standards. Included in the committees recommendations were the consideration of:-

1. The acreage which one grower should be allowed to enter.

2. The acreage which can be adequately inspected by an inspector.

3. The number of hills to be counted in field inspections.

4. The training of inspectors through a careful study of demonstration plots and through regional conferences.

5. The adoption of uniform disease tolerances.

6. The protection of certified seed from fraud, either through the use of trade marks, or the adoption of a U. S. Grade.

7. The election of a permanent certification Committee.

A definite move toward uniformity of inspection standards was made in the form of a proposed set of rules for use by all states. The tables which will follow gives a summary of the standards in use in 1925, together with the standards proposed by the Committee. This report has proven helpful in standardizing inspection and certification in the various states.

Kansas City Standards- 1925

Field Inspections-Allowances

	Per cent first inspection			Per cent second inspection		
	Mean	Min. Max.	Proposed	Mean	Min. Max.	Proposed
Mosaic	3.7	2 - 5	3.0	2.7	1 - 5	2.0
Curly Dwarf	3.3	1 - 5		3.2	1 - 5	
Leaf roll	5.4	2 - 5	3.0	2.4	1 - 5	1.0
Spindle tuber	3.3	2 - 5	2.0	2.9	1 - 5	2.0
Yellow dwarf	1.8	1 - 4	0.5	1.5	0.5 - 5	0.5
Giant hill	3.0	1 -5	1.0	2.0	.1 - 3	0.5
All combined	5.2	5 - 10	5.0	4.7	2 - 5	4.0
Blackleg	1.8	1 - 3	1.0	1.4	0.5 - 3	1.0
Wilt	2.5	1 - 3	2.0	1.9	0.5 - 3	1.0
Rhizoctonia	6.0	4 - 10	3.0	2.7	1 - 5	
Total diseases	7.0	4 - 10	7.0	6.4	2 - 10	5.0
Weak Plants	4.0	2 - 5	3.0	0.3	0 - 1	0.25
Variety mixture	2.5	0 - 5	2.0	3.0	1 - 5	0.25

Bin Inspection - Allowances

Per cent

	Mean	Min. & Max.	Proposed
Yellow Dwarf	0.5		0.5
Spindle tuber	2.4	1 - 5	2.0
Wilt or stem end browning	5.0	2 - 10	4.0
Rhizoctonia	8.1	5 - 12	10.0 *
Scab	6.9	5 - 10	10.0 *
Late Blight rot	1.7	1 - 2	1.5
Total disease	10.7	10 - 12	10.0

* Ten per cent Rhizoctonia or scab, or ten per cent combined.

The report of the Certification Committee (22) for 1926 showed a decided tendency toward the general use of more rigid inspection standards. In 1922 (18) only two virus diseases had been listed, mosaic and leaf roll. The limit of tolerance for mosaic at the first field inspection was 5 per cent in six states, and 10 per cent in 9 states reporting. In 1926 (22) only one state permitted 10 per cent of mosaic at the first inspection, 4 allowed 5 per cent, 8 allowed 3 per cent and only 2 allowed 2 per cent. Besides mosaic and leaf roll, curly dwarf, spindle tuber, yellow dwarf, giant hill and witches broom were listed as virus diseases.

Further advances-

At about this time, the use of the seed sample trial plot first came into prominence, 10 states requiring it in 1926. Tuber-indexing was being practiced by Michigan, New York, Minnesota and Wisconsin. More attention was being given to the parent stock planted by certified seed growers and the trend was toward more field inspections.

Just prior to the Nashville, Tennessee meeting of the Potato Association of America, December 28-30, 1927, 17 of the 22 certifying states reported that they were operating under standards which met those suggested at Kansas City in 1925. At the Nashville meeting, the Certification Committee (23) submitted a detailed plan for the adoption, copyrighting and protection of a national trademark for certified seed potatoes.

Their plan included the formation of an "Association of Seed Potato Certification Executives" to be affiliated with the Potato Association of America in this special work. The suggested plan provoked considerable discussion but it was not especially well received.

And so, we have traced the development of seed potato certification in this country through the past twenty years. Great advances have been made and recorded and we find the industry of today firmly established. Still, possibilities for continued advances and development seem almost unlimited. The tendency is not only forward but upward.

The tables which follow will serve to present data regarding the past development which may later be of interest and of use. Though much of these data are incomplete, they are apparently the most authentic information now available.

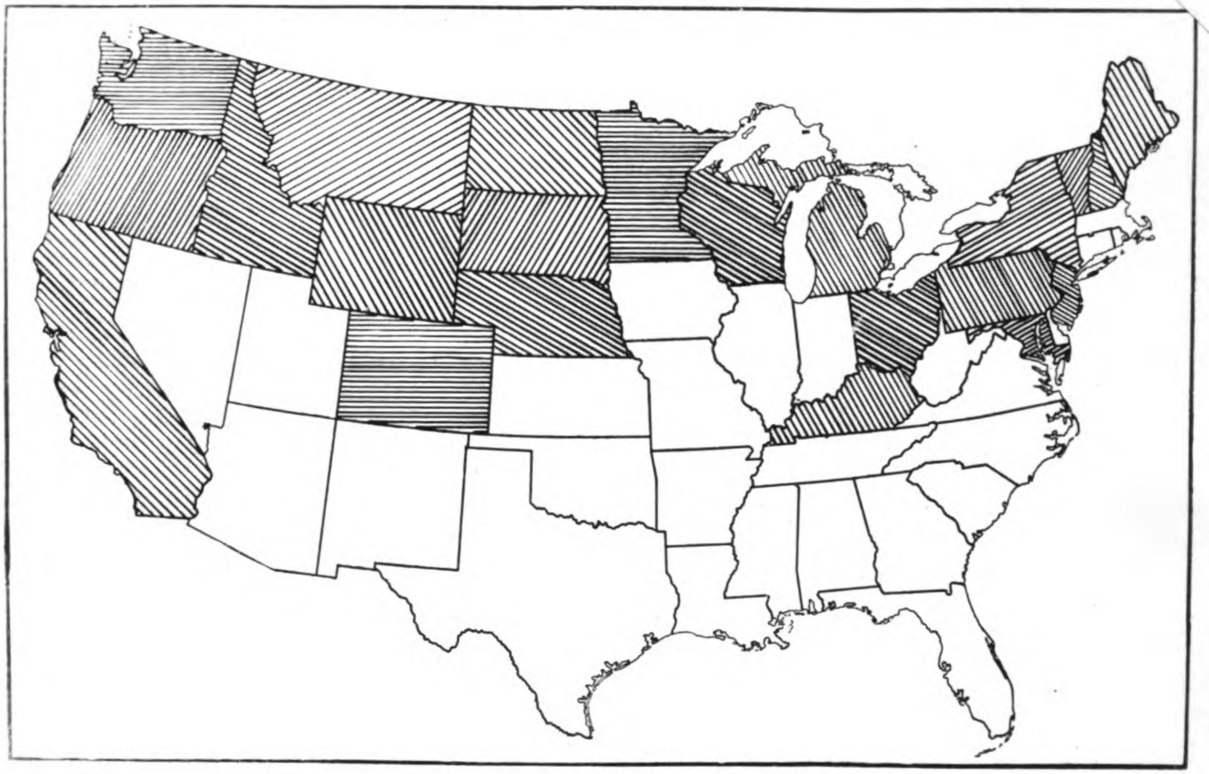


FIGURE 2- States Certifying Seed Potatoes in 1939.

The Progress of Seed Potato Certification

Table I - The AcreageEntered

	State	Year started	1921	1922	1924	1925	1928	1929
1.	California	1919	795	1534		60	130	
2.	Colorado	1917		800	250	320	1684	559
3.	Idaho	1914		4086		1800	7625	3243
4.	Kentucky	1922			195	205	203	153
5.	Maine	1914	1315	2802	25517	18311	25543	15529
6.	Maryland	1915			315		341	581
7.	Michigan	1920	1030	3196	2508	2145	3742	5833
8.	Minnesota	1919	4582	3530	6141	4664	9760	6792
9.	Montana	1921	443	1276	231	481	2394	1132
10.	Nebraska	1919	1085	4500	3358	3000		8916
11.	New Hampshire	1921			108	47	120	49
12.	New Jersey	1919	908	763	757	716	587	621
13.	New York	1915	1638		1592	1483	2394	2636
14.	North Dakota	1919		8615	4745	4164		10710
15.	Ohio	1918					95	48
16.	Oregon	1920	1355	2992	1990			1120
17.	Pennsylvania	1921	400	988	421	66	550	432
18.	South Dakota	1922		830	526	389	735	558
19.	Vermont	1914	782	1100	700	875	1179	1004

Table I (continued)

State	year started	1921	1922	1924	1925	1928	1929
20. Washington	1921	572	1210	124	275	943	616
21. Wisconsin	1913	3000	4225	4250	2555	4084	2719
22. Wyoming	1920			500			3723
TOTAL		17905	42447	54228	41509	62109	66973
Utah	1922		75				

Table II- Number of Growers and Acres per Grower.

State	1921	1922	1925 Growers	1928	1929	'21	'22	'25 Acres	'28	'29
Cal.	27	40	6	29		29.4	38.3	10.0	4.4	
Colo.		110	39	224	73		7.3	8.2	7.5	7.7
Idaho		798	160	600	238		5.1	11.2	12.7	13.6
Ky.			31	32	23			6.6	6.3	6.7
Me.	118	240	623		516	11.1	11.7	29.4		30.1
Md.				85	177				4.0	3.3
Mich.	146	532	325	825	802	7.1	6.0	6.6	4.5	7.3
Minn.	504	441	511	581	488	9.1	8.0	9.1	16.8	13.9
Mont.	78	246	44	277	110	5.7	5.1	19.2	8.6	10.3
Nebr.	62	298	114		234	17.2	15.1	26.3		38.1
N. H.				18					6.6	
N. J.	85	103	81	74	64	10.7	7.4	8.8	7.9	9.7
N. Y.	272	208	182	254	241	6.0		8.1	9.4	10.9
N. D.		833	123		430		10.3	33.8		24.9
Ohio				22	9				4.3	5.3
Ore.	288	290			152	4.7	10.3		10.3	7.4
Pa.		187		53	84		5.3		10.5	5.1
S. D.		138	85	70	38		6.0	4.6	4.7	14.7
Vt.	203	277	180	248	149	3.9	4.0	4.8	6.2	6.7
Wash.	105	188	38	151	134	5.4	6.4	7.0	11.0	4.6
Wis.	370	560	259	371	262	8.1	7.6	9.8		10.4
Wyo.					202					18.4
TOTAL	2358	5489	2801	3914	4426	7.6	7.7	14.8	15.8	15.1

Table III - Acreage Certified

State	1921	1922	1924	1925	1928	1929	1921	1922	1928	1929
	Acreage certified						% Acreage certified			
Cal.	420	1384		35	86	55	52.8	90.2	58.3	
Colo.		500	151	216	775	431		62.5	67.5	77.1
Idaho		1464	1333	1678	5590	2457		35.8	93.2	75.8
Ky.			178	174	123	120			84.9	78.4
Me.	608	1189	14645	9489	16728	10799	46.2	42.4	53.7	69.5
Md.		48	161		229	342				58.9
Mich.	660	2429	1824	1876	3258	4023	61.4	76.0	87.4	68.9
Minn.	3783	2671	5164	3496	5579	5347	82.6	75.6	74.9	78.7
Mont.	295	318		447	1849	990	66.6	24.9	93.1	87.5
Nebr.	656	1800		1721		7636	60.5	40.0	57.3	85.6
N. H.			103		95	33				68.0
N. J.	574	288	658	542	580	543	63.2	37.8	75.6	87.4
N. Y.	1121	1803	1327	1243	1754	2474	68.4		83.8	93.9
N. D.				3232		6076			77.6	56.7
Ohio					51	44				91.7

Table III - (continued)

State	1921	1922	1924	1925	1928	1929	1921	1922	1928	1929
	Acreage certified						% Acreage certified			
Ore.	387	550	220			878	27.5	18.4		78.4
Pa.	68	316	260	66	209	282	17.0	32.0		65.3
S. D.		678	274	219	620	476		81.7	56.3	85.3
Vt.	480	588	645	470	629	502	61.4	53.5	53.7	50.0
Wash.	447	216	53	145	779	533	78.1	17.9	52.8	86.5
Wis.	1500	2000	2490	931	2833	1954	50.0	47.4	36.4	71.9
Wyo.			400			3495				93.9
TOTAL	10999	18242	28952	25980	41767	49490	59.5	42.9	62.5	74.0
Utah		17								

Table IV - Acreage Rejected in 1928 (24)

State	Samp. plot	1st. field	2nd. field	3rd. field	Tuber	Total	Reason rejected
Cal.	4	40	0	0	0	44	L.R.,Stand,Var. Mixt.
Colo.	97	448	240		124	909	L.R.,Mos.,B.L.,S.T.,Wilts
Idaho		1547	488			2035	B.L.,Mos.,W.H.
Ky.	4	25	36		15	80	Mos.,S.T.,Early Frost
Me.		5840	2857		118	8815	Mos.,B.L.,S.T.,L.R.,Prox. other fields
Md.		112				112	Virus & other disease, Prox. other fields
Mich.		190	234	60		484	B.L.,Mos.,W.H.,Drowned out
Minn.		400	3781			4181	Mos.,S.T.,B.L.,L.B.,Dr. out
Mont.		261	167	117		545	Diseases,bugs,culture
Nebr.							
N. H.		11	14			25	Diseases
N. J.		5	2			7	Mos., mixture
N. Y.	334	264	42			640	L.R.,Mosaic
N. D.							

Table IV (continued)

State	Samp. plot	1st. field	2nd. field	3rd. field	Tuber	Total	Reason Rejected
Ohio	9	27	8			44	L.R.
Ore.							
Pa.		341				341	Mos.,L.R.
S. D.		49	55		11	115	S.T.,L.B.,B.L.,Rhiz., Cul
Vt.		440	110			550	L.R.,Mos.,B.L.
Wash.						164	Weeds,Lack of vigor
Wis.		904			347	1241	Mos.,Lack of vigor
Wyo.							
TOTAL	448	10904	8034	177	368	19438	

Key to abbreviations found on page 88.

The Trend of Certified Seed Potato Production in the United States.
1 square = 100,000 bushels.

FIGURE 3-

Table V. Bushels of Seed Certified.

State	1921	1922	1924	1925	1928	1929
Cal.	90,000	100,000		7,000	11,350	11,335
Col.		84,000	24,500	32,760	57,850	72,350
Idaho			137,478	283,333	345,067	185,263
Ky.			10,000	15,000	9,900	21,117
Me.	217,360	297,250	4,832,850	1,779,187	5,094,128	3,998,902
Md.		6,316	15,285	8,204	21,581	40,488
Mich.	97,000	315,758	870,950	225,000	673,500	530,411
Minn.	605,280	338,100	774,800	593,175	1,140,987	911,099
Mont.	30,858			70,000	266,600	69,350
Nebr.	44,885	84,000		112,000	152,400	317,770
N. H.			25,418	12,287	17,250	5,500
N. J.	574	46,120	80,000	57,912	100,355	62,286
N. Y.	235,915	306,119	281,400	240,000	404,300	553,200
N. D.			78,000	240,000	539,855	510,200
Ohio				4,120	8,000	6,400
Ore.		10,000	14,050	27,600	154,237	76,200

Table V (continued)

State	1921	1922	1924	1925	1928	1929
Pa.	24,875	67,827	64,700	25,965	60,490	69,760
S. D.		28,873	46,940	29,546	55,515	59,206
Vt.	100,000	125,000	185,000	115,000	140,575	75,000
Wash.	23,530	26,500	10,493	11,500	81,825	50,800
Wis.	250,000	400,000	465,000	159,950	441,360	290,426
Wyo.				21,000	350,000	187,420
TOTAL	1,719,703	2,235,863	7,316,814	4,067,539	10,127,225	8,104,483
Utah		3,000				

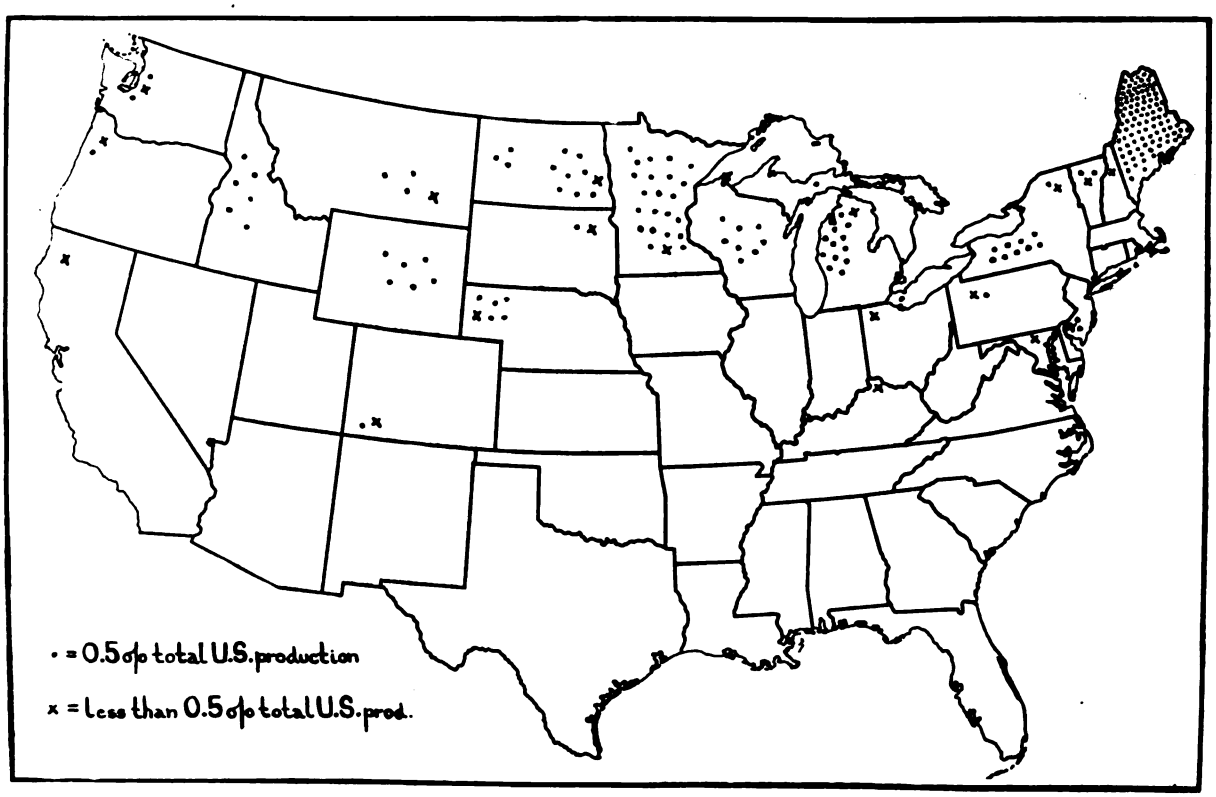


FIGURE 4- [illegible] is produced in the United States- [illegible] of 1955-1956.

Table VI Bushels Certified per Acre

State	1921	1922	1925	1928	1929
Cal.	214	72	200	132	206
Colo.		168	152	75	168
Idaho			169	62	75
Ky.			86	80	176
Me.	358	250	188	305	370
Md.		132		94	118
Mich.	147	130	120	207	132
Minn.	160	126	170	204	170
Mont.	105		157	144	70
Nebr.	69	47	65		42
N. H.					167
N. J.		160	107	173	115
N. Y.	210	170	193	231	223
N. D.			74		84
Ohio				157	145
Ore.					87
Pa.	366	215			247
S. D.		43	135	90	124
Vt.	208	213	245	223	149
Wash.	53	123	79		95
Wis.	167	200	172	156	149
Wyo.					54
TOTAL	156	123	153	210	164

Certified Seed Potato Production in

the United States.

(From Incomplete Reports of the Certification Committee)

Year	Acreage Inspected	Acreage Certified	Per cent Acreage Qualified	Bu. certified seed Produced
1913				30,000
1917		2,000		291,670
1919	8,600	3,750	43.5	475,308
1920	12,665	6,618	52.25	1,060,120
1921	17,905*	10,999*	59.5	1,719,703*
1922	42,522*	18,259*	42.9	2,237,863*
1923	45,040	21,883	48.5	4,437,215
1924	54,228*	28,952*	53.4	7,316,814*
1925	41,509*	25,980*	62.5	4,067,539*
1926	45,849*	32,045*	70.0	5,080,708
1927	58,879*	36,752*	62.5	7,127,640
1928	62,109*	41,767*	67.25	10,127,225
1929	66,973	49,490	74.0	8,104,483

*These figures are known incomplete.

2.a (2.) Canada

The early developments of seed potato certification in the United States and in Canada have such a common background that it is hardly possible to separate them. Both programs had their inception in the same general need and at about the same time. Because of her more unified governmental organization, Canada has perhaps been able to work out plans more methodically and completely. Generally stated, however, the developments in the two countries have paralleled each other from the start and the utmost spirit of cooperation and good-will between the various agencies concerned has prevailed throughout.

Leaf roll and mosaic were first observed as such in Canada in the summers of 1913 and 1914. In his report for 1915, the Dominion Botanist, Dr. H. T. Gussow (25) discussed these two diseases and even went so far as to recommend that all fields showing more than 5 per cent of infected plants should be discarded for seed. Dr. Gussow's work was closely in harmony with that then being done by Dr. W. A. Orton of the U. S. Department of Agriculture. He had accompanied Dr. Orton and Dr. Appel of Germany on a part of their 1914 summer tour of the principal potato sections of the United States. From this trip, he gleaned many ideas which later influenced his part in the setting-up of seed potato certification in Canada. The work in Canada from the start has been under the supervision of the Division of Botany of the Dominion Department of Agriculture, headed by the Dominion Botanist, Dr. Gussow.

Representatives of this Dominion Division were active participants in the Philadelphia Conference (14) of December 28, 1914 on Standards for Seed Potato Inspection and Certification.

Start of Inspection Work

For several seasons, the plant disease inspectors of the Division had been conducting roguing demonstrations and field inspections of seed potatoes on a small scale. The object was to reduce varietal mixtures and diseased plants. The benefits of the work, as given by Dr. Gussow (26) were--

(1) Reduces the disease present and improves general stand.

(2) Encourages the farmers to take up the work themselves.

(3) Affords an opportunity for educational work on diseases and disease control.

(4) Serves as an economic potato disease survey.

(5) Improves the market value of Canadian seed.

In the summer of 1915, about 100 farms were inspected in this manner on Prince Edward Island. Over 100 fields were rogued in New Brunswick and the crops of 33 of these were recommended to prospective buyers for seed purposes. A similar survey was conducted in Nova Scotia. In each case, a record was kept of the percentage of diseases and of foreign

varieties rogued out, and the field inspection was followed by a bin or cellar inspection. A number of valuable statistics were accumulated. A large part of the success of Canada's system of certification from the beginning can be traced to the complete set of records always kept available for reference purposes, which started with the data just mentioned.

This same general procedure of conducting a combined survey and educational program in each province before any actual inspections for certification were made was typical of the Canadian method. Two years of preliminary work usually preceded the start of inspection.

The Start and Spread of Certification

Certification was first made in 1916 (27) in the three maritime provinces of Prince Edward Island, New Brunswick and Nova Scotia. In the last-named province, a limited number of crops of the Carnet Chili variety were certified for export to Bermuda. This was the start of the now famous Canadian certified potato seed export trade.

Inspection and certification was extended into Quebec and northern Ontario in 1918 (27); into southern Ontario and Manitoba in 1920; and into Saskatchewan, Alberta and British Columbia in 1921 (28).

Organization

Until 1918, the work in Prince Edward Island and Nova Scotia had been conducted by the Botany Division officer in charge of the Charlottetown (P.E. I.) Laboratory; and that in New Brunswick and Quebec by the officer in charge of the Fredericton (N. B.) Laboratory. In 1918, because of the increased scope of the work and the desire for uniformity of standards and methods, the whole was placed under the control of one man, who was Dr. Paul. A. Murphy of the P. E. I. Station.

The inspection service had become so widely established by the spring of 1920 (27) that it was deemed best to place it in direct charge of the office of the Dominion Botanist, at the Central Experimental Farms, Ottawa, which office had already supervised the work indirectly. George Partridge was made the first Chief Inspector in Charge. He was succeeded by John Tucker in 1926.

In British Columbia, the work was originated by the Provincial Department of Agriculture. Starting in 1924, the inspection work was carried on cooperatively between the Provincial and Dominion Departments of Agriculture. The Dominion authorities took over the work entirely in 1927, thus placing all nine provinces under one head, with one set of standards, rules and regulations.

It was interesting to note in 1927 (29) that the total cost of the Canadian Inspection Service for certifying potato seed was estimated at $78,000. Two senior inspectors

and seven district inspectors on full time, and fifty temporary inspectors, traveled over 300,000 miles by car and rail in the pursuance of their duties. One field inspection was made that year on 31,601 acres, a second field inspection on 20,500 acres, over 6,000 tuber inspections, and about 2,000 shipping inspections. The total cost per acre for all inspections varied from $1.20 on P. E. I. to $3.72 in British Columbia.

Fees

No fees have ever been charged the Canadian grower for his use of the Inspection Service. The entire expense is borne by the Dominion Government through the disease control work of the Botany Division. Since the export trade has become an important phase of the industry, part of this cost could perhaps rightly be assessed to the promotion of industry and commerce.

The Influence of the P. A. A.

The similarity between the standards in use in Canada and in the United States can be traced in part to the Association of the certifying officials of these two countries in the activities of the Potato Association of America. At the third Annual Meeting of this Association (30) in 1916, the word "National" was purposely dropped from the Association name, so as to pave the way for the active membership of the Canadian potato men. Canada has had a prominent part in the work of the Association ever since.

Certification Standards

In the development of the first Canadian work, and up into 1920, only one field and one tuber inspection was made. Complete records were made on each inspection and were filed in the Central Office. Two grades of seed were passed at that time as follows:-

	Grade No. 1	Grade No. 2
Field Inspection - all diseases, weak and foreign plants allowed	5%	7%
Tuber Inspection - all diseases, injuries and impurities allowed	10%	12%

A final supplementary or shipping inspection was introduced in 1920 on all potatoes shipped out of the producing area. Tags were issued by the inspector and placed by him on the shipment at the point of loading.

"Mixed" or "unknown" varieties were the cause for much of the disqualified acreage at the start. Government workers paid considerable attention to the introduction of pure seed of one variety into some sections. The Department of Agriculture even purchased a quantity of certified seed from New Brunswick growers for distribution in other sections.

In 1920 (27), the No. 2 grade was abolished, and all fields which met the Grade No. 1 standard at blooming time were given a second inspection just before maturity.

Due to the difficulty sometimes experienced in recognizing the presence of leaf roll and mosaic, the standards were raised in 1921 (30) to cut out all allowance for weak plants. As a further check, the right was reserved to reject a field on the basis of its past history in regard to virus diseases. This was made possible by the maintainance at headquarters of a complete card index system, containing the history and behavior of hundreds of lots of seed inspected year by year, together with their origin. A questionable field could thus be traced back for several years and possibly disqualified, even if the current report were favorable. The value of such a system in guaranteeing quality in seed stock offered for sale is obvious.

The following amounts of disease were present in fields accepted for certification (31) in 1922:- Blackleg - .47%, Leaf roll - .65%, Mosaic - 1.06%, and Wilts - .14%, or a combined average of 2.2%. Rhizoctonia was reported as being by far the most serious tuber disease.

Permanent Standards

Inspection standards were formulated annually up until 1922. In this year (31) the first set of "permanent standards" were adopted. There were applicable to all inspections of potatoes for seed certification made in the Dominion.

The standards first put into use in 1922 were slightly modified for the 1925 inspections (32). They were then as follows:-

Field	% allowed	Tuber	% allowed
Blackleg	3	Wet rot (bacterial)	2
Leaf Roll (curly dwarf, etc)	2	Late blight and dry rot	3
Mosaic	2	Common scab and Rhizoctonia - severe	5
Wilts	3	Powdery scab	1
Foreign	1	Necrosis, wilts and internal discolor.	5
Total	6	Total*	10

*No more than 2 per cent of the tubers shall be foreign, badly off-type, or damaged by sunburn, cuts, cracks, bruises, insects, etc.

No frost injury shall be allowed.

Not more than 5 per cent by weight of the tubers shall be below 3 ounces or above 12 ounces.

Two field inspections were instituted in 1925, one at the time of blossom, and the second 3 to 4 weeks later. Practically all of the fields rejected that year were not planted with certified seed.

In addressing the twelfth annual meeting of the Potato Association of America at Kansas City, Missouri, December 30, 1925, D. J. MacLeod (33) stated the chief problems of certification in the Dominion as --

1. Continued use of uncertified seed as parent stock.

2. Difficulty in obtaining field registrations from the grower by the required date set.

3. Unfair complaints due to poor storage of seed after certification and shipment.

4. Elimination of oversized seed in grading certified stock.

5. Use of bogus certification tags.

6. Growing of seed potatoes in unsuited localities.

Tagging Certified Seed

To add a distinctive note to Canadian certified seed of the two most important varieties, and to facilitate the tagging operation, specially printed tags (34) yellow in color for the Irish Cobblers and green for the Green Mountains, were first provided in 1926. Other varieties, making up less than 10 per cent of the crop, were marked with the standard buff-colored manilla tags as provided before. All seed was tagged as "Extra No. 1", which meant that it was up to the requirements of the inspection standards already given. The date of issuance was stamped on the

"This tag has been issued to the grower on the date shown on the front of the tag for one container of potatoes, and is to certify that satisfactory evidence has been given that the potatoes have been grown by the person whose certificate number it bears, and that they have been inspected in the field and after harvest by an officer of the Dominion Department of Agriculture and have been found to be sufficiently vigorous and free from serious diseases, pests and foreign varieties to warrant them being classed as GRADE EXTRA No 1 SEED POTATOES."

"This tag has been issued on the express condition that the person to whom it is issued and whose certificate number it bears, undertakes to grade the potatoes for which it is to be used so that they shall be practically free from rotted or cut or seriously injured, foreign or off-type tubers, and that not more than five per cent by weight shall be below three ounces or above twelve ounces, and on the further condition that the said person assumes entire responsibility for the contents of any package to which this tag may be attached by him."

"THE ORIGINAL PURCHASERS OF CERTIFIED SEED POTATOES ARE REQUESTED TO EXAMINE THEIR POTATOES AT ONCE AND LODGE ANY COMPLAINTS FORTHWITH. AFTER BEING KEPT IN UNSUITABLE STORAGE FOR ANY LENGTH OF TIME, NO GUARANTEE CAN BE GIVEN AS TO THEIR QUALITY."

FIGURE 5- Canada's Official Certified Seed Tags.

front of each tag, to give a check on storage difficulties after inspection.

The Export Trade Development

The demand for Canadian certified seed stock for export increased rapidly from the time of the first shipment to Bermuda (27) in 1916. Buyers in the United States especially soon appreciated the uniform quality of the seed from the maritime provinces of Prince Edward Island, Nova Scotia and New Brunswick. The demand was so brisk, and the prices so high in 1923, that some difficulty (32) was experienced in these provinces with getting the growers to carry over enough seed for their own planting the following season.

This export development became of real economic importance, and it has effected the standards of Canadian seed, because the government certification authorities realized that to retain and increase the foreign demand they would have to maintain the highest possible level of quality.

In 1927 (29), $1,500,000 worth of certified seed was exported to the Atlantic seaboard states of the United States, to Cuba, Bermuda, Jamaica and British Guiana. The following are estimates of the shipments to the United States for four representative years:

1920 - 48,750 bu.
1921 - 61,100 bu.
1926 - 973,000 bu.
1927 - 1,100,100 bu.

A limited number of sales have been made into the western United States from British Columbia and Alberta. This trade (35) was started with some trial demonstration shipments into California and Oregon in 1925.

Prince Edward Island has continued to expand her acreage until she now ranks as the leading certified potato seed producing state or province in America. This little island province of only a million acres (about the size of Long Island) and 95,000 inhabitants has an ideal potato soil and climate (36), and is further aided by excellent facilities for shipping by rail or water. Most of the seed from the Island is sold through the Cooperative Potato Growers Association, the principal shipping ports being Charlottetown and Summerside in the fall, and Georgetown in the winter season. About 51 per cent of the total potato acreage, or 24,815 acres, was inspected for certification in 1927 (29) and 81 per cent of this passed. The average yield for certified fields was about 300 bushels to the acre. Only the Irish Cobbler and Green Mountain varieties were handled. Further facts are given in Table IV which follows this section.

Changing Standards

Although a so-called "permanent standard" had been set up and put into use in 1932 (31), it was found advisable to make occasional changes in this standard as

unforseen conditions warranted it. The revision of 1925 (32) was followed by a minor change in 1926 (37) which reduced the misses allowed to 2 per cent, unless these skips could be traced to mechanical causes.

The use of two field inspections in 1925 had made other changes necessary. As the standards used in 1929 were practically the same as those issued in 1927 (29), the 1927 standards are here given for reference purposes.

Field

	1st inspection per cent	2nd inspection per cent
Blackleg	3	1
Leaf roll, curly dwarf	2	1
Mosaic	2	1
Wilts	3	2
Foreign	1	½
*Misses (if due to roguing)	2	
Total disease	6	3

*Deleted in 1928 because lack of roguing favored disease spread; but placed at 10% in 1929.

Tuber

	per cent
Wet rot (bacterial)	½
Late blight or dry rot	1
Scabs or Rhizoctonia	
Slight	10
Severe	5
Necrosis, wilts and internal discolorations other than due to variety.	5
Total(except slight scab or Rhizoctonia)	7
Powdery scab under scabs	1
Malformed, spindly, badly damaged by sunburn, cuts, cracks, bruises, insects, etc.	2
Frost injury	0
Foreign tubers	0

Not more than 5 per cent by weight of the tubers shall be below 3 ounces or above 12 ounces.

At fall bin inspection if more than 3 per cent late blight is found in the bin, grower will not be allowed to grade for fall shipment, but may hold for spring shipment, subject to re-inspection.

It can readily be seen by an analysis of these standards that they are not superior or even equal to those in force in a few of our own United States. The success of the Canadian system is due not so much to its rigid standards as it is to the thoroughness with which these standards are applied and the unity of the system that is back of them. Canadian Certified Extra No. 1 Seed Potatoes have thus come to represent the finest in a uniform quality. The work has been zealously supported by the Dominion Department of Agriculture because it has added another source of foreign revenue for Canadian farmers, as well as helping to improve the lot of all those who grow potatoes for any purpose, by offering them superior seed stock. The misuse of Canadian certified tags or the false advertising or selling of certified seed throughout Canada is prohibited by Dominion law and punishable by heavy fine. The future of the Canadian certified seed as a market proposition lies in convincing the prospective purchasers of seed stock that a product of superior quality is always to be

found under the Dominion seal. Briefly, the policy for the furtherance of this end, as stated by H. S. MacLeod (38), is this:--

1. Increasingly high standards.
2. Strict enforcement of these standards.
3. A tuber-unit seed plot to be maintained by each grower.
4. Regional testing of seed stock to bring out virus diseases.
5. Encouragement of the use of certified seed by more commercial growers.

The Progress of Seed Potato Certification

in Canada.

Table I. Acreage Inspected.

Province	Year started	Total acres inspected. 1920	1921	1924	1926	1927	% total acreage planted 1926	1927
P. E. I.	1916	886	963	9,003	9,275	24,845	26.58	50.91
Nova Scotia	1916	379	276	298	219	620	.71	1.90
New Brunswick	1916	1,413	951	6,310	2,032	2,777	4.75	5.91
Quebec	1918	3,869	4,106	1,351	340	590	.21	.36
Ontario	1918	472	486	1,083	826	1,205	.54	.76
Manitoba	1920	594	613	190	146	145	.50	.52
Saskatchewan	1921		374	371	213	407	.48	.93
Alberta	1921		131	337	152	250	.47	.80
B. Columbia	1921			296	512	762	2.57	3.81
TOTAL		7,613	7,900	19,259	13,717	31,601		

Table II Acreage Passed.

	Total acres passed					% acres passed				
Province	1920	1921	1924	1926	1927	1920	1921	1924	1926	1927
P. E. I.	753	541	8,365	7,597	19,915	84.9	56.2	92.8	82.0	80.1
Nova Scotia	315	208	224	172	377	83.1	75.4	75.4	78.5	60.8
N. B.	868	639	3,595	1,195	1,732	61.4	67.2	56.9	58.8	62.4
Quebec	1,286	1,726	352	182	385	33.2	42.0	26.0	35.6	65.3
Ontario	384	431	671	579	950	81.4	88.6	61.9	70.1	78.8
Manitoba	350	520	80	100	57	58.9	84.8	42.0	68.6	39.3
Saskatch.		159	246	103	131		42.3	66.3	48.0	32.2
Alberta		66	183	56	50		50.4	54.3	36.8	20.0
B. C.			201	409	278			67.7	79.7	36.6
TOTAL	3,956	4,290	13,917	10,393	23,875	51.9	54.3	72.3	75.8	75.6

Table III. Number of Growers

Province	Number 1925	Number 1927	acres per grower. 1925	acres per grower. 1927
P. E. I.	1,210	4,385	6.0	5.7
Nova Scotia	118	248	2.5	2.5
N. B.	476	338	7.9	8.1
Quebec	154	319	3.6	1.9
Ontario	316	354	4.0	3.4
Manitoba	38	24	3.4	6.0
Saskatch.	91	50	3.5	8.1
Alberta	121	72	2.8	3.5
B. C.	282	320	1.6	2.5
TOTAL	2,796	6,110	5.2	5.2

Table IV. The Rise of Prince Edward Island's Production.

	Acres inspected	acres passed	% total acres passed in Dominion
1920	886	523	13
1921	963	541	13
1922	2,367	2,155	31
1923	3,213	3,049	43
1924	9,004	8,339	60
1925	7,331	6,516	60
1926	9,275	7,597	73
1927	24,845	19,915	83
1928	32,083	25,886	82
1929	22,565		

Table V. Reason for Field Rejections 1927

Province	Black leg	Leaf roll	Mosaic	Wilts	Foreign varieties	Lack of vigor	Adjacent to disease
P. E. I.	294	6	401	51	154	66	78
N. S.	11	9	26	5	42		24
N. B.	49	7	155		8		17
Quebec	17	3	50	6	7		40
Ontario	23	16	25		8		27
Manitoba	9	1	2		3	5	1
Saskatch.	30	2	11		8		9
Alberta	22	6	11		6	2	4
B. C.	6		132	10	22	22	89
TOTAL	461(20%)	50	813(36%)	72	258	95	289

Province	Lack of cult. insect injury	Late blight	Misses	Not eligible	Rejected fields	Rejected area
P. E. I.		10		111	1,171	4,930
N. S.	4		1	29	151	243
N. B.					236	1,045
Quebec	8	6			137	205
Ontario	6		3		108	255
Manitoba					21	88
Saskatch.			2	1	63	276
Alberta	1				52	200
B. C.				43	324	484
TOTAL	19	16	6	184	2,263	7,726

The Production of Certified Seed in Canada.

Year	Number of fields inspected	Number of acres inspected	Number of fields passed	Number of acres passed	percentage of fields passed	percentage of acres passed	Bushels certified Total	Per acre
1920		7,613		3,956		51.75	337,517*	
1921	2,646	7,900	1,634	4,290	61.7	54.3	320,000*	
1922	3,283	11,250	2,139	6,991	65.3	62.1	490,000*	
1923	8,914	9,681	2,061	7,100	70.7	73.3	318,500*	
1924	5,586	19,239	3,868	13,917	69.25	72.3		
1925	4,542	14,451	3,307	10,857	72.8	75.1	1,776,666	164.0
1926	4,212	13,715	3,094	10,393	73.5	75.8		
1927	5,388	31,601	6,125	23,875	73.0	75.6	3,600,100	151.0
1928		40,494		31,503		77.8	6,815,050	216.0
1929		32,007		24,281		75.9	4,750,200	196.0

*The figures for these years are apparently incomplete.

2. b. In Europe

The potato is the main source of revenue from agriculture in many areas in Central Europe, where it is the chief food of the common people and is also used extensively for stock feeding, and for the manufacture of starch, flour and alcohol. More than 90 per cent of the world's potato crop (39) is still grown in Europe.

Germany a Leader-

Germany has long been noted for the development and intensity of her potato culture. Dr. W. A. Orton (40) of the U. S. D. A., made a careful study of her potato industry in 1911, and one of the factors that he placed foremost as being responsible for her high yields was the use of disease-free seed.

The inspection and certification of seed potatoes appears to have been made first of all in Germany. It began very early in the present century (probably 1902), a few years after the establishment of the German Agricultural Society (41) in 1897. German pathologists are the first recorded as having classified the leaf roll disease, and they made recommendations for its control through field roguing. The early work was carried on directly through experts of the Agricultural Society, who issued certificates to the owners of disease-free crops. Later, the system was broadened to work through the local Boards or Chambers of Agriculture (42),

of which there is one in nearly every state and province. Seed potato certification in Germany has never become as highly organized or as generally used as it has in some other countries; but the German system has been the parent of many of those which now surpass it, including the United States.

Holland's Contribution-

Holland has also been a leader in seed potato certification. Her Scientists were giving close attention to the classification of the virus diseases back in the 19th Century, and began field roguing for disease control (43) about 1900. A cooperative method of field inspection has been in operation since 1903 (in Friesland), being organized by the Provincial Agricultural Societies. The inspectors are not State officials, but qualified men of local reputation. In 1919, the work of the 13 small societies was brought together under the Central Committee for Seed Inspection and Recognition. A greater uniformity of standards has thus been developed, in cooperation with the 4 Government institutions for plant study. The seed dealers of Holland have a separate organization, which has rules insuring the handling of only certified seed by members of their association.

Other Countries in Continental Europe

Certification in Austria (41) has been going forward since 1907 and two systems are now carrying on the

work there. The State system is widely spread, and some work is also done by the German Agricultural Society for Austria. Each Austrian province has a Field Inspection Committee, the members of which are the seed specialists of the provincial Agricultural Society, as well as officials of the Government Agricultural Experiment Stations.

Hungary also has a complete state system. Checkoslovakia's work is very similar to that of Germany. Soviet Russia has certified some potato seed. Denmark has built an inspection service about her well-known Cooperative Farmers Unions. France is carrying on potato certification in several of her northern provinces. Belgium, Estonia, Lithuonia, Poland and Switzerland are all known to have developed some system of organized seed potato certification.

In Italy and Spain, there is no work of this type now carried on. These countries buy some certified seed from Holland, Germany and Scotland.

In Great Britian-

England and Wales have established a system of certification about their campaign to subdue the dreaded wart disease. Difficulty in obtaining sufficient seed of the immune varieties for planting in quarantined areas of infestation in 1918 was the immediate reason for the start of inspection. Virus diseases were later taken into

consideration (44), and since 1921, when wart quarantine restrictions were relaxed, the demand for certified potato seed has continued just the same.

Scotland (45) started certification at the same time as England, and because of a favorable climate has developed considerable of a seed potato industry. As much as 40 per cent of the total potato acreage (1925) has been inspected for seed. Scotland has had practically a monopoly on the English and Welsh export trade. Most of the better Scotch farmers have their seed fields inspected, if only for their own use.

Northern Ireland certifies some potato seed on a scheme that is similar to the English one.

The Irish Free State (46) formerly had a profitable seed trade with western England, Wales and Malta. Since the war, she has been striving to regain this trade through the development of a certification program(47) against virus diseases and varietal mixture. Climatic conditions there are very favorable for the production of high quality seed stock.

Elsewhere

New Zealand started the certification of seed potatoes in the 1927-28 season, and is the only country known to be certifying outside of Europe and America.

The Known Progress of Seed Potato Certification Outside of America.

Certifying country.	Year started	System based on
Austria	1907	German
Belgium	1928	Dutch
Checkoslovakia	1921	German
Denmark	1910	
England	1918	
Estonia		German
France	1921	Dutch
Germany	1902	
Holland	1903	
Hungary	1923	
Irish Free State	1918	English and Canadian
Northern Ireland	1922	English
Lithuania		German
New Zealand	1927	Canadian
Poland	1907	German
U. S. S. Russia	1926	German
Scotland	1918	English
Switzerland	1916	German

IV. 1. A Summary of the Present Situation in America.

(I.) Administration

	Agencies certifying and headquarters	In charge of
Can.	Dominion Dept. of Agriculture, Ottawa	J.R. Tucker
Cal.	State Dept. of Agriculture, Sacramento	J. E. Currey
Colo.	Cert. Seed P. G. Assoc. & Hort, Agr. College, Fort Collins	C. H. Metzger
Idaho	Cert. Seed P. Imp. Assoc. & Hort, Agr. College, Boise	E. R. Bennett
Ky.	Hort, Agr. College, Lexington	J. S. Cardner
Me.	State Dept. of Agriculture, Augusta	E. L. Newdick
Md.	Seed Cert. Bd. & Path., Agr. College, College Park	R. A. Jehle
Mich.	Crop Imp. Assoc. & Fr. Crops, Agr. College, East Lansing	H. C. Moore
Minn.	State Dept. of Agr., St. Paul	A. G. Tolaas
Mont.	Pot. Imp. Assoc. & Hort, Agr. College, Bozeman	F. M. Harrington
Nebr.	Cert. Pot. G. Coop & Hort., Agr. College, Alliance	Wm. Morrow
N. H.	Botanist, Expt. Sta., Agr. College, Durham	O. Butler
N. J.	Pot. Assoc. & Dept of Agr., Trenton	Paul Mott
N. Y.	Seed Imp. Coop Assoc. & Pathology, Agr. College, Ithaca	Karl Fernow
N. D.	State Seed Commissioner, Fargo	E. M. Gillig
Ohio	Cert. Seed P. G. Assoc., & Hort, Agr. College, Columbus	E. B. Tussing
Ore.	Farm Crops, Agr. College, Corvallis	E. R. Jackman

Table I (continued)

Agencies certifying and headquarters		In charge of
Pa.	State Dept. of Agr., Harrisburg	K. W. Lauer
S. D.	Pot. C. Assoc & Agron., Agr. College, Watertown	A. W. Palm
Vt.	Coop S. P. G. Assoc., & State Dept. of Agr., Bradford	Harold Bailey
Wash.	State Dept. of Agriculture, Olympia	Chas. D. Gaines
Wis.	Hort., Agr. College, Madison	J. G. Milward
Wyo.	Agronomy, Agr. College, Laramie	Glen Hartman

(II) Fees and Expenses

Can. (48)	None
Cal.	200 bu. or less-$3.50 acre, 201-300 bu. -$4.50 a., 301-400 bu.-$5.50., etc.
Colo. (49)	$5 applic. fee, over 1 a-$1.00 per a., also $ .01 sack, tags $2 hund.
Idaho (50	$6 first 5 acres., $ .75 a. for each additional.
Ky. (52)	$10 min. daily charge to county assoc. for traveling expenses.
Me. (53)	$ .50 each a. entered, $2. more each a. and $ .05 each bbl. certified.
Md. (54)	$ .50 a. second inspec., $1 a. passing second., $ .05 each seal and tag.
Mich. (55)	$1 membership., $4- 1st 5 a., $ .75 additional a., $ .02½ bu. certified.
Minn. (56)	$5 first 5 a., $1 a. 6-10., $10 first 10 a., $.75 a. over., $01½ bu., max. Grading $4 car.
Mont. (57)	$12 minimum., $8 application fee., $3 inspection fee
Nebr. (58)	$5 membership, $1 yr. dues, min.- $10, $1 acre, bin inspec.- $.03- .06 bu., mkt fee- $ .10 cwt.
N. H. (59)	$6 per a., $ .01 for each bu. sold.
N. J. (60)	$5 registration, $1.50 a., refunds on withdrawls and rejections.
N. Y. (61)	$5 membership, $6 farm, plus $3 field, plus $3.50 acre.
N. D. (62)	$5 first field, $1 additional f., $3 min. bin, $ .00½ - .01 bu., $3 car lot inspec. $ .03 each tag and seal.

(II) Fees and Expenses. (continued)

Ohio (63)	$5 min., $1 acre, $ .05 bu. first 100, $ .02 bu. over 100 bu.
Ore. (64)	$5 min., $2 acre, refunds for withdr. or rej., $ .01 each seal and tag.
Pa. (65)	None
S. D. (66)	$2 dues, 1-3 a- $2 a., 4-10- $1.75, 11-20-$1.50, 25 up-$1.25, $ .02 bu, adver., $ .01 tags.
Vt. (67)	$5 min., $1-$5 acre, depending on acreage of grower.
Wash. (69)	$5 applic. fee, 1-10 a., -$3 a., above 10 a.- $2.50 a.
Wis. (70)	$5 applic. fee, 1st inspec. 1-25 a- $1.50 a., over 25 a.-$.50 a., 2nd-$1.25 a.
Wyo. (71)	$3 applic. fee, $1 a. inspection, $1 a. additional for cert.

(III-) Parent Seed Requirements

	Source of seed	Test sample required	Req. and standards for test plot
Can.	certified	Indexing	
Cal.		Yes	Same as field
Colo.	Certified	Yes	Arrive by June 1, some virus as 1st. inspection
Idaho (51)	Disease-free	Yes	Arrive by middle Feb.
Ky.	Best	Yes	Visually clean
Me.		No	
Md.		Yes	
Mich.	Certified	Yes	Same as field, (pre-planting seed inspection made)
Minn.	Indexed or approv.	Indexing	Triumph and Green Mt. stock must be indexed
Mont.	Best	Yes	Arrive by May 1, planted under irrigation
Nebr.	Certified	Yes	By May 1, total 10% mosaic and spindle tuber
N. H.	"	Yes	Same as field up to Aug. 1
N. J.	"	Yes	L.R-4%, Sp.t.-2, mos.-3, total-6%
N. Y.	"	Yes	L.R.-5%, Sp.t.-5, mos.-9, y.d.-2, total-10%
N. D.	Indexed or approved	Indexing	By Apr. 1 for indexing
Ohio	Certified	Yes	By May 15, virus diseases 5%
Ore.	"		Most of present seed from tuber-indexed stock
Pa.	"	Yes	

	Source of seed	Test Sample required	Req. and standards for test plot
S. D.	Certified or approved	Yes	By May 1
Vt.(68)	Certified	No	
Wash.	Certified or approved	Yes	By Apr. 15, l.r.-6%, Sp.t-6, nos.-12, total 15%
Wis.		No	
Wyo.	Certified	Yes	10% degenerative

(IV.) Pre-planting Requirements

	Soil and rotation requirements.	Distance other pot. fields feet.	Seed treatment required.
Can.		200	
Cal.		300	Yes
Colo.	Potatoes once in 5 yrs.	300	Cor. Sub.
Idaho	Clean land	300	
Ky.		150	
Me.		250	
Md.		50	
Mich.	Potatoes once in 4 yrs, good soil, well-prepared	300	Cor. Subl.
Minn.		160	
Mont.		200	Yes
Nebr.		200	
N. H.		200	
N. J.		200	
N. Y.		3 ft. for each % virus found	
N. D.		165	Yes
Ohio	Use enough fertilizer for good growth	100	
Ore.		300	Yes
Pa.	Crop Rotation	150	Yes
S. D.		300	Yes
Vt.		200	
Wash.		300	
Wis.			
Wyo.	Potatoes once in 5 yrs, dry land cond't (4000 ft. Elev)		Cor. subl. or hot form.

(V.) Preparation for Inspection

	Latest date for application	Field and cultural requirements
Can.	June 15	Must cultivate thoroughly and spray
Cal.		
Colo.	June 1	
Idaho	July 1	
Ky.		
Me.	June 15	Reasonably free weeds, insect injury, spray for l. blight
Md.	3 weeks before planting	Free from weeds and insect or disease injury
Mich.	June 1	Thorough cult., at least 7 Bord. applic, with 250 lb. pressure
Minn.	July 1	Cultivate and spray
Mont.	June 1	
Neb.	May 1	Clean culture
N. H.	July 1	
N. J.	Aug. 25	Clean culture and thorough spraying
N. Y.	June 20	
N. D.	July 1	
Ohio	May 1	Clean cult; spray or dust Bordeaux at least 5 times
Ore.		Keep down weeds and insects; irrigate properly, if at all
Pa.	July 1	
S. D.	June 1	
Vt.	July 1	
Wash.	June 1	Free from weeds
Wis.		
Wyo.	July 1	

MICHIGAN SEED POTATO INSPECTION AND CERTIFICATION SERVICE

1929

MICHIGAN STATE COLLEGE
and
MICHIGAN CROP IMPROVEMENT ASSOCIATION
East Lansing, Michigan

Application Blank

Date_____

To H. C. Moore, Chief,
Seed Potato Inspection and Certification Service,
East Lansing, Michigan.

I hereby apply for the inspection and certification of my seed potato field in the season of 1929.

I agree to comply with the rules that have been specified by the Michigan State College and adopted by the Michigan Crop Improvement Association relative to the growing of the 1929 crop of certified seed potatoes.

Enclosed find_____to cover inspection of_____acres

Variety _____
(List each variety with acreage)

Planting date_____Source of seed_____

_____
(Give grower's name and address or certificate number)

Crop history of field intended for certification:

Crop in field last year_____two years ago_____

three years ago_____four years ago_____

Type of soil _____

P. O. address_____County_____

Railroad station_____

Distance and direction from station_____

Signed_____

June 1st, Last Day for Receipt of Application

(VI.) Other Preparations

	Seed Increase plot req.	Seed plot requirements	Roguing required
Can.	Recommended	Tuber unit	Up to 10% Allow.
Cal.			
Colo.	Yes	50 ft. other pot., 10% acreage, tuber unit or hill selected.	Several times *
Idaho	Rec.	1/8 acreage entered, tuber unit, rogued clean	Throughout season
Ky.	Yes	Tuber-unit at least every other year	
Me.			Inspection time
Md.	Rec.		Constant
Mich.	Yes.	Isolated, at least 1/4 tuber unit, 7 sprayings, 5 roguings, dug by hand	At least 3 times
Minn.	Yes	Must be hill unit at least every 2nd year	Constant
Mont.	Yes	Isolated, enough for seed next year, tuber unit	Early and const.
Neb.			*
N. H.			After 1st. insp.
N. J.			Early and const.
N. Y.	Yes		After each insp.
N. D.	Yes	Isolated, planted hill unit, hill selected	Early and Const.
Ohio	Yes	3 rows main crop, enough for seed next year, tuber unit	Early and Const. At least 3 times
Oreg.			Early and often
Pa.			* After 1st. insp.
S. D.	Yes		Const. and thorough

	Seed increase plot req.	Seed plot requirements	Roguing required
Vt.			
Wash.	Yes	Enough for seed next year, tuber unit	Constant
Wis.			
Wyo.			

* Colo, N. H., Pa., do not allow roguing before first inspection.

(VII) Field Inspections

	No.	When made 1st.	2nd.	3rd.	No. of counts per acre 1 a.	5 a.	10a.	20a. plus
Can.	2	6-7 wks. after pl.	2-4 wks. later					
Cal.	3	8-10" high	2 wk. later	Before Mat.	3-4	7-8	10-15	15
Colo.	2	8" to bloom	tubers ½" dia.		3	3-5	5	5
Idaho	2	Bloom	Just before mat.		Left to inspector			
Ky.	2	6" high	2 wk. later		4	10	15	
Me.	2	Bloom	Still green		Depends on amount of disease			
Md.	2	"	Just before mat.		Left to inspector			
Mich.	3	8" high	Late growing season	Before har.	3	3	5	5
Minn.	2	Bloom	30 days later		5-10	10-20		
Mont.	3	6-8" high	2 wk. later	2 wk. later				
Nebr.	2-3	7-10" high	10-15 in.	Before mat.				
N. H.	2	40-50 days	90 days after pl.		400	500	plants 1000	2000
N. J.	2	4-6 wks after pl.	3-4 wk. later		4	8	12	15

FIGURE 7 - [illegible] Beets in [illegible] County.

FIGURE 8- Collards in [illegible] County.
[illegible] Field Inspection for
Certification.

	No.	When made 1st.	2nd	3rd	No. of courts per acre 1a.	5a.	10a.	20a.
N. Y.	2	40-70 days after pl.	4 wk. af. tubers well-formed		5	5	5	8
N. D.	2							
Ohio	2	8-10" high	near mat.					
Ore.	2							
Pa.	2	8-10" high	3 wks. later					
S. D.	2	Bloom	Before vines die		4	5	8	8
Vt.	2	"	3-4 wk. later		5-10	10-20	20-25	25-30
Wash.	3	6-8" high	Bloom	3-4 wk. later	3	5	8	10-15
Wis.	1 or 2	Before bloom	Bloom		Left to inspector			
Wyo.	2	8-12" high	Before mat.					

(VIII) Disease Tolerance First Field Inspection

% Disease allowed

	L.R.	Mos.	C. D.	S. T.	Stk.	Total virus	B. L.	Wilts	L.B.	C.H.	Total all
Can.	2	2	2				3	3			6
Cal.						5					10
Colo.	3	3	2	2		5	1	4		3	6
Idaho	5	5	5	5		5	2	3			5
Ky.						4		1			6
Me.	2	3				3	2	2			8
Md.	2	3	1	2	1	5	2	2		1	5
Mich.	1	1	1	1	1	2	1	1			2
Minn.	5	5	5	2	5	5	2	2	0	1	6
Mont.	3	3		3		5	1	2		3	6
Nebr.*	5	3		5		5	1	1.5			5
N. H.	4	5		1		5	1				5
N. J.	3	3		3		5	1	2		3	6
N. Y.*	2	3	0.5	2		4	1	2			6

	L.R.	Mos.	C. D.	S. T.	Stk.	Total virus	B. L.	Wilts	L.B.	G.H.	Total all
N. D.	5	5		2		5	2	2	0	3	6
Ohio	4					5					6
Ore.	2	5		5		5	3	3	(chlorosis-5)		10
Pa.	4	3				5	2	2		3	5
S. D.	3	3	3	3		5	1	2			5
Vt.	3	3	3	3			1	3		3	6
Wash.	2	5		2		5	2	2			5
Wis.		5									
Wyo.	3	4	3	4		5	1	2			5

* So-called "advanced classes" in these states are considered on page 66.

(IX.) Disease Tolerance Second and Third Field Inspections.

% Disease Allowed

	L.R.*	Mos.*	C.D.	S.T.	Stk.	Total virus	B.L.	Wilts	L.B.	G.H.	Total All
Can.	1	1	1				1	2			3
Cal.						5	1	1			9
Colo.	2	2	1	1		4	1	2		2	5
Idaho	Practically free of all disease										
Ky.	2	2				4		1	sl't		5
Me.	1	2		5			1	1		5	7
Md.	1	1	1	1	1	4	1	1		1	
Mich.	0.5	0.5	0.5	0.5		1	0.5	0.5	sl't	0.25	1
Minn.	4	4	4	2	4	4	trace	0	0		4
Mont.	3-3	3-3		3-3		5-4	1-1	2-1		3-3	6-5
Nebr.	4	3		4			1	1.5			5
N. H.	3 diseased plants in a 100 ft. row										
N. J.	1	1	0.5	1	0.5	4	0.5	0.5			5
N. Y.	1	2	0.5	1		3	1	1			5

	L.R.*	Mos.*	C.D.	S.T.	Stk.	Total virus	B.L.	Wilts	L.B.	G.H.	Total all
N. D.	3	2		2		3	0.5	0	0	1	4
Ohio	0					1					2
Ore.	2	5		5		5	3	3	sl't		10
Pa.	2	2				2	2	2	sl't	2	
S. D.	1	1	1	1		2	1	1	0		
Vt.	1	1	1	1			1	1	sl't	2	5
Wash.	2	4		2		4	2	2			7
Wis.											
Wyo.	2	3	2	3		4	1	2			5

* A key to these disease name abbreviations is given on page 80.

(X.) Purity and Vigor

Varietal Mixture; Weak Plants; and Other Disqualifications.

	Var. Mixt.		% tolerance Weak plants		Other disqualifications.
	1st	2nd.	1st.	2nd.	
Can.	1	0.5	0	0	Excess weeds or insect injury
Cal.	5	0			" " " " " ;tuber moth, eel worm
Colo.	2	0	3	2	Eel worm, t.moth, wart, pwd.scab, viol. rhiz.
Idaho	5	0	5	5	" " " " " " " "
Ky.	rogue	1	5	5	Excess insect injury, low vigor
Me.	1.5	0.5	3	1	
Md.	rogue	0.5	3	2	Excess weeds, insects or disease injury, wart, nematode, t.moth.
Mich.	0.25	0	3	0.5	Excess weeds, hopper burn, early blight, insects, etc.
Minn.	2	0	3	3	Excess missing hills, aphids, leaf hoppers, grass hoppers
Mont.	1	1-0.25	2	2-2	Excess weeds, insects, poor irrig, wart, eel worm, t. moth
Nebr.	2	0.25	5		- If less 80% stand, excess insects, poor culture, etc.
N. H.	1		5		Excess insect or fungus injury
N. J.	1	0.25	2	2	Excess insect injury, blight or tip burn
N. Y.	2	0.25	2	2	Any field likely to produce unsuitable seed
N. D.	2	2	3	3	Excess weeds, insects, missing hills, wart

	1st.	2nd.	1st.	2nd.	
Ohio	2	0.25	3	2	Excess early or late blight, l. hopper, Colo. beetle, flea beetle, yield below normal for soil, variety, season
Oreg.	rogue	trace	5		Excess weeds, insects, over-irrig., poor stand, wart, eel worm, t. moth
Pa.	0	0			Excess weeds, insect injury, lack thrift and vigor, less 85% stand
S. D.	1	0.25	3	2	Excess early blight, insects, weeds
Vt.	4	1	5		Excess missing hills at first inspec., weeds, insects, general Rhiz.
Wash.	0.5	0.5			Eel worm, tuber moth
Wis.					
Wyo.	2	trace	5	5	Excess weeds, insects, other diseases, lack vigor, poor stand

* Advanced Classes

Nebraska and New York each certifies an advanced class of certified seed as follows:-

1. Nebraska Super-Certified (58)

Standard-

	Any field inspec.	% highest tolerance	Bin Inspec. on unsorted
Spindle tuber	0.5		0.5
Unmottled curly dwarf	0.25		.1
Mild mosaic	1.5		
Rugose mosaic	0.5		
Fusarium wilt	1.0	either or both	1.0
Black leg	1.0		1.0
Rhizoctonia	no limit		no limit
Any other disease	1.0		
Total all diseases			2.0

Otherwise as regular certified stock.

2. New York Registered-Certified (72)

This grade is the extension of a program of seed potato improvement which has been carried on during the past several years in New York state by certain selected growers cooperating with the Department of Plant Breeding of Cornell

University. The idea is to isolate certain disease-free and high yielding strains and then to increase these strains under careful supervision for commercial plantings. Only growers who have previously met these selection and test requirements are eligible to submit fields for inspection as Registered-Certified. This work will be considered later in this thesis. The field requirements of the class are given herewith:-

1. Seed shall have been produced in a multiplication plot conforming to certain yield and disease standards already mentioned.

2. Field shall not show more than 0.5% virus diseases at any inspection.

3. Field shall not show more than 500 aphids or 100 leaf hoppers per plant at any inspection.

4. Any other potatoes grown within 300 feet of the field showing more than 5% virus diseases shall reject for registered-certified.

5. Conditions highly unfavorable for the detection of disease may reject the field for registered.

Key to Abbreviations

L.R., l.r.- leaf roll

Mos., mos.- mosaic

C.D.-curly dwarf (yellow dwarf also included)

S.T., s.t.- spindle tuber

Stk.- streak

B.L., b.l.- black leg

L.B., l.b., l. blight- late blight

G.H.- Giant Hill

Rhiz, rhiz.- rhizoctonia

Com. scab- common scab

Inter. discolor- internal discoloration(also includes stem end browning)

Mech. injury- includes mechanical injury, cracks, dirt, foreign matter, etc.

W. H.- Weak Hills

(XI.) Tuber or Bin Inspection

% Tolerance

	Rhiz.	Com. scab	Inter. discolor.	Sp. tu.	Off type	L.B. rot	Other rots	Total	Frost inj.	Mech. inj. & dirt
Can.*	10 (sl't)	5(sev)	5		2	1		7		2
Cal.			3							
Colo.#	5	5	5	1	prac. free	p.f.		10	p.f.	p.f.
Idaho	12	5	5			2		12	p.f.	p.f.
Ky.	5 (10)	5	5	1						
Me.										
Md.	mod.	sl't	5	2		2				
Mich.	5		1		p.f.	sl't			0	p.f.
Minn.	mod.	sl't	5	1	. .	0	0		1	5
Mont.	10	10	5	1			1		1	
Nebr.	mod.	sl't	4	5			1.5		5	
N. H.	sl't	10	3		p.f.	sl't	p.f.		p.f.	p.f.
N. J.	5	5	2	1		1.5				5
N. Y.			5							
N. D.	mod.		5	1		0	1			3

	Rhiz.	Com. scab	Inter. discolor.	Sp. tu.	Off type	L.B. rot	Other rots	Total	Frost injury	Mech inj. & dirt
Ohio		10	(all other diseases) -10							
Ore.	sl't	sl't	11			0			0	
Pa.		3	5	(Wire worm injury-5)				6	1	2
S. D.	10	10		1	10	0				
Vt.	10		5	1	p.f.		2		0	p.f.
Wash.	12	5	2	(Black leg -2)		2		12		
Wis.										
Wyo.	10	10	5	1	5	0			0	5

* Minn., Mont., Nebr., N. D., S. D., Wash., Wyo., specify 0 Powdery scab. Canada allows 1%.

Colo., Md., Mont., N. D., Ore., S. D., Vt., Wyo., specify 0 wart disease.

(XII.) Grading Standards

Grade No. 1

	No. of grades	Min. size dia. in.	allow-ance %	Max. wt. oz.	Allow-ance %	Other considerations (U.S.No.1 standard)
Can.	1	3 oz.	5	12	5	Same as tuber inspection
Cal.	1					*Equal U. S. No. 1
Colo.	1	1½	5			" " " "
Idaho	2	2oz.	5	12	5	" " " "
Ky.	1	1¾	5			" " " "
Me.	1	1¾	5			Equal or exceed U. S. No. 1
Md.	2	1¾	5	12	5	" " " " "
Mich.	1	1 7/8		10	2	Better U. S.No.1, 3% total allowance
Minn.	1	1¾-1 7/8	5	14	1	Equal U.S.No.1, 5% total allowance
Mont.	1	1.5 oz.	5	12	5	" " " ,4% total allowance
Nebr.	1	1½	2	12	2	Better U.S.No. 1, 3% total allowance
N. H.	2	1¾	5	12	5	Equal U. S. No. 1
N. J.	1	1¾	5			" " "
N. Y.	1	1½	5			" " "

Grade No. 1

	No. of grades	Min. size dia. in.	allow-ance %	Max. wt. oz.	Allow ance %	Other considerations (U. S.No. 1 standard)
N. D.	1	1¾-1 7/8	5	14	1	Better U.S.No. 1, 3% allowance
Ohio	1	1¾	5			Equal U. S. No. 1
Ore.	2	1¾	5	12		" " "
Pa.	2	1 7/8	3	12	3	Same as tuber inspection
S. D.	1	1¾- 1 7/8	5	12	2	Equal U. S. No. 1
Vt.	2	1¾- 1 7/8	5	10-14	5	" " "
Wash.	2	2 oz.	5	12	5	Not equal U.S.No.1--15% defects all.
Wis.	1	1½ - 1 7/8	5			Equal U.S. No. 1
Wyo.	1	1½	5	12	5	Better U.S. No. 1, 5% allowance

* A description of the U. S. Market Grades is given on page 95.

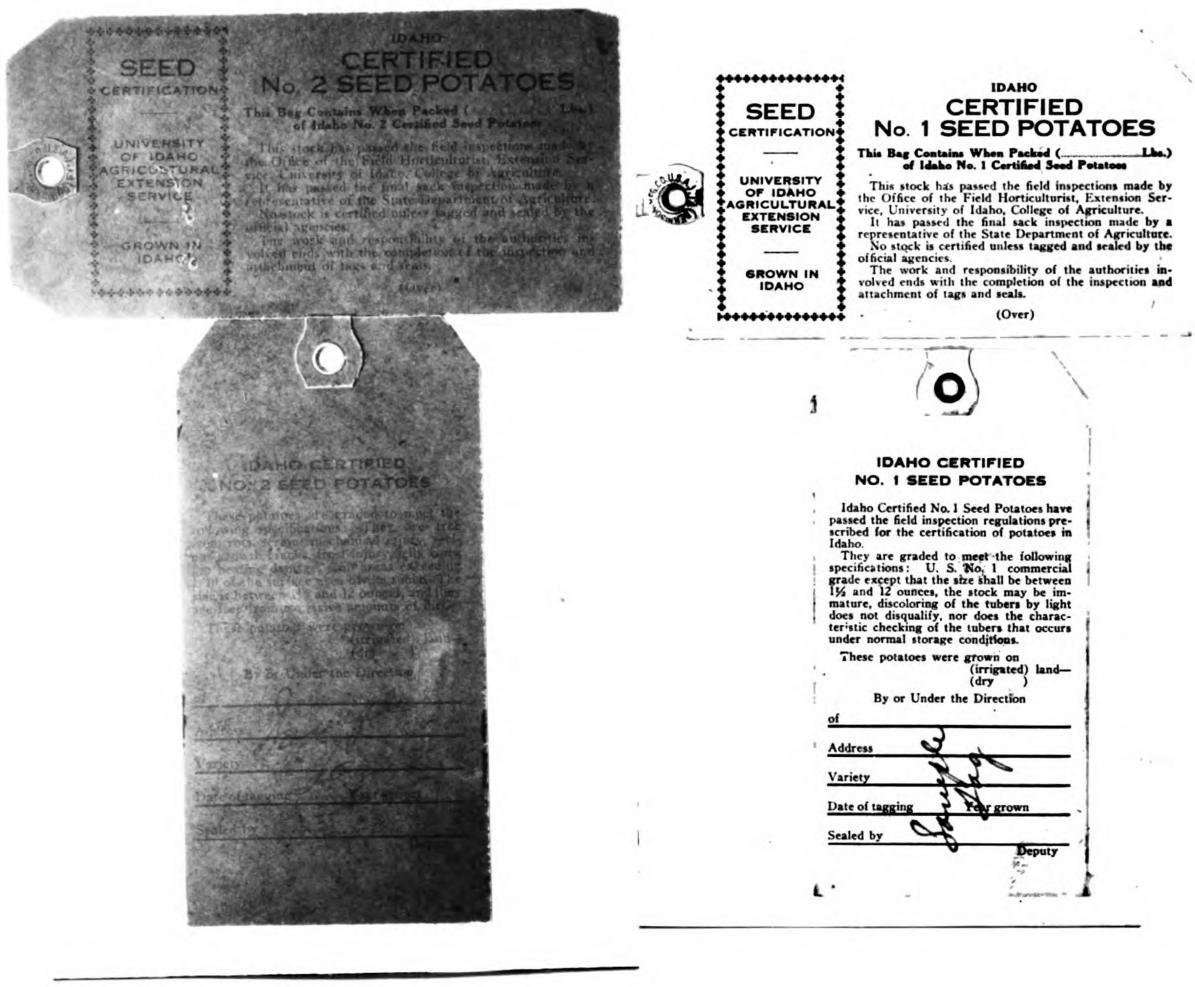


FIGURE 9- Some States, as Idaho, Have Two Grades of Certified Seed.

(XIII) Grading Standards

Requirements of Grade 2.

		Shipping inspection	When tags are issued
Can.		Requ.	shipping time
Cal.		Req.	
Colo.		Req.	sacking time
Idaho	Requirements of Grade 2 not stated	Req.	after sacked
Ky.		Rec.	shipping time
Me.		Req.	"
Md.	*Equals or exceeds U.S.No.2	Req.	"
Mich.		Req.	"
Minn.		Req.	after field insp.
Mont.		Req.	shipping time
Nebr.		Req.	when needed
N. H.	Corresponds to U.S.Grade No.2	Req.	
N. J.		Req.	shipping time
N. Y.		Req.	after field insp.
N. D.		Req.	shipping time
Ohio	(allows 8% wilt,16% stem end		after bin insp.
Ore. "Standard Grade"	(discolor,5% virus and 15% total dis.)	Req.	" " "
Pa.	"Small Size"-same as Grade 1, except 1½ -1 7/8 in. dia.	Req.	Shipping time
S. D.	"Secondary Grade"-1½ in. min. dia., 2% soft rot all.	Rec.	After tuber insp.
Vt.		Req.	shipping time

		Shipping inspection	When tags are issued.
Wash.	"Field Inspected" -same as U.S. No. 2., except 1¼ in. dia.	Req.	shipping time
Wis.		Rec.	
Wyo.		Req.	shipping time

*A description of the U. S. Market Grades is given on page 95.

Oregon 1929 Certified
BURBANK SEED POTATOES

This Special Tag is issued by the Certification Board of the Oregon Agricultural College, Corvallis, Oregon, for exclusive use on certified seed potatoes grown by or for the undersigned, and is valid only when the guarantee is signed by him.

I guarantee to the original purchaser that the potatoes in this container passed the Oregon inspection requirements for Certified Seed in 1929 and that the grade is at least equal to the standard of the Oregon Certification Board.

..... Grower.

..... Oregon.

P. I. 56.

Penna. Certified
SEED POTATOES
GRADE — STANDARD SIZE
1929
Variety .....
Grown By .....
County .....
Cert. No. ..... Amt. .....

CERTIFIED SEED—COLLEGE INSPECTED
Grown by Members of
NEW YORK SEED IMPROVEMENT CO-OPERATIVE ASSOCIATION, INC.
ITHACA, N. Y.

This tag is issued to the grower whose name or number appears hereon to be attached only to seed which has been inspected by specialists of the New York State College of Agriculture and found by them to conform in health, vigor, purity and type to the published standard of excellence of this Association.

In attaching this certification tag the grower guarantees to the first buyer that the seed contained in this package actually is the seed inspected by the College and found to conform to the aforementioned standard. The grower further guarantees that any statement appearing on the back of this tag properly refers to this seed. Should proof be presented to this Association by the first buyer that seed bearing this tag is not the seed as represented above or that it fails to conform to the Association grading standard the grower agrees to make suitable adjustment up to the full extent of the purchase price.

Maine Department of Agriculture
DIVISION OF PLANT INDUSTRY

Variety .....

The seed in this package is from fields inspected and passed by the Maine Department of Agriculture.

CROP OF 1929

No. 383024 .....
Grower

.....
Address

Final inspection made by .....

OFFICIAL TAG
Minnesota Certified Potato Seed Grade

Defects Allowed:
Common scab-slight infection
Rhizoctonia-moderate infection
Stem end discoloration—5% of tubers
Spindle tuber-1% of tubers
Late blight rot-none
Black leg rot-none
Powdery scab-none
5% by weight under size allowed.
3% total following defects allowed: dirt, foreign matter, frost, sunburn, second growth, hollow heart, growth cracks, cuts, dry rot, insect injury.
90% of tubers must conform to characteristic type of variety.
(N. B. The Minnesota regulations require a state certificate of seed grade quality with each car shipped. Ask your dealer to show you this certificate.)

FIGURE 10- Some of the Certification Tags Used in the United States in 1929.

*U. S. Standard Potato Grades (73)

U. S. No. 1 shall consist of potatoes of similar varietal characteristics which are not badly mis-shapen, which are free from freezing injury and soft rot, and from damage caused by dirt or other foreign matter, sunburn, second growth, growth cracks, hollow heart, cuts, scab, blight, dry rot, disease, insects, or mechanical or other means.

The diameter of potatoes of round varieties shall not be less than 1 7/8 inches and of potatoes of long varieties 1¾ inches, but lots of potatoes which are not less than 1½ inches in diameter and which meet the remaining requirements of this grade may be designated "U. S. No. 1, 1½ inches minimum".

In order to allow for variations incident to proper grading and handling, not more than 5 per cent, by weight, of any lot may be below the prescribed size. In addition, not more than 5 per cent, by weight, may be damaged by hollow heart, and not more than 6 per cent may be below the remaining requirements of this grade, but not to exceed one-sixth of this amount or 1 per cent shall be allowed for potatoes affected by soft rot.

U. S. No. 2 shall consist of potatoes of similar varietal characteristics which are free from freezing injury and soft rot and from serious damage caused by sunburn, second growth, growth cracks, hollow heart, cuts, scab, blight, dry

rot, disease, insects, or mechanical or other means.

The diameter of potatoes of this grade shall be not less than 1¾ inches.

In order to allow for variations incident to proper grading and handling, not more than 5 per cent, by weight, of any lot may be below the prescribed size and, in addition, not more than 6 per cent, by weight, may be below the remaining requirements of this grade, but not to exceed one-sixth of the tolerance or 1 per cent shall be allowed for potatoes affected by soft rot.

(XIV-) Other Considerations

Can. If more than 3% late blight at bin inspection, grower may hold until spring for re-inspection.

Colo. At least 3 growers necessary in localities isolated from main lines of travel. Plan to have no stock more than 5 years removed from tuber-index. Plant test plots at high altitudes.

Ky. Work is carried on only through organized groups of growers.

Md. Only wart immune varieties are certified near quarantine zones. Seed rejected at shipping inspection may be sold as "Inspected Seed", with defect properly stated.

Minn. Careful supervision of seed storage.

Mont. New grower cannot enter more than 5 acres. If asked for, 50 lb. sample of seed stock for demonstration purposes is required for each acre certified. All seed stock to be tuber-indexed next winter.

Nebr. Careful supervision of storage. Each lot of seed tested every other year in plots in Florida.

N. H. Gross yield must be at least 200 bu. for early and 250 bu. on acre for late varieties.

Ohio. New grower must pass certification one year before he can sell seed.

Ore. Seed grading over or under size but otherwise meeting standards may be sold if properly marked.

Pa. No fields of less than 3 acres considered. Stock passing field but not grading inspection may be sold as "Penn. Field Cert. Seed".

S. D. Grower must send 60 lb. sample to State Fair, a bushel and a peck sample to the Annual Potato Show.

Vt. Seed from fields which have passed 2nd inspection except late blight may be certified for delivery after Feb. 1. Grower must plant 100 tuber seed test plot in units for check on seed.

Wyo. No less than 5 acres considered for inspection. All seed strains tested in southern Texas each year, besides local tests.

	Containers required.	Method of selling-% each directly	contract or agreement	cooperatively
Can.		15		85
Col.	New sacks or containers	100		
Colo.	New 100 or 120 lb. sacks	100		
Idaho	New sacks or containers	100		
Ky.		25		75
Me.		75	25	
Md.	New 150 lb. sacks or standard bbl.	20		80
Mich.	New, clean sacks	25	35	40
Minn.	New, even-weight sacks	10	65	25
Mont.	New, uniform, even-weight sacks	67		33
Nebr.				100
N. H.				
N. J.	New sacks	100		
N. Y.		35	15	50
N. D.			30	70

	Containers required	directly	Method of selling-% each contract or agreement	cooperatively
Ohio		100		
Ore.	New sacks or containers	75	20	5
Pa.		80		20
S. D.		100		
Vt.		25	50	25
Wash.	New sacks or crates	90	10	
Wis.	New 100, 120, 150 lb. sacks	100		
Wyo.	New 120 lb. sacks	40		60
TOTAL		55	25	20

FIGURE 11- [illegible] certified
[illegible] for [illegible] to
[illegible].

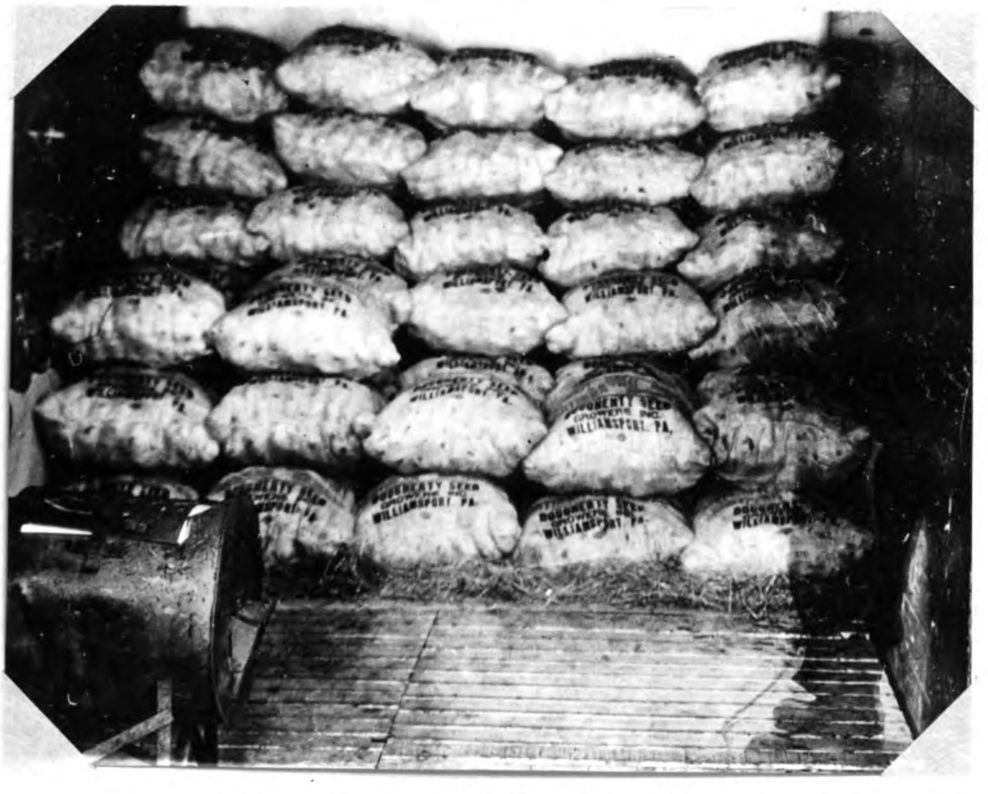


FIGURE 12- A [illegible] protection
[illegible] and well-[illegible] seed
[illegible] buyer.

(XVI.) Outside Markets

Can.	Eastern Atlantic seaboard, Cal., Nev.; also Cuba, Bermuda, British Guinea, Newfoundland.
Cal.	Intrastate only
Colo.	Texas, La., Ariz., N. M., Nebr.
Idaho	Wash. (Yakima Valley), Utah
Ky.	W. Va., Tenn.
Me.	N. Y., Va., Fla., N. C., S. C., Conn., Mass., Penn., N. J., N. H., R. I., Md., Ga., Texas, Ohio, Del., W. Va., D. C., Vt., Tenn., Ky.; also Porto Rico.
Md.	N. J., Pa., Va.
Mich.	Pa., Ohio, Ind., Ky., W. Va.
Minn.	Extreme southern states, Ind., Ohio, Ill., Mo., Kan., Wash., Ore., Cal., Iowa., Nebr., Okla., Ky.
Mont.	Wash., Idaho, Utah, south-central states
Nebr.	Texas, La., Ala., Miss., Ga., Fla., Okla., Ark., Tenn., Kan.; also Bermuda, Cuba, Porto Rico
N. H.	Intrastate only
N. J.	Pa., N. Y., (L.I.)
N. Y.	Conn., W. Va., Ohio, Pa., N. J., (L.I.)
N. D.	Texas, La., Ark., Kan., Mo., Okla., Miss., Ala., Ga., Fla., Ill., Ohio
Ohio	Intra-state only
Ore.	Cal., Wash.
Pa.	Intra-state only
S. D.	Eastern shore Va.

Vt. N. Y. (and L.I.), Conn., N. J., Mass., N. H., Va., Md.

Wash. Mont., Ore.

Wis. Fla., Ala., La., Texas, Tenn., Mo., Ohio, Ill., Ind., Iowa, N. Y.

Wyo. Gulf states, Kan., Mo., Okla., Texas.

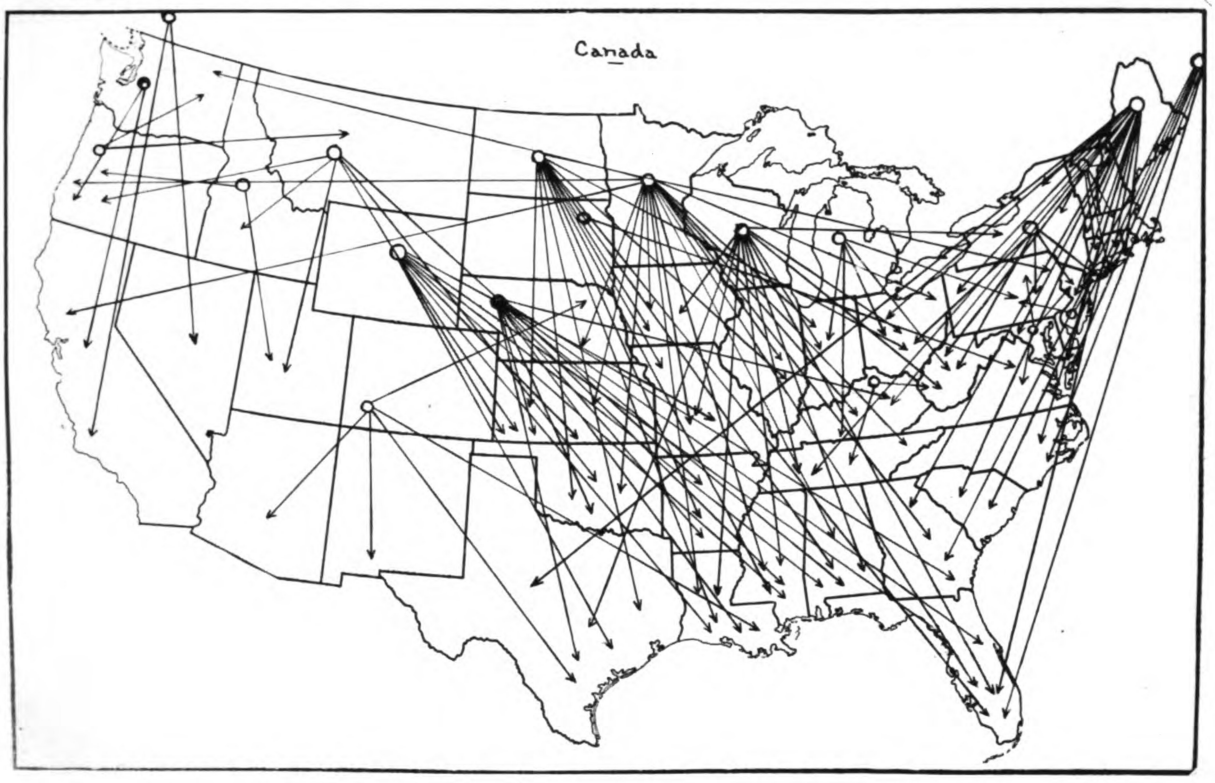


FIGURE 13- The Present Trend of Interstate and Canadian Shipments of Certified Seed In the United States.

(XVII.) Varieties- Amount Grown (74)

U. S. Average 1928- 1929

Early Varieties.

Variety	Total bu. grown	% certified seed	% early varieties
Irish Cobbler	3,062,439	33.16	68.13
Bliss Triumph	1,213,292	13.13	27.00
Early Ohio	205,810	2.23	4.59
Earliest of all	10,320	.11	.23
	4,491,861	48.63	100.00

Late Varieties.

Variety	Total bu. grown	% certified seed	% late varieties
Green Mt.	2,353,187	25.48	49.61
Spaulding Rose	637,767	6.91	13.45
Smooth Rural	264,972	2.87	5.59
Russet Rural	810,229	8.77	17.08
Idaho Rural	14,680	.16	.31
Burbank	75,190	.82	1.59
Russet Burbank	11,906	.13	.25
Netted Gem	420,425	4.55	8.86
Other varieties	154,915	1.68	3.26
	4,743,281	51.37	100 .00

Production in Canada 1928 (23)

Variety	Total bu. grown	% of certified seed
Irish Cobbler	4,238,800	62.22
Bliss Triumph	53,750	.79
Green Mountain	2,105,250	30.90
Spaulding Rose	43,000	.63
Smooth Rural(Dooley)	191,500	2.81
Other varieties (Garnet Chili, etc)	180,750	2.65
	6,813,050	100.00

(XVIII.) Varieties Where Grown (74)

Based on average U. S. Production 1928-1929

Variety	Leading state	% total crop prod.	2nd.	3rd.	4th.	5th.
Irish Cobbler	Maine	60	Minn.	N.D.	N.J.	N.Y.
Bliss Triumph	Minn.	20	Nebr.*	Wyo.	Wis.	N.D.
Early Ohio	Minn.	52	N.D.	S.D.	Idaho	Colo.
Earliest of All	Ore.					
Green Mt.	Maine	78	N.Y.	Vt.	Mis.	N.H.
Sp. Rose	Maine	93				
Smooth Rural	N. Y.	51	Wis.	Mich.	Pa.	Minn.
Russet Rural	Mich.	80	N.Y.	Pa.	Ohio	Md.
Idaho Rural	Idaho	93	Ore.	Cal.		
Burbank	Ore.	93	Wash.	Cal.		
Russet Burbank	Minn.	58	Colo.*	S.D.	Mich.	
Netted Gem	Idaho	57	Wash.	Mont.	Ore.	Wyo.
Other varieties	Maine	65	Ore.	Colo.	Cal.	Wash.

* led in 1929

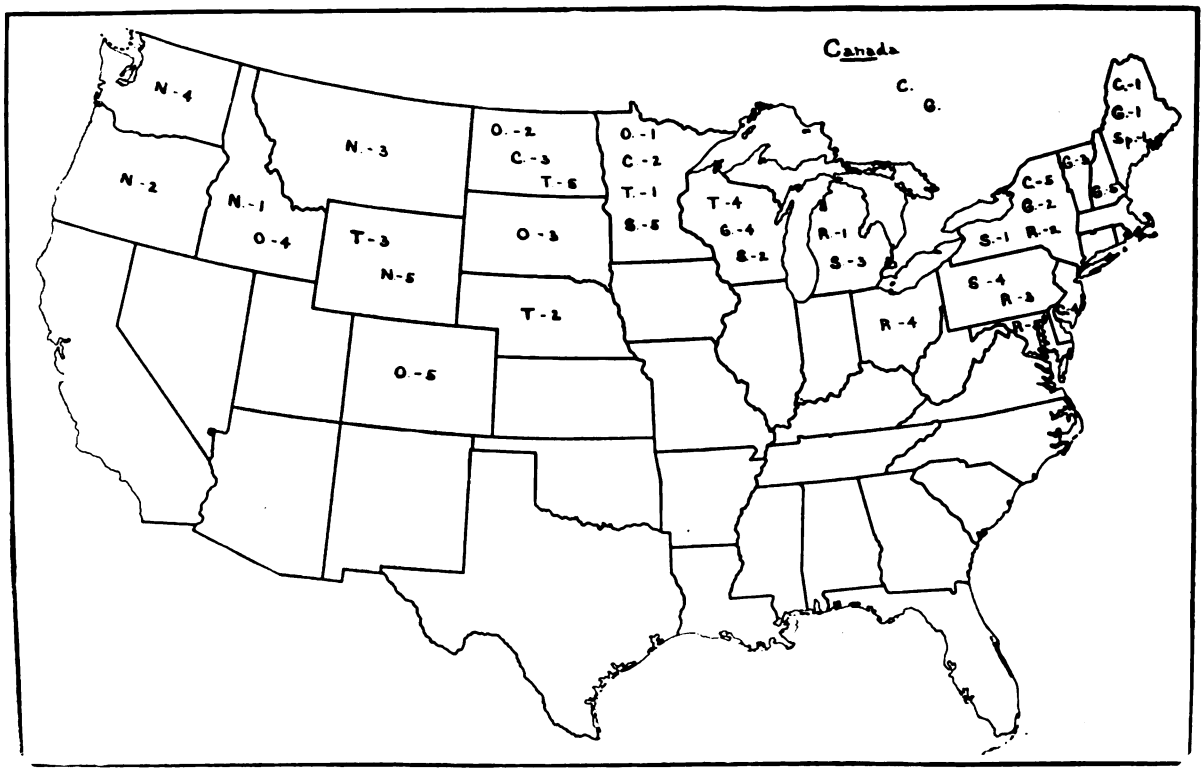


FIGURE 14- Where the Most Important Varieties were Grown in the Years 1938 and 1939.

KEY

C- Cobbler O- Early Ohio Sp.- St. Regis R-Russet Burbank
T- Triumph G- Green Mt. S -Sebago S-Katahdin

(XIX.) Varieties - Important in Each State (74)

Arranged in order of importance 1939

	1st. importance	2nd.	3rd.	4th.
Can.	Cobbler	Green Mt.	S. Rural	Sp. Rose
Cal.	British Queen	Triumph	Burbank	White Rose
Colo.	Triumph	S. Rural	Cobbler	R. Burbank
Idaho	Netted Gem	Triumph	Idaho Rural	Cobbler
Ky.	Cobbler			
Me.	Green Mt.	Cobbler	Sp. Rose	
Md.	Cobbler	R. Rural	Green Mt.	S. Rural
Mich.	R. Rural	S. Rural	Cobbler	Green Mt.
Minn.	Cobbler	Triumph	E. Ohio	S. Rural
Mont.	Triumph	Netted Gem	Cobbler	Green Mt.
Nebr.	Triumph	Cobbler		
N. H.	Green Mt.			
N. J.	Cobbler	Green Mt.	Red Skin	
N. Y.	Green Mt.	S. Rural	R. Rural	Cobbler
N.D.	Cobbler	Triumph	E. Ohio	Green Mt.
Ohio	R. Rural	S. Rural		
Ore.	Burbank	Netted Gem	E. of All	Cobbler
Pa.	R. Rural	S. Rural		
S.D.	Cobbler	E. Ohio	Triumph	R. Burbank
Vt.	Green Mt.	Cobbler	R. Rural	
Wash.	Netted Gem	Cobbler	Burbank	Triumph
Wis.	Triumph	S. Rural	Cobbler	Green Mt.
Wyo.	Triumph	Cobbler		

(XX.) Importance and Value

	Prod. 1928	Ranking 1929	% total commercial acreage planted cert. seed 1929	Price advantage per bu. over U.S.No.1 table stock. 1925-29	1926	1929
Can.			20.0	.50	20% inc.	.60
Cal.	20	20	5.0	.30-.60	.30-.60	.30-.60
Colo.	16	12	5.0	.75	.50	.50
Idaho	8	9		.50	.50-.75	1.00
Ky.	21	19	30.0	.30-.50	.50	.35
Me.	1	1		.20-.40	.30-.40	.30-.60
Md.	18	18		.50	.50	.50
Mich.	3	4	10.0	.75	.65	1.00
Minn.	2	2	20.0	.20-.60	.25-.60	.50
Mont.	9	14	5.0	.50-2.50	.50-1.00	up to 2.25
Nebr.	11	6	20.0	.50-.90	.50-.75	.50
N.H.	19	22			.50	
N.J.	13	15	95.0		.50-.75	
N.Y.	6	3	40.0	.50	.50-.75	.75

	Prod. 1928	Ranking 1929	% total commercial acreage planted cert. seed 1929	Price advantage per bu. over U.S. No. 1 table stock		
				1925-29	1926	1929
N.D.	4	5	4.5	.20-1.00	.40	
Ohio	22	21	15.0	.25-.75	.50	.25
Ore.	10	10	20.0	.30	.30-.60	.60
Pa.	15	13	12.0	.25-.50	.25-.50	.50
S.D.	17	16	5.0	.40	better	.25
Vt.	12	11	10.0	.60-.75	25% inc.	.60-.75
Wash.	14	17	15.0	.60	better	.75-.90
Wis.	5	7	10.0	.45-1.00	.40-.50	.50
Wyo.	7	8	75.0	.60	.50-1.00 sack	.60

...nd New Zealand.

(I)

Country	Authority	Acres 1939 entered	Acres 1939 passed
Austria	Dr. Gustav Rechy, Bundesanstalt fur Pflanzenschutz, Vienna		
Belgium	Dr. G. Verplanche, Station de Phytopathologie, Gembloux		(3,700 bu.)
Denmark	Dr. E. Grum, Statens Plantepatalogiske Forsog, Lyngby		
England & Wales	H. V. Taylor, Horticulturist, Ministry of Agr., London	6,400	7,900
France	Prof. Et. Foex, Directeur, Station Centrale De Pathologie Vegetale, Versailles	4,714(inc.)	3,000
Germany	Dr. Otto Appel, Reichsanstalt fur Kart-offelbau, Berlin, Dahlem	136,000*	113,445*
Holland	Secretary, Central Committee for Seed Inspection, Wageningen		
Hungary	Dr. Bela Muss, Royal Hungarian Hort. School, Budapest	3,153	1,614
Irish Free State	Dr. Paul A. Murphy, Albert Agr. College, Dublin		3,256
Northern Ireland	G. S. Robertson, Ministry of Agr. for N. Ireland, Belfast	10,500	3,445
Lithuania	Dr. V. Vilkaitis, Chief, Bureau of Pathological Survey, Dotnuva		

Country	Authority	Acres 1939 entered	Acres 1939 passed
New Zealand	J. W. Hadfield, Agronomist, Plant Research Sta., Dirfields, Palmerston North	3,000	
Poland	Dr. L. Garbowski, Division of Plant Pathology, Agr. Institute, Bydgoszcz		6,550*
U. S. S. Russia	S. Bukasov, Institute of Applied Botany and New Cultures, Leningrad	9,884	
Scotland	Thomas M. McIntosh, Dept. of Agr. for Scotland, Edinburgh	59,002	

*1938 figures

Country	Work Carried on by	% total potato acreage planted certified seed
Austria (41)	State through Agr. Expt. Stations and province Agr. Central Boards	
Belgium	State Potato Commission through Gov. Institutions and with coop. Growers Associations	10
Denmark	Local and provincial Farmers Unions through local and provincial Farm Bureau Advisers	
England	Horticulturist, Ministry of Agriculture	20
France (79)	Local Agr. Syndicates under the Provincial Directors of Agr. Service and the Agr. Colleges (no central control)	
Germany(41)	German Agr. Society through local Chambers of Agriculture to be found in nearly every state and province.	10
Holland (41)	Central Committee through 13 Prov. Seed Improvement Committees, and in coop.with 4 Gov. Instit.	
Hungary	Potato Production Office, Royal Hung. Ministry of Agriculture (G. Takats), coop. R. Hung. Exp. Sta. for Plant Pathology	
Irish F. S. (46)	Dept. of Agriculture (W. D. Davidson)	
N. Ireland (75)	Dept. of Agriculture for N. Ireland	
Lithuania	Bureau of Pathological Survey	

Country	Work Carried on by	% total potato acreage pl. certified seed
N. Zealand(76)	Dept of Agriculture through Field Superintendents in each province	14
Poland	Central Section for Seed Affaires (Warsaw) through the Sections of Seed Investigation in 10 districts	
U. S. S. R.	Government Institutions through special district Soviet Stations of Seed Control	
Scotland (77)	Board of Agriculture for Scotland, Inspectorate Division	31 inspected

Country	Fees	Seed Req.	No. of inspections	System of Classification
Austria		inspected		percentage
Belgium	2 Fr. for 220 lb.	known origin	2 field, 1 tuber	Points, 1(v.p.) to 10 (exc.)
Denmark			3 field	Varies with province
England	2 s. 6 d. per acre	approved	1-2 field	No definite standards set down
France	13-30 frs. per 100 kgs.		1-3 field	Points and %
Germany	.10 gold marks per ha	certified or approved	2 field, 1 tuber	%
Holland			2 field, 1 tuber	Points, 1 to 10
Hungary	25.5 or .47 bu. depending on acreage	tested stock	2 field, 1 tuber	%
Irish F. S.(47)	None	certified	2 field, 1 tuber	%
N. Ireland	None for field inspec. 6 d. ton if exported.	approved	1-2 field	Not definite

Country	Fees	Seed Req.	No. of inspections	System of classification
Lithuania			2 field	?
N. Zealand		seed test plots required	2 field, 1 tuber	?
Poland			2 field	?
U. S. S. R.	None		2 field, 1 tuber	?
Scotland (45)	2 s. per acre, with 5 s. min.	approved	1-2 field	not definite

(IV.)

Country	Field Disease Tolerance
Austria	Total-6%, virus-3%, wart-0, misses-3%, all diseases must be rogued.
Belgium	Most imp't. diseases in order rolled-leaf roll, mosaic, l. blight, rhizoctonia and black leg. At least 6 points needed at each inspection.
Denmark	Most imp't. diseases- leaf roll, mosaic, black leg, rhizoctonia, and late blight.
England	Wart-0, also the virus diseases and black leg, too many misses disqualifies.
France	5-15% of all diseases, including virus and rhizoctonia, and varying with the province.
Germany	Mild mosaic alone-20%, other virus diseases-5%, wart 0, all diseases-10%, misses-3% (or 10%, if otherwise O.K.)
Holland	Three classes of seed based on the points scored for disease on inspection as follows: Class A-9; Class B-6; Class C-6.
Hungary	Total-10%, any virus-2%, minor diseases-5%; must not rogue before inspection; leaf roll, bacterial ring disease and black leg most important.
Irish F. S.	Leaf roll (severe)-0, severe mosaic-1%, all black leg must be rogued, but no roguing is permitted before 1st inspection.
N. Ireland	Practically free leaf roll, substantially free mosaic and black leg, misses cannot be numerous, wart 0.
Lithuania	Total of 5% of black leg, common scab, rhizoctonia, fusarium and bacterial wilts, mosaic, streak, leaf roll, leaf curl.
N. Zealand	First inspec-30% total degenerative, wilt and others. Second inspec.-l. blight-35%, mattery eye-4%, wilts-10%, powdery scab-7%, degenerates-5%, eel worm-6%; misses-8% first inspection if roguable, otherwise 2% each inspection.
Poland	From 1-2% each of virus diseases allowed, wart-0, no roguing before first inspection.

Country	Field Disease Tolerance						
U.S.S.R.	Total allow.	Vir- us	Rhiz.	L.B.	E.B.	B.L.	Wilts	All but virus
Choice	3	0	0	0	3	0	3
Ordinary	5	3	3	3	5	0	10

Scotland — Visibly free from virus diseases, substantially free from all other diseases, wart-0.

(V.)

Country	Other field considerations
Austria	Varietal mixture-2% allowed, lack of uniformity will disqualify.
Belgium	Varietal mixture-6 pts. needed at each inspec; less than 5 p'ts. each on productivity and general condition of field will disqualify.
Denmark	Stress placed on freedom from var. mixture.
England	More than 2.0% var. mixt. in seed prohibited by law.
France	0-2% varietal mixture is allowed, rogaing is required at each inspection, weak plants count as diseased plants.
Germany	Var. mixture-2%; 10 hills dug at 2nd inspec., and disease, lack of uniformity or low yield will disqualify.
Holland	Free from varietal mixture
Hungary	1% varietal mixture, allowed, 5% weak plants
Irish F. S.	Varietal mixture-½% allowed
N. Ireland	Varietal mixture-½% allowed
Lithuania	5 foreign plants allowed in 200 square meters
N. Zealand	2% foreign varieties allowed
Poland	Varietal mixture-1% allowed
U. S. S. R.	Mixture considered but tolerance ot specified
Scotland	½% mixture of other varieties is allowed; in a second or "B" Grade, 2.0% mixture is the limit.

(VI.)

Country	Tuber Inspection Requirements
Austria	50 tubers must be submitted for inspection on uniformity and freedom from mixture.
Belgium	Tubers must be medium size, three grades of seed from fields rating for disease at each inspection as follows:- A-9 points; B-8; C-6.
Denmark	
England	
France	No mixture is allowed. No other standards stated.
Germany	No frosting allowed and little rot, int. discoloration, or varietal mixture; small potatoes only are cert. for seed, as they are planted whole, 3.4-4.8 in. dia. and not over 10 cm. long.
Holland	
Hungary	10 kg. sample is sent to Exp. Sta. at harvest; little trouble with rhizoctonia or late blight; size is min. diameter 3.5 cm. and max. 7 cm., max. length 9 cm.
Irish F. S.	Complete absence of blight, dry and soft rot, and reasonable freedom from other injuries and blemishes.
N. Ireland	Only on exported stock-112 lb. pkg. required, 3 lb. frost damage allowed, ½ lb. rot, 3 lb. other defects, which includes dirt, misshapen tubers, injuries or damage.
Lithuania	
N. Zealand	From 100 tubers taken at random, the largest 16 should not weigh over 6 lb. and the smallest 16 should not run under 1½ lb. (2/1½ stock); also graded for condition, uniformity, purity and as follows: 1. blight-4% allowed, powd. scab-4%, mattery eye-3%, pot. moth-4%, eel worm-4%, scab, dry rot, etc., -10%, off-type-2%.
Poland	

Country	Tuber inspection requirements									
U.S.S.R.										
Allowance	wart	net necrosis	late bl.	rhiz.	bl. ring	Bact. rot.	Fus. wilt	scab	off type	all tuber disease
Choice	0	0	0	3	0	0	0	3	3	5
Ordinary	0	0	0	5	3	3	3	5	5	10
Scotland										

Country	Miscellaneous Comments
Austria	The German Agr. Society for Austria also carries on certification of potatoes there, in addition to the State System.
Belgium	An attempt is being made to isolate the better strains of seed, following Dutch methods.
Denmark	Diseased seed from poor seed areas is rejuvenated by moving it to a more favorable location known as a "sanitorial district". Here diseased plants will die out, and the better stocks will be isolated, propagated and returned.
England	The English system is still directed mostly against the dreaded wart disease.
France	Great stress is placed on varietal adaptation and improvement and one variety often dominates a whole region. Seed treatment before planting is practiced extensively, and the growers also sprout their tubers, removing weak and diseased ones before planting. In a dry season virus diseases are more difficult to detect and the number of inspections is increased.
Germany (78)	Some Chambers require a series of seed test plots on seed whose quality is questioned. In 1928- 6.9% of the rejections were for black leg, 8.3%-rhizoctonia, 2.6- l. blight, 7.3-wart, 15.6- virus, 7.3-other diseases, 16.8-varietal mixture, and 34.9-withdrawals. Railroads carry seed potatoes at 50% regular rates.
Holland	Certificates of certification are only good if sealed in the sack. A trade-mark is used to protect tags from fraudulent use. The Dutch system is more efficient than the data here given might indicate.
Hungary	Foreign shipments only are tagged. Growers must send in 4 bu. sample of seed of each variety for plot testing.
Irish F. S.	Seals are attached after tuber or bin inspection. An attempt is being made to increase the planting of varieties desired by the export trade.
N. Ireland	Seed must be shipped in clean sacks or other suitable containers.

Country	Miscellaneous Comments
N. Zealand.	Two seed sample trial plots are planted, one of 100 tubers locally, and 50 tubers at the Gov. Plant Research Station. These are checked against field inspections during the growing season. What is known as "cropping powers" is determined from the 100 tuber trial plot by adding to the yield per acre of table tubers, one half of the yield per acre of seed-size tubers. Pig potatoes are not weighed. Great care is taken in the planting and management of these test plots One line of seed is distributed each year for use as a standard. The aim is to bring out superior strains of adapted varieties. A complete system of records is maintained at the Central office of all stock inspected. The plan resembles the one used in Canada.
Poland	Wart disease has been and apparently still is considerable of a problem here. Certificates are issued after the "bing" inspection and are placed in the sack just before sealing.
U.S.S.R.	Following the Soviet policies, certification work is largely an educational endeavor.
Scotland	Undoubtedly has a larger part of its acreage planted with certified seed than any other country. All of Great Britian is affected by the Seeds Act of 1920, which requires 97% purity in seed stock.

V. The Results of Certification in America

1. Improved Quality

The first criterion of the success of any movement is to be found in the worthwhile results that it has accomplished. Before the advent of certification in America, seed potato buyers were complaining of the poor quality of the stock then generally available. The average buyer was forced to evaluate the seed almost entirely on its appearance. Even at the present time (31), a grower is apt to be far more concerned over the appearance of the seed that he buys than he is over the certification tag on the sack. In the table-stock market of today, keen competition has made a quality product necessary, especially if the grower is to expect a consistent profit. The first step in the production of this type of tuber has proved to be the use of certified seed- free from disease, sound, smooth and true to type.

In the early days of certification, field inspections were given the most attention; but tuber or bin inspections soon became an essential part of the system, and a grading requirement was established by most of the certifying states. The aim of the certification authorities has been not only to produce a seed product of superior quality but also to place that product in the hands of the buyer in as near its best market condition as possible. Moore (82) in 1928, estimated that crops from certified seed average 20

P. L. 54.

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF AGRICULTURE

Bureau of Plant Industry

Seed Potato Certification Certificate No. 56

This is to certify that the seed potatoes as listed below and grown by Leo Cretin, Nashville, Pa Pa., have been officially inspected and passed in accordance with the standards adopted by the Pennsylvania Department of Agriculture for the certification of seed potatoes.

Crop of 1930. Variety Grown Russet Rural Acres Certified 10

Bushels per Acre 247 Bushels certified 2470

The granting of this certificate to the above named grower will permit him to market his seed potato crop of 1930, which has been officially inspected, as Pennsylvania Certified Seed Potatoes, provided that the official printed tag of Certification issued by the Bureau of Plant Industry is attached to each sack or container of seed potatoes so marketed.

Issued at the State Capitol, Harrisburg, Pa. Nov. 8, 1930

K. W. Sauer
Certification Inspector.

P. H. Bell
Director.

FIGURE 13- A Growers certificate of certification.

per cent better in plant quality than ours from ordinary seed. There is still a big problem in the selling and storing of the certified seed to be solved, and there always will be. Rigid inspection of trade stock has had a wholesome effect in improving the delivered quality. This inspection was required by 10 of the certifying states in 1938, and provided by the others. Practically all of the growth restrictions requiring the elimination of over-size, or small undersized tubers. Tubers labeled with mildly to the certified standard of perfection, so that it could be readily identified by the planter.

Internal quality is highly influenced by climatic influences, soils and cultural practices; but there is considerable difference in the quality of the various varieties. Certification has encouraged the growing of fewer and better varieties.* Seed buyers can now obtain good certified stock in all of the important standard varieties. The ultimate effect of this varietal specialization on the table-stock trade should not be underestimated.

*Three varieties (Cobbler, Triumph and Green Mountain) made up 73% of the certified production in an average for 1936-1939. With three other varieties (Sparkling Rose, Russet Rural and Netted Gem), they made up 84% of the total.

2. Increased Yields

An increase in yield which comes from the use of better seed is one of the surest ways of reducing the bushel cost and raising the chances of a profit to the grower. Certified seed has consistently given an increased yield over non-certified seed, other factors being equal.

Moore's Report-

Most of the comparative tests of certified versus non-certified seed made up through 1934 were summarized by Moore (63) in his comprehensive report which covered 11,627 tests conducted in 37 states, and 8 provinces in Canada. Only 2 states reported no increase in yield from certified seed and some reports gave average increases as high as 219 bushels (Mont.) and 150 bu. (Ore.) to the acre. Nebraska had an average increase of 141 bushels for 64 tests. Michigan, in 314 tests, found certified seed to give a 73 bushel to the acre advantage; and 327 tests of Michigan certified seed in other states gave a 50 bushel average increase. In Canada, 15 tests gave certified seed an average gain of 63 bushels to the acre. For all of the 11,627 tests considered, there was an average acre increase of 46.4 bushels for certified seed.

Later Tests and Reports-

Moore's report was widely accepted as concrete evidence of the general superiority of certified seed. Many

states have since discontinued their certified versus non-certified seed tests in favor of seed source tests. The later reports given are almost entirely in concurrence with those already mentioned. Four typical ones follow:

Harderburg (34) reported on nearly 100 tests extending over a 5 year period in 13 counties of New York which gave a 70.7 bu. 1 increase per acre average for certified seed, or 45 per cent.

Mc. Clintock (35) reported a 5 year average gain in tests conducted in Tennessee of 30 bushels per acre in favor of certified seed.

Hedgcorth, Anderson and Wallace (36) in Mississippi reported a test running from 1925 to 1933 with the following results:

Seed Used	No. of trials	Av. yield bu. per acre	% increase for cent.
Uncertified Triumph	21	84.2	
Certified Triumph	52	120.2	42.8
Uncertified Cobbler	7	128.2	
Certified Cobbler	28	135.8	57.8

Certified seed from 10 states was represented in this test.

Wilkinson (37) reported on 6 comparative tests by growers in Connecticut that an average gain of 114 bushels per acre was made by certified seed over non-certified; and during a five year period at the Storrs Experiment Station, an average gain of 33 bushels was received.

Yields of Certified Fields High-

The decidedly higher yields obtained by the growers of certified seed themselves are a ple evidence of the value of good seed, coupled with better than average growing conditions . For the period 1925 to 29, 16 certifying states reported on average increase of 25 to 140% in the yields of their certified fields as compared with the state average yields. Canada reported a 250 bushel average compared with 130 bushels or an increase of 91 per cent for the certified fields.

Influence on Commercial Production-

The peak of certified seed production in the United States has reached in 1930, when 10, 127,040 bushels were certified. We also imported approximately 1,200,000 bushels from Canada, making better than 12,325,000 bushels of certified seed for planting the U. S. crop in 1929. At an estimated rate of 15 bushels of seed to the acre, this could have planted 821,667 acres or about 20 per cent of the total potato acreage of the country. Since about 67,000 of these acres were submitted for certification, and 50,000 acres were passed in 1929, only about 771,667 acres of table stock and non-certified seed could have been produced from certified seed. New Jersey reported about 95 per cent of her commercial acreage planted with certified seed; Wyoming and New York reported 75 and 40 per cent of their acreage respectively

thus planted; and Canada had about 20%.

No figures are available on the non-certifying states, but it is known that a large part of the seed bought into all of the important commercial potato centers is certified seed. A great additional influence is exerted by the large quantity of seed used each year which is only one or two years removed from certified stock.

Certified seed has been a primary factor in the upward trend of average acre yields of potatoes in the United States, for this rise has paralleled the advance of the certification movement. From 96.5 bushels in the period from 1908-1912, and 97.9 bushels in 1914-1930, our average per acre production has increased to 107.5 bushels in 1921-1925, and 116.8 bushels in 1926-1928. This rise has been made in a period when superior seed quality must be credited mostly to a decreased infection of virus diseases. Certification has practically saved potato production for the Corn Belt and more especially for the trucking sections of the South, and the Eastern seaboard. When greater attention is eventually given to isolating high yielding strains within each important variety, the possibilities favor a more rapid advance in average acre yields.

VI. The Trend of Certification in America.

A movement which has developed so rapidly and has spread so widely as has seed potato certification is bound to have many problems. The trend of certification in America can be best traced through a brief study of the more outstanding of these problems, their status and the efforts which are being made to meet them.

1. Isolating High-yielding Strains.

It is not only common observation, but a demonstrated fact (88) that there are high and low yielding strains of potatoes, within a given stock of a variety, irrespective of their disease content. Most authorities believe that these strains can be so isolated as to be able to maintain their superiority in succeeding crops. In some of the countries of central Europe (41) yielding ability has long been considered as a part of the certification requirements for seed stock. Very little has been done along this line in America except in a general way. Our attention to yield has been principally from the angle of disease control.

Experimental Work Done. -

Krantz and Tolaas (89) reported from their work in Minnesota that if hereditary differences in yielding ability exist between seed stocks which are otherwise apparently alike, they are too small to be of commercial

importance.

An opposite experience has been reported by such investigators as Myers (90) and Livermore (91) in New York, Macoun (92) and McCulloch (93) in Canada, Harrington (94) in Montana, and Edmundson (95) of the U. S. D. A. in Wisconsin, Minnesota and Colorado.

The certifying states of California, Colorado, Idaho, Maine, Maryland, Michigan, Montana, North Dakota, Oregon, Pennsylvania and Wyoming stated that they were carrying on some work in isolating the high and low yielding strains of their seed stock in 1939. In the last three states named, the seed source test plot was mentioned as the means of comparing these strains. Since 19 states now require these test plots, this work could be expanded to other states very easily. Canada is also at work on this problem.

New York a Leader-

One state has gone so far as to make yield considerations a definite part of its certification program. In New York, the first effort to isolate superior tuber-lines in seed stock being grown commercially was made in 1919. Myers (90) reported representative results obtained by six growers in one county from three years of comparative tests of selected tuber-lines, over a random sample of the original stock. The average gain for 6 tubers lines was 48.1 bushels to the acre.

This work is supervised (96) by the Plant Breeding Department of the Cornell Experiment Station. The growers are selected as being those in adapted regions who should be capable of producing a superior grade of seed stock. They are mostly men who have been growing high-quality seed potatoes for sale to the other growers.

To be eligible to enter stock for certification in the "Registered-Certified" class (72) a grower must carry on 3 years of preliminary selection work in cooperation with the College representatives. This work includes the conduct each year of a tuber-unit seed plot on the growers farm; the increase, after the first year, of superior selections in a multiplication plot; and the sending in each year, for testing by the College, of a 500 tuber sample from the plot.

Selection for yield must be practiced each year either in the multiplication plot, or in the seed plot. The yield of the sample test plot at the College shall not be more than 10% below the average yield of all samples of the same varietal type in the same test; and not more than 1% of virus diseases is allowed at any inspection before August first.

About 25-30 farmers cooperated with Cornell in this work in the summer of 1939. While comparatively little registered-certified seed has yet been made available, at least three valuable strains have been developed and have

spread to outside growers. It is the object of this work to have these better strains distributed for further increase under certification.

VI. 2. Decreasing the Disease Content.

Increased information on the recognition and control of virus diseases has resulted in a remarkable decrease in the disease content of our certified seed stocks, in the last decade. It is now commonly known that certain of the diseases, as mosaic and spindle tuber, do not show their symptoms under conditions of drought and high temperature. This "masking" has too often resulted in passing over diseased plants in the field inspection, with disastrous results to the grower the following season.

Some stocks are so badly infected with disease as to make further propogation under any conditions impractical. These strains should be tested and eliminated. The outstanding methods now being used to decrease the disease content of certified seed stock will be discussed here:

a. Sample Test Plot

The benefits to be derived from the growing of sample seed test plots, from samples submitted by each grower, as enumerated by Barrus (97) are as follows:-

(1) Saves expense to both grower and certification agency through the elimination of fields planted with diseased seed.

(2) A report of disease counts to the grower enables him to know what to look for in his roguing.

(3) A study of the plot by the inspector at a time and under conditions favorable for the detection of a virus disease enables him to detect masking in the field.

(4) When a sample approaches the limit of tolerance the inspector is more critical in his examination of the field.

(5) Makes it unnecessary that the grower delay roguing until after the first field inspectionis made.

(6) Study of the samples year after year will assist in determining the sections of the state which are freer from virus diseases and better adapted for seed growing.

(7) A preliminary method in isolating disease free stocks.

(8) Growers are afforded an opportunity to examine their stock on an equal away from home basis with other certified stock, and to make comparisons.

(9) Disagreements are frequently eliminated, since the grower whose seed does not pass inspection will withdraw his field rather than have it turned down at field inspection.

Folsom and Schultz (98) in Maine were able to reduce the mosaic content of a stock of Bliss Triumphs from 57 to 9% in two years by means of tuber-unit seed plots. By the same means, they practically eliminated 20 to 30% of spindle tuber in a year.

A sample for testing of each seed lot to be planted by the grower was required in all of the certifying states, but Maine, Minnesota, Vermont and Wisconsin in 1929. In only ten states were definite standards for the sample seed plot given. Vermont is requiring the seed sample in 1930.

The plot is usually planted at some place where conditions favor virus disease expression at a maximum. Colorado plants her stock at higher and Idaho at lower altitudes to get this effect.

Canada does not require the seed plot, but a field may be rejected on the basis of the past history of its seed stock, a careful record of which is maintained.

b. Tuber Unit Planting.

An essential part of the sample test plot just discussed has been the planting in tuber-units. By this method (98) all of the plants coming from a single tuber will be in adjoining hills and the group of consecutive plants representing a tuber is known as a tuber-unit.

The advantages of tuber-unit planting as given by Harrington (99) are:-

(1) Easier identification of diseased plants.

(2) A bunching instead of a distribution of diseased plants and fewer centers for disease dissemination.

(3) Less chance of dwarfed plants being overshadowed by large healthy plants.

(4) Easier roguing possible and earlier.

(5) Late developing diseased plants can be detected through their diseased sisters in the same unit.

(6) Close planting holds down size of the tubers with less danger of overshadowing.

This method of planting facilitates selection for all plant characteristics and is used in strain isolation work. It was required in practically all of the sample seed plots in 1929, and in 10 of the 12 states requiring their growers to maintain seed increase plots.

The development of the mechanical tuber-unit planter, as reported by Ashegaard (100) has done much to popularize the use of tuber unit planting by the grower. Cases have been reported in Michigan, Minnesota and Montana where growers have planted their entire certified acreage in tuber units. Some authorities as Harrington (99) and Bonde and Folsom (101) have predicted that tuber unit planting may eventually be largely used or even required in producing all certified seed.

c. Advanced Testing in the South.

To determine before planting time which seed stocks are badly infected with the virus diseases, some states have adopted the practice of sending samples of all their seed to the south for planting during the winter. Inspections are made by representatives of the northern certifying agency. In Florida, for example, the seed is planted about February first and inspected about April first. This type of work was first reported by Fernow (102) of New York.

New York now tests some samples each winter in Bermuda. Colorado sends her Triumph seed to Louisiana and Texas; Nebraska formerly tested in Louisiana, but now sends samples of every lot of seed to be planted for certification to Florida every other winter; Vermont sent some of her best strains to Florida for testing in 1933, and Wyoming each year tests all of her seed strains in southern Texas.

These tests have furnished considerable advertising value to the states using them, but they should not be confused with the seed source tests conducted by many of the southern states, although some of the last named tests (103) have aided materially in isolating superior strains of northern seed.

d. Tuber-index Work.

One of the most promising developments in virus disease control work has been a method known as tuber-indexing.

F is method was first advocated by Blodgett (104) who used it to eliminate mosaic from individual tubers.

The Method-

The system is well and completely described by Stuart (105) and Werner (106) and a brief outline only will be given here. The work is done during the winter in the greenhouse. From tubers representative of the lot of seed to be tested, a piece containing one good eye is removed, usually from the apical end. Each tuber and its seed piece is numbered alike, an indelible pencil or India ink being used. The knife is sterilized after each cutting. The parent tubers are allowed to dry their cut surfaces and are then returned to storage. The seed pieces are treated with ethylene chlorhydrin to break the rest period and hasten germination. Then, they are planted in a greenhouse bench, or in pots, and properly labelled. They are given sufficient moisture and temperature for rapid growth. After the sheets are a few inches high, the temperature is gradually lowered. Inspections are made at regular intervals and diseased plants showing up are rogued out. Careful records are kept of all roguings and the cause. Readings are made until after the plants are 13 to 24 inches high. At this time, diseased samples are brought out and discarded. The parent tubers remaining from stocks which have tested (indexed) clean are saved for planting the field seed plot.

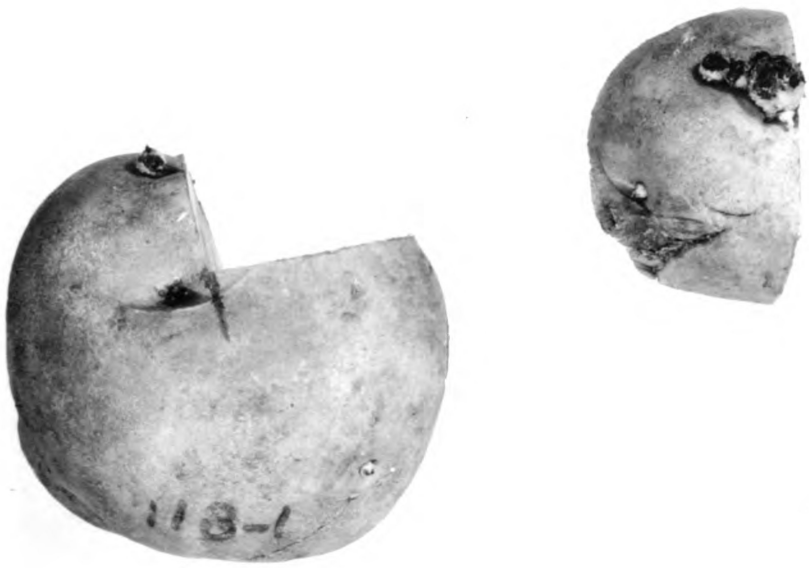


FIGURE 16- A Tuber and Its Index Seed Piece Ready for the Greenhouse Test.

The Uses-

The uses for tuber-index work are listed by Werner (106) as follows:-

(1) To check up on the disease content of seed stock before and after planting.

(2) To develop tuber-lines of seed stock free from disease.

(1) The complete annual indexing of all seed stock requires more greenhouse space than has generally been available. North Dakota was the only state reporting that this was being done in 1939. In Cal., Minn., Nebr., Ore., and Wis., most of the seed stock was indexed, and all of the questionable stock. Minnesota indexed all of her Triumphs. Montana thus tested 25% of her stock in 1939 and will take in all seed stock in 1940. In Colorado, no seed can be more than five years removed from tuber-indexed stock. Some indexing work of this sort has been or is being done in Canada, Idaho, Maine, Maryland, Michigan, New Jersey, New York, Ohio, South Dakota, Vermont, Washington and Wyoming.

(2) Probably the real value of the tuber index method lies in its second use. The first use just discussed contributes directly to the development of superior tuber lines. In many cases, disease free lines discovered in mass testing are isolated and form a basis for this more advanced work. A few examples will serve to illustrate the encouraging progress that has been made.

FIGURE 17- A Tuber Index Test Showing Healthy Plants in the Greenhouse.

Hotila (107) and (108) reported on 7 years work in the isolation of disease-free strains through the tuber-index method in Michigan. He used 6 standard varieties and followed up his indexing with isolated field increase plots. In 1938, some lines had been increased to more than 1,000 bushels which traced back to a single tuber from a high-yielding hill.

Milward (109) reported that in Wisconsin a foundation supply of Triumph which is practically free from mosaic has been developed by this method. Werner (106) and Gillig (110) reported work of this sort with the Triumph variety in Nebraska and North Dakota respectively.

Harrington (111) reported on a similar project in Montana. Schultz and Folsom (112) in their survey cite several other instances of the use of tuber-indexing for the isolation of disease-free stocks. This method appears to be the foundation for our future progress in the control of the virus diseases. The conditions essential for the success of such a program in any state are enumerated by Hotila (107) as:

1. The foundation tubers should be selected with extreme care.

2. Adequate isolation of increase plots is necessary, and these plots should be at least one-quarter of a mile away from the nearest potatoes.

3. Frequent and thorough inspections must be made, and all plants suspected of being diseased or off-type

FIGURE 18- An Isolated Strain Increase Plot.

FIGURE 19- Harvesting Strain Test Plots. Some Potato Improvement Work in Michigan.

for the variety must be rogued out as soon as discovered.

4. The work should be carried on in a region where masking of symptoms of virus diseases does not occur.

It is understood also that all increase plots are to be planted in tuber-units.

e. Other Factors in Disease Control.

The more important advances in lowering the disease content of our certified seed stock have been considered. Other factors contributing toward this end should be mentioned.

Isolation-

It has been shown by different investigators (112) that aphids are the principal carriers of the virus diseases. If disease-free stocks are to be maintained, they must be isolated (23) from other potato fields, and be kept as free as possible from aphids. In 1929, 20 of the 22 certifying states, and Canada, had a specified isolation requirement which varied from 3 feet for each % of virus diseases in an adjoining field in N. Y. to 300 feet in 7 states. Until more definite knowledge is obtained on this subject, it would seem that the maximum requirement were the safest.

Roguing-

Roguing of diseased plants from the field (112) should be started as soon as they can be recognized and should

continue regularly throughout the season. An allowance should be made in the standards to cover the skips resulting (as is done in Canada). Three states (Colo., N. H., Pa.,) did not allow roguing by the grower before the first inspection, in 1939. This does not seem a logical ruling. Roguing on cloudy days has been shown (112) to facilitate the detection of mosaic and spindle tuber. All diseased vines and tubers should be taken out, sacked and removed from the field.

Number of inspections-

Where trouble is encountered in the masking of mosaic or spindle tuber, or where black leg or Giant Hill are prevalent, three or more field inspections should be made, depending on the season. Only 5 states required as many as three field inspections in 1939.

Adapted Regions-

Some parts of each certifying state are far better adapted for certified seed production than are other parts. The factors involved are many, but the temperatures during the growing season and the prevalence of transmission agencies as aphids are two that are known to play a part. The observations of Fernow (113) in New York, Stuart (105) in Vermont and Werner (114) and (115) in Nebraska and elsewhere, serve well to stress this point. Fernow found

that 3 counties in N. Y. which produced about one-fifth of the certified seed of the state produced about one-half of the inferior seed samples, over a 4 year period.

Acres per grower-

A study of 1929 figures shows that the acreage entered per grower varied from 3.3 in Maryland to 30.1 in Nebraska. Some growers enter as much as 100 acres. It is questionable whether one man can satisfactorily rogue so many acres. This complicates the inspection work and there is a chance of fields slipping by that would otherwise be rejected. This brings up the further question (110) of whether or not we should recognize two types of growers. The first would plant a relatively small acreage, maintain his isolated tuber unit seed plots carefully each year, and receive a greater premium for his efforts. The second would plant a large acreage, avoid excess hand labor and excessive roguing through the use of high quality foundation stock and sell his seed at a profit without the excessive premium now required.

f. Some Promises for the Future

No matter what combination of methods is used, there is bound to be much progress in decreasing the disease content of certified stock in the years immediately ahead. An adequate system of records must be developed by

each state to back up its testing and isolation work. The value of well-kept records is shown in the efficient Canadian system. North Dakota reports that she has a registered history for many years on certain of her best certified seed stock.

The improvement work of individual growers should not be disregarded. It is the education of the grower that certification should keep as its foremost aim. Bailey (117) reported that more than 90% of the certified Green Mountains in Vermont in 1933 were grown from five major strains, developed by individual growers for their disease freedom and productiveness. The same condition is true to some extent in most of the certifying states.

3. Greater Uniformity of Standards.

When we consider that certification in the United States has from the start been a state and not a national enterprise, and also the wide range of conditions under which potatoes are certified in this country, it is natural that a divergence in the standards as used by the various states, should have been one of our outstanding problems.

The early standards used were modeled after a plan suggested by the late Dr. W. A. Orton (13) of the U. S. D. A., and later amended (14) at a conference called by the U. S. D. A. for that purpose. Still, in 1916, only two years later, Chairman Barrus (15) of the Certification

Committee of the Potato Association of America reported a considerable variation in the standards then in use made a strong plea for uniformity.

Sectional Conferences-

There are records of 3 scattered series of conferences between state officials at which this problem has been attacked. The first (118) was held at Berkeley, Cal., on May 28-31, 1911. Here the states of Arizona, California, Idaho, Montana, Oregon, Utah and Washington formulated and agreed upon a set of standards which has ever since had a definite influence on the conduct of the work of certification in these states.

An informal conference (30) was held at Baton Rouge, La., in March 1924 which was attended by representatives of the certification services in Minnesota, Montana, Nebraska, North Dakota, and Wisconsin. These leading Triumph producing states then formulated a program for the cooperative improvement of certified seed in this variety. The disease control problems of the Triumph have made it difficult for these states to meet uniform standards which applied to other varieties less susceptible to mosaic and spindle tuber.

In the east, the first of a series of Annual Conferences (119) sponsored by the Certification Committee of the P. A. A. was held at Freehold, New Jersey, on June 22-23, 1925. Officials of Canada, Maine, Michigan, New Jersey,

New York, Pennsylvania and Vermont were in attendance. This meeting served as a "builder" for the now-famous Kansas City report.

The Kansas City Report-

At the twelfth annual meeting of the Potato Association of America, held in Kansas City, Mo., on December 29-31, 1925, the Certification Committee (21) made a move for the greater uniformity of standards through advancing a definite set of standards for use by all of the states. In its report, the Committee recognized the fact that some states were already operating under standards more severe than those suggested, and that some deviation in the matter of individual disease tolerance would be necessary in the different states. They further stated that most states should expect to meet the total allowances set up at least as a maximum, cutting them still further as they were able. This standard is still the one recommended by the Committee, and because of its basic importance to the industry, it is given here:

Field Inspections

	% tolerance 1st inspec.	2nd inspec.
Combined degeneration (virus) disease	5	4
Black leg	1	1
Fusarium wilts	2	1
Combined diseases	6	5
Weak plants*	3	2
Varietal mixture	2	0.25

*By "weak plants" is meant plants which appear to be affected by a virus disease. Small plants are not necessarily weak.

Tuber Inspection

	% tolerance by weight
Spindle tuber	1
Stem end discoloration(wilts)	5
Scab (moderate)	10
Rhizoctonia (moderate)	10
Rots	1.5
Powdery scab	0
Black wart	0
Size-under or oversize*	2
Grade#	2

*Size- as per sales agreement. Otherwise, not less than one and one-half (1½) inches in diameter. Tubers weighing more than twelve (12) ounces must be removed.

"Grade- of one variety, practically free from dirt or foreign matter, frost injury, sunburn, second growth, growth cracks, hollow-heart, cuts, bruises, insect or mechanical injuries or other defects. Seed stock improperly stored, as indicated by excessive sweating, sprouting or shriveling, will be refused certification.

The Kansas City report has been, with a few exceptions (120), well-taken thruout the industry. We find a general tendency toward meeting the proposals advanced in 1935 in the standards used in 1939. Of the 30 states reporting, the following data indicates the present situation.

Recommended- Field Inspections.	No. states complying	% tolerance allowed- range.
5% total virus disease-1st	20	2(Mich)to 5 (13 states)
4% " " " -2nd	12	1(Mich)(Ohio) to 5 (Cal., Mont., Ore.)
6% total all diseases -1st	18	2(Mich)to 10(Cal.,Ore.)
5% " " " -2nd	11	1(Mich)to 10(Ore.)
2% varietal mixture -1st	18	0.25(Mich)to 5(Cal.,Idaho)
0.25% " " -2nd	11	0.0(6 states)to 2(N.D.)
Tuber Inspections	11	Considerable variation on scab and rhizoctonia.

More Uniformity is needed-

Our certifying states are undoubtedly producing a higher quality of seed stock today than ever before.

Still, it is obvious that with such a diversity of standards as are now in use, one can hardly be expected to hold a definite and constant meaning for "certified seed", irregardless of its source.

Canada (27), with the advantage of a centralised governmental control, has been operating under a uniform set of standards practically since her system was started, and actually since direct control was taken in British Columbia (38) in 1917. Her standards are equal to those suggested at Kansas City. Since Canadian certified seed from all 9 provinces is sold under one standard and one grade, it has a uniformity of meaning as a market product that cannot be obtained where 48 different standards are in use.

Replies received from the certification authorities of 19 states, in 1930, showed 12 of them in favor of a nationally uniform set of rules, 3 opposed, and four partially opposed, to such a plan. The situation does not offer a suggestion of any great immediate progress along this line.

4. Improving the Inspection Service.

a. The organization of inspection.

There are three general types of organizations conducting seed potato certification, which may be distinguished as follows:-

1. State Departments of Agriculture, in 8 states.

2. State Colleges of Agriculture, or State Agricultural Experiment Stations, in 6 states.

3. Growers Associations, in cooperation with or through their State Colleges of Agriculture, in 8 states.

All of these types of inspectional organizations are doing good work in the various states (a list of them is given on page 69). It is hardly possible to state which is the most satisfactory, as local conditions have a big influence. There has been a tendency toward an increase in the part played by growers associations during the past few years. This is a healthy sign.

A query of certification authorities in 1929 brought forward the following advantages for the two contrasting types of inspection services, the State Department of Agriculture versus the State College of Agriculture, either directly or through growers organizations:

State Departments-

(a) Better adapted to regulatory work and enforcement.

(b) Easier to secure protection from fraud.

(c) Easier to adjust legal difficulties.

(d) Colleges should be kept out of controversies.

(e) Responsibility can be centered more directly.

(f) Employment for more inspectors on full time.

State Colleges-

(a) Connect certification with extension program. Educational need is still as great as the regulatory need.

(b) Freedom from political influence.

(c) Freedom from charges of political influence.

(d) Greater continuity of policies.

(e) More chance for selection of personnel.

(f) More freedom from "red tape".

(g) Greater adjustability of standards.

(h) Better equipped for such work as seed testing.

(i) Results of latest research are sooner applied.

(j) Expert instruction available for inspectors.

(k) Gives College closer contacts with its farmers.

b. Better-trained inspectors

No matter how uniform a set of standards may be put into use, they must receive a uniform interpretation from the inspectors, or a uniform seed product cannot be expected to result. The direct conduct of inspection in each state was originally in charge of one or a few men; but as the industry has expanded, many new men had to be used in the service each year. Maine now employs 10 full-time inspectors, and others during the field inspection season. In Canada, 9 full-time and about 40 temporary inspectors are employed.

Choosing the Inspectors-

The problems of finding capable men to fill the

POTATO INSPECTION REPORT NO. 377

Name ..... County .....

P. O. Address ..... R. R. Station .....

Distance and direction from station .....

Acres inspected ..... Variety ..... Source of seed .....

Name of inspector ..... Date of inspection, 1st ..... 2nd ..... 3rd .....

DISEASE	First Inspection Percentage	Second Inspection Percentage	Third Inspection Percentage	Bin Inspection Percentage	INJURY DONE BY	None	Slight	Considerable	Serious
Wilt					Leaf Hoppers				
Black Leg					Aphids				
Mosaic					Colorado Beetles				
Spindle Tuber					Flea Beetle				
Spindling Sprout									
Leaf Roll									
Giant Hill					Early Blight				
Black Scurf					Late Blight				
Scab									

FIRST INSPECTION

Field No. ..... Location .....

Distance from uncertified potatoes ..... Rate of planting .....

Planting date ..... Whole or cut seed .....

Spacing distance ..... Per cent stand .....

Seed treatment ..... Vigor of plants .....

Cultural conditions ..... Per cent weak hills .....

Per cent variety mixture ..... Manure .....

Soil ..... Size of plot in tuber units .....

Commercial fertilizer ..... Recommended for certification? .....

Seed plot ..... Remarks .....

SECOND INSPECTION

Per cent weak hills ..... Per cent variety mixture .....

General vigor of plants .....

Estimated yield per acre ..... Tuber type .....

Cultural conditions ..... No. times sprayed .....

Spray material used ..... No. times rogued .....

Condition of seed plot .....

Recommended for certification? .....

Remarks .....

THIRD INSPECTION

No. times sprayed ..... No. times rogued .....

Remarks on thoroughness of work .....

Remarks on vigor of plants and tuber type .....

Remarks on disease condition .....

Recommended for certification? .....

BIN INSPECTION

Date of harvesting ..... Date of first killing frost .....

Per cent variety mixture ..... Per cent mechanical injury .....

Maturity ..... Per cent frost injury ..... Color .....

Type ..... No. tubers in 20 lb. sample .....

Per cent hollow heart .....

Graded or field run .....

Where is stock stored? .....

Is it stored near bin of uncertified potatoes? .....

No. bushels grown ..... No. bushels certified .....

No. bushels certified to sell .....

Recommended for certification? .....

Remarks .....

Weather conditions under which crop was grown .....

June ..... July ..... August .....

September ..... October .....

MICHIGAN CROP IMPROVEMENT ASSOCIATION

EAST LANSING, MICHIGAN

SEED POTATO INSPECTION SERVICE

LOADING INSPECTION

Grower's name ..... Certificate No. .....

Grower's address .....

Number of potatoes in 20 lb. sample .....

Type and uniformity .....

Per cent scab ..... Per cent black scurf .....

Per cent wilt .....

Notes on other diseases observed .....

Notes on condition of seed .....

(Plus or Wilt) (Burnout or Sprouted), lbs. .....

Per cent mechanical injury .....

Per cent tubers showing frost injury .....

Per cent tubers discolored because of poor storage conditions .....

Per cent tubers with hollow heart .....

Name of variety ..... Per cent of mixture .....

Note: Field inspection data furnished on request.

Name of purchaser .....

Address of purchaser .....

Initials of car ..... Number of car .....

How many bushels shipped .....

Inspector ..... Date .....

FIGURE 20- Report blanks used by the Michigan Inspectors.

temporary positions has come to the fore in most of the larger states. Some states are using College men, preferably graduate students with training in plant pathology, for this work. In other states, members of the College and Experiment Station Staff act in this capacity. Maryland uses her county agents. The men are usually trained on seed test plots at the College, and by sending them out at first with the older inspectors. It is a decided advantage to use the same men from year to year as much as possible.

The qualifications of an inspector, as given by H. C. Moore, Chief of the Michigan inspection service, follow :

(1) Training- an Agricultural College senior or graduate student, with training in plant pathology.

(2) Maturity- at least 24 years of age, must make a good impression on the grower.

(3) Farm experience- necessary to give him a better understanding of the problems to be faced.

(4) Personality- ability to make a turndown and leave the grower satisfied.

(5) Judgment- an important factor in all dealings.

Interpreting the Standards-

Because of the scattered conditions under which the virus diseases express themselves, it has been difficult many times to secure an agreement on the identity and

pathological classification of a disease trouble. The regional conferences (118), (20) and (119) already mentioned have helped to emphasize and also to overcome this difficulty. At the annual Freehold meetings (120) samples of the virus diseases from each state are sent to New Jersey and there planted in tuber-unit plots. These plots are inspected by all of the visiting officials and then serve as the basis for the discussion which follows. The annual meetings of the Potato Association of America serve to bring about a broader understanding of the problems of inspection. Individual officials have devoted considerable time and travel to a study of the same problems. There is a wider agreement on the interpretation of the standards today than ever before, and a greater similarity of the methods used in the inspection work.

5. Protecting Certified Seed From Fraud.

The increased price of and demand for certified seed soon resulted in the appearance on the seed market of stock marked as "certified" which had not met the inspection of any authorized certifying agency. Protection of certified seed from fraud has since been a big problem. It is evident that the dangers and injustices of allowing such misrepresented stock to be traded (132) effect and injure not only the buyers of this seed, but also the producers of genuine certified seed, and the State and Federal Governments who have spent large sums of money in promoting

seed improvement projects.

What has been done-

Various solutions for this problem have been suggested and attempted. Clark (124) tried to register the word "certified" as it applied to officially inspected seed potatoes. The decision from the Solicitors Office of the U. S. D. A. was in the negative, on the grounds that the meanings and usages of the word for many purposes were already too general. It was suggested by the Office that some distinctive term which would include the word certified in connection with seed potatoes be registered as a trademark.

Another suggestion (121) was to the effect that such a trademark could be copyrighted by the Potato Association of America and its use granted to one official agency in those certifying states who would attempt to meet or better the standards set down in the Kansas City report. In accordance with this sentiment, the Certification Committee in 1927 (33) presented such a plan, the work to be in charge of an association of certifying officials representing both the United States and Canada. The general feeling seemed to be that such a program would not be effective and the matter was not approved.

Many have felt that the U. S. Government should establish a legal U. S. Grade for certified seed. Canada (48)

has done this with great success, but she is operating under one uniform set of standards throughout the Dominion. Until our standards in the U. S. can be made more uniform, little official recognition of this problem can be expected from the national government.

Some states have attempted to protect their certified seed through publicity and educational work, impressing in the mind of the buyer a knowledge of how to distinguish certified from uncertified stock on the basis of source, sacking and tagging. Distinctive copyrighted tags, as used by Nebraska (shaped as the state) and Michigan (representing a Rural Russet potato), have helped. The extensive use of registered trade-names by cooperative associations as the "Chief Petoskey Brand" in Michigan and the "Blue Tag Brand" in New York, have also contributed toward the solution of this problem. Other states (125) use the official seal of the state on their tags. The increased adoption of shipping point inspections has kept much uncertified stock from leaving the producing sections in the same car with certified seed. More closely supervised issuance of certification tags and the sealing of the tags to the sacks are other aids in preventing misrepresentation.

State Laws-

Perhaps the most encouraging development of all, as far as present effectiveness is concerned, has been the protection of certified seed by state law. Minnesota (36)

NEBRASKA SEED POTATO CERTIFICATION STANDARD

All potatoes that have been certified for seed purposes have been grown in the high altitude regions of western Nebraska and have passed three field inspections and one bin inspection according to the following standard:

1. **True to variety type** and free from variety mixtures.
2. **Free from wart, powdery scab and late blight. (These diseases** have not yet been found in western Nebraska.)
3. **Not to exceed 5 per cent of all vine diseases. Less than 10 per cent of all tuber and vine diseases. Only slight scab infection will be permitted.**
4. **Certified seed is graded according to the U. S. No. 1 grade except for size. Potatoes passing over a 1⅛-inch screen are permitted in Certified seed.**
5. **The association will hold the grower responsible for the grade.**

This seed stock has been inspected twice in the field and once in the bin under the direction of the **Michigan State College.** It meets the prescribed standards relative to varietal purity and freedom from disease. It is the product of vigorous satisfactory yielding fields.

Certified seed must be carefully graded for size, type, blemishes, mechanical injuries, etc., before it is offered for sale. When shipped in car load lots it must be inspected at time of loading under the direction of the **Michigan State College.**

Each sack must be sealed with a lead and wire seal to which the official certification tag of the **Michigan Crop Improvement Association** is attached. This tag is to be used only on seed potatoes that have passed the inspection requirements of the **Michigan State College** and that have been certified by the **Michigan Crop Improvement Association.**

The inspection records of this seed can be procured — from —

THE MICHIGAN STATE COLLEGE
Office of Seed Potato Inspection Service
East Lansing, Michigan
(When writing state Certificate Number.)

Caution to Purchaser — Keep this seed in a cool, well ventilated, frost-proof storage. Do not expose it to extremes of temperature. If stored in large piles, provide for aerating the piles. Use care in cutting and planting the seed.

MICHIGAN CROP IMPROVEMENT ASSOCIATION
East Lansing, Michigan

FIGURE 21- Top- Nebraska Below- Michigan

Distinctive Copyrighted Tags are Good Advertising and Help to Protect Certified Seed from Fraud.

was one of the first states to offer direct protection to its certified seed by law. Section 10 of her law states- " It shall be unlawful to use or employ the term "certified" or the term"inspected" or the term "registered", or any term or terms conveying a meaning substantially equivalent to the meaning of any of said terms, either orally or in writing, printing, marking or otherwise in reference to or in connection with, or in advertising or characterizing or labeling seed potatoes or the containers thereof, unless such potatoes shall have been duly inspected, registered and certified pursuant to the provisions of this act".

In Oregon (136), the law considers not only certified seed originating within the state, but also any seed shipped in from other states under the classification of certified. To quote from Section 6 of the Oregon law- "All certified or standard seed sold or offered for sale or shipment in the state of Oregon shall bear the official tag or seal of the potato certification board of the Oregon Agricultural College, or if certified in another state the official tag or seal of the certifying agency of that state; provided, that no potatoes may be sold or offered for sale as "certified" or "standard" seed potatoes, and no brand or labels for seed potatoes may include the words "certified" or "standard" in the state of Oregon unless said potatoes have passed all the requirements and carry the official tag of the official certifying agency of the state in which they originate, and that the standards of such a state are

determined to be equal to the standards established by the Oregon potato certification board." California and Washington (69) have laws similar to the Oregon law.

Maine, North Dakota (68) and Pennsylvania (187) are the other certifying states reporting laws for the protection of certified seed in 1939. A complete copy of the Pennsylvania Act No. 305 is given on the two following pages.

Mississippi (66) has a state law which prohibits the importation of seed as "certified" unless it has been properly certified by state officials. This law is known as State Plant Board Rule No. 60 and it reads as follows:- "In order to discourage the introduction into and the dissemination with Mississippi of mosaic, scab, leaf roll, spindle tuber, late blight, wilt, rust, and other diseases of Irish potatoes, the use of the terms "certified", "inspected", "registered", or any other terms conveying a meaning substantially equivalent to these terms, either orally or on the labels or containers thereof, is hereby prohibited, except when such potatoes shall have been inspected and certified by the legally constituted inspection officials of the state in which they were grown, or by such other agencies as may be approved by the State Plant Board of Mississippi."

These various state laws are backed by penalties which include fines of from $10 to $1000, and 10 days to 6 months imprisonment. All of the states using them report that they are giving satisfactory and effective results.

No. 205

AN ACT

Providing for the certification of inspected seed potatoes, agricultural and vegetable seeds; prohibiting the use of the words "certified," "inspected," "registered," or similar terms, in connection with the sale of seed potatoes and agricultural and vegetable seeds, unless inspected and certified as provided in this act; providing for the enforcement of this act by the Department of Agriculture; prescribing penalties, and conferring jurisdiction in certain cases upon the courts of common pleas.

Department of Agriculture.

Seed potatoes and vegetable seeds.

Section 1. Be it enacted, &c., That the term "department," as used in this act, shall mean the Department of Agriculture of the Commonwealth of Pennsylvania.

"Certified seed" defined.

The term "certified seed," as used in this act, shall include seed potatoes, and such agricultural or vegetable seeds as shall have been inspected during their period of growth and preparation for market by the department or its authorized agents (or by the legally constituted inspection officals of the State in which such seed potatoes or agricultural or vegatable seeds were grown, or by such other agencies as may be approved or recognized by the department), and found to be reasonably free from diseases and other defects, as specified in the rules and regulations issued by the Department under the provisions of this act.

"Seed potatoes" defined.

The term "seed potatoes," as used in this act, shall be construed to mean the tubers of the Irish potato, which are grown and intended to be used as seed.

"Agricultural seeds" defined.

The term "agricultural seeds" shall include all seeds which are commonly known as farm crop seeds, which are grown and intended to be used as seed in raising farm crops.

"Vegetable seeds" defined.

The term "vegetable seeds" shall include all seeds which are commonly known as vegetable seeds, and which are grown and intended to be used as seed in raising garden and truck crops.

Application of grower for certification.

Section 2. Any grower of potatoes, agricultural or vegetable seeds, located in Pennsylvania, may make application to the department for inspection and certification of his crop for seed purposes, under such rules and regulations as the department may issue.

The department, or its authorized agents, shall issue such certificates of inspection, and designate or provide such official tags for marking containers of "certified seed," and establish such standards of grade and quality, as are necessary to safeguard the privileges and service provided for in this act.

Fees.

Section 3. The department shall have authority to fix, assess and collect, or cause to be collected, fees for the certification inspection service authorized by this act, the same to be paid in such manner as it may direct. Such fees shall be large enough to meet the reasonable expenses incurred by the department or its agents in making such inspections as may be necessary for certifi-

cation. Fees so collected shall be paid by the department into the State Treasury through the Department of Revenue.

Section 4. It shall be a violation of this act to use the term "certified," or any form or modification of this term which tends to convey to the purchaser of such seed that the same has been certified as defined in section one of this act, on tags or containers, either orally or in writing, or in advertising material intended to promote the sale of seed potatoes or agricultural or vegetable seeds, or on labels or containers, except when such seed potatoes or agricultural or vegetable seeds shall have been inspected and certified to under the provisions of this act.

Authority.

Section 5. Authority to make all necessary rules and regulations to carry out the provisions of this act is hereby conferred on the department.

Violations.

Section 6. Any person, copartnership, association or corporation, and any officer, agent, servant or employe thereof, violating any of the provisions of this act, shall be guilty of a misdemeanor, and, on conviction, shall be

Fine.

sentenced to pay a fine of not more than two hundred dollars ($200.00) for each offense. All fines collected under this act shall be paid to the department and shall be, by it, paid into the State Treasury through the Department of Revenue.

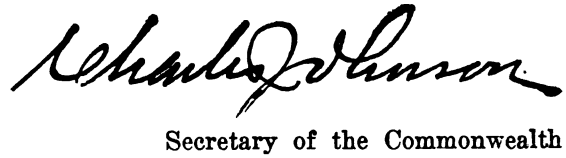
Enforcement.

Section 7. The department shall be charged with the enforcement of this act and shall furnish the Department of Justice with information of violations of the provisions thereof. The Attorney General may, in the name of the Commonwealth, institute proceedings in equity in the court of common pleas of any county for the purpose of enjoining the use of the words "certified," "inspected," "registered," or any other term or terms conveying a meaning substantially equivalent to these terms, contrary to the provisions of this act, and, for such purpose, jurisdiction is hereby conferred upon said court. In any such case, the Attorney General shall not be required to give bond.

APPROVED—The 11th day of April, A. D. 1929.

JOHN S. FISHER

The foregoing is a true and correct copy of Act of the General Assembly No. 205.



Secretary of the Commonwealth

The Present Situation-

There is very little agreement at the present time as to just what should be done in this matter. A questionnaire submitted by the Certification Committee (34) of the P. A. A. in 1930 was answered by 16 states with the following results-

Plan A--that the P. A. A. establish a trademark.
" B--that a special organization be formed to establish a trademark.
" C--that the U. S. D. A. establish a certified seed grade.
" D--That the protection of the word "certified" be left to the various states.

Plan	First choice	Second choice
A	Colo., Ky., Mont.	Mich., Minn.
B	Idaho	N. Y., Vt.
C	Me., Md., Minn., N.Y., S. D., Wash.	Cal., Colo., Ky., Mont., N.J., Ohio
D	Cal., Mich., N.Y., Ohio, Vt., Wis.	Me., Md., Wash.

This report shows that there is considerable favor for the establishment of a U. S. certified seed grade. Still other of our important certifying states prefer to maintain their "individuality". Looking into the future

of certification as an industry, it would seem that "certified seed" should have a more universal meaning than can be obtained by individual state effort. To bring this about will require more education and a greater spirit of cooperation between the states. Seed which cannot meet a set of standards as proposed at Kansas City (21) should not be sold or given protection as certified seed.

6. Marketing the Certified Crop.

In 1929, about 55 per cent of the United States crop was marketed directly from the grower to the buyer or his dealer; 25 per cent was sold on contract or agreement; and about 20 per cent cooperatively through growers organizations.

The whole basis of success in certification is cooperation and it is natural that the growers cooperatives should slowly but surely be exerting a greater influence on the marketing of the certified crop. This system is especially advantageous to the smaller grower; and it has been shown in both this country and in Canada that the grower with a comparatively small acreage is the basic unit in the production of high quality certified seed.

Canada marketed 85 per cent of her crop through growers cooperatives in 1929. The rapid expansion of her export trade is ample evidence that from the buyers point of

view this method can be carried out satisfactorily. Of the larger producing states in this country in 1929 Nebraska sold her entire crop cooperatively (all certification is controlled by the growers coop), North Dakota 70 per cent, New York 50 per cent, Michigan 40 per cent and Minnesota 35 per cent.

Space does not permit an extended discussion of the broad subject of marketing in this thesis. The recent development of the "pooling idea" in buying certified seed (128), as well as in selling it, may have a big influence on future marketing operations. A great deal of uncertified seed on the market today is of excellent quality. This competition must be largely worked out through the marketing process.

7. Expanding the Market for Certified Seed.

A large part of the problems of certification are still educational, rather than regulatory. The continued expansion of the industry is dependent on opening up new markets for certified seed, not only in outside states, but in the producing states themselves. Michigan, for instance, exports about 75 per cent of her crop, yet only 10 per cent of her commercial acreage in 1929 was planted with certified seed. The movement of certified stock from the north and west to the southern trucking sections will continue to increase. This increase can be made soundly and permanently only through continued educational efforts in these states;

What Do You Know
about
VERMONT POTATOES
?

Check up with the answers and ask us any others

At Your Service

THE VERMONT CERTIFIED SEED POTATO GROWERS' ASSOCIATION

L. H. BALL	E. A. JONES	H. L. BAILEY
President	Vice President	Sec'y.-Treas.
Randolph Ctr.	Waitsfield	Bradford

NEBRASKA CERTIFIED SEED POTATOES

Are A Vital Factor

In Securing

A Better Stand
A Surer Crop
A Higher Yield
A Lower Production Cost
and A Greater Profit

This pamphlet contains a few facts which we have assembled for the benefit of those sincerely interested in potato production for profit

NEBRASKA CERTIFIED POTATO GROWERS
ALLIANCE, NEBR

FIGURE 24- Attractive Circulars Help Increase the Market for Certified Seed.

and there must be more "missionary work" right at home. The doctrine of certified seed must not only be told to the grower, but it must be proven to him through the field performance of certified stock. Convince a grower in dollars and cents that certified seed is consistently superior seed, and he will be one of the industry's best boosters.

The following means of increasing the demand for certified seed were given by authorities of the certifying states in reply to a recent questionnaire-

(1) Lectures, demonstrations and correspondence by College extension workers and county agents.

(2) Ploting demonstrations, other demonstrations and lectures by the inspectors, in the home and other states.

(3) Extension work by railroads and commercial firms.

(4) Salesmen for cooperatives.

(5) Inspecting customers crops during the growing season to discern and adjust difficulties.

(6) Raising the standards, and improving the quality of the stock sold, through careful supervision of all inspections.

(7) Furnishing samples for demonstration plots-

a- In over-state tests in home state

b- In seed-source to be in other states.

(8) Distributing sample lots to growers at table stock prices, through county agents, local farmers organizations, members of commerce and railroads.

Vermont Certified Seed Potato Growers' Association

Circular of Information

New Series. BRADFORD, VT., JAN. 15, 1930. No. 16.

HAROLD L. BAILEY, Secretary-Treasurer

What Vermont Is Doing In the Certified Seed Potato Industry

AT THE OUTSET of this year, A. D. 1930, of the American Republic 154, and P. C. 17—standing, of course, for Potato Certification unless you were in the stock market and read it Post Crash—it seems proper that we take a look around to see just where we stand under the signs of the potato calendar. Leaving, with Kipling, those things which we have not done that should have been done, and those which we have done which should not have been done, "For things we never mention, For art misunderstood—For excellent intention that did not turn to good;" we can fairly make the folowing claims for Vermont in the certified seed industry: With our certification service antedated by that of only one state, we have a long and valuable experience upon which to build; the project here has shown a healthy growth; Vermont certified seed has gained a reputation for producing first class results in the great commercial potato growing regions to the south of us. Our acreage is small compared to that of Maine and several other major potato growing states, yet it is larger than that of about half the twenty states having certification, and it represents a development well fitted to the general farming practice of the state.

Beginning with the early days when almost every field represented a separate and distinct seed source, and when varietal mixture, late blight and rhizoctonia were about all the troubles to be looked for, strain selection has been carried out until a great portion of the acreage is now grown from a few of the very best strains. Disease tolerances have been reduced in line with similar reductions in other states; field isolation has been insisted upon; a shipping inspection has been established and strengthened; systematic instruction has been provided in roguing and grading work; tuber-uniting and hill-uniting and the use of the seed plot have been encouraged and field inspection has been made closer through a larger inspection force. Inspections supplementary to the regular first and second have been made a regular feature of the work in order that the fields may be visited at best time for disease detection. In short, all known methods for the improvement of seed quality have been adopted as they became known, and close touch has been kept with the work in other states. The establishment of the sample test-plot, which goes into effect this year, adds one more important feature to the Vermont certification system.

That there are difficulties and discouragements besetting seed potato work is certainly not to be gainsaid. The potato is a perverse "vegetable," and it sometimes seems that it brings down more than a fair share of hard luck upon its growers who try to keep it in the straight and narrow path. However, it must be considered that the project of producing certified seed is still in

(Concluded on page 4)

HILL UNIT PLANTING FOR SEED IMPROVEMENT

Hill-unit planting is one of the methods recommended for the elimination of virus disease from seed stock. All the potatoes from one hill are planted one after another in a section of row, or unit, separated from the next unit by a space of one hill. If one diseased plant is found in a unit all the plants therein are taken out on the suspicion that others have the disease about them in an indeterminable form. While merely planting the seed pieces from one tuber in separated units—the tuber-unit method—is generally considered sufficient, the hill-unit plan offers a still more thoroughgoing system. The above picture shows the field of Buell Lake of Jeffersonville, where Mr. Lake and County Agent F. D. Jones carried on interesting and extensive experimental work.

FIGURE 25- Some Growers Associations Have Excellent News Bulletins.

(9) Supply lists gratis for 4-H Club work.

(10) Magazine ads [illegible] money for advertising and publicity.

(11) Circulars, lists of growers and news bulletins.

(12) Distinctive tags and seals.

(13) Radio talks.

(14) Potato Clubs.

(15) Grad potato tours.

(16) Potato products trains.

(17) High-yield contests.

(18) Exhibits at farmers meetings and fairs.

C. Increasing the Acreage of Certified Seed.

It was brought out in the discussion of the results of certification that in any one year no more than 20 per cent of our total U. S. commercial potato acreage has been planted with certified seed. This includes our importations from Canada. The evident superior results from the use of certified seed and the potential markets yet to be opened should allow for an almost unlimited expansion of production. A query of the certifying states in 1930 brought out the opinions that the possibilities for expansion are limited in the states of Maryland, Nebraska, New Jersey, New York, Ohio, Oregon, Pennsylvania and Wisconsin, but they are excellent to unlimited in California, Colorado, Maine, Michigan, Minnesota, Montana, North Dakota, Vermont and Washington, and in Canada.

FIGURE 26-Michigan State Potato Show, 1930.

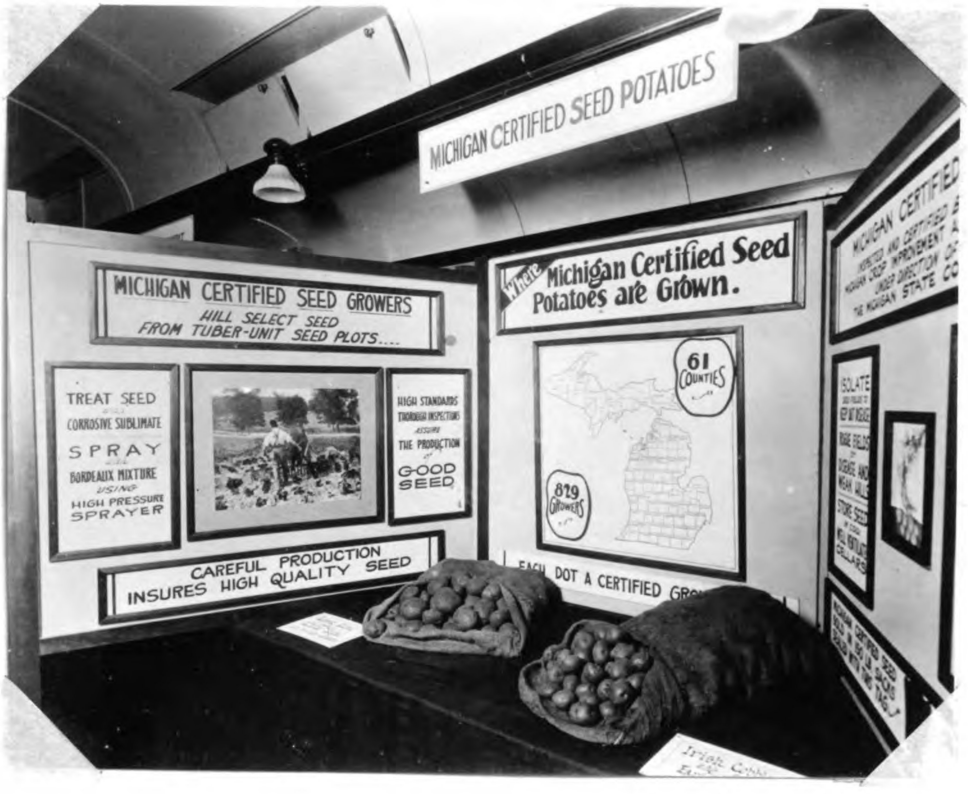


FIGURE 27- On a Potato Improvement Train in Ohio, 1929. Education Increases the Demand for Certified Seed.

The general attitude toward increasing the acreage of certified seed at this time is that it can be readily brought about as the market demand warrants it, but there are other problems within the industry that should first be worked out. Sources of disease-free foundation stock must be made certain, high-yielding strains isolated and used, inspection methods and organization perfected, and marketing better organized before an increase in acreage is encouraged.

A part of this future program must be the education of the certified grower to the responsibilities of his task. The extra expense involved in properly growing a crop of certified stock requires that the grower be fairly compensated. In some states, the margin of premium over table stock prices is too small to expect the necessary care and interest from the grower. Some unadapted sections in several of the states should be eliminated from production. More experimentation should be devoted to this matter of the influence of environment on quality in seed stock.
* It is desirable that greater effort be given to make "certified seed" as a market product more uniform throughout America. These, and many other problems, must necessarily be considered in increasing the acreage of certified seed.

* New growers should be required to successfully pass a year of probationary inspection before being allowed to enter stock for certification.

VII. SUMMARY

Seed potato certification in the United States is the result of a demand by commercial growers for a reliable source of high-quality seed stock.

The work was first started in Wisconsin in 1913. In 1922, 23 states were certifying potato seed; and 32 of these states are now carrying on the work, Utah having dropped out in 1934.

Canada commenced certification in 1916 and has developed a system in each of the 9 provinces of the Dominion.

Potato certification has been practiced in Europe since the start of the present century, and it is now carried on to some extent in practically all of the important potato producing countries.

Considering the scattered centers of control, there is a great similarity between the organization, standards and conduct of the certification work in the various states of the United States. Michigan has the most exacting set of standards in use in America today. Due to centralized governmental control, the Canadian system is uniformly conducted throughout the Dominion.

The European systems of potato certification are mostly modeled after those first started in Germany, Holland and England, and the one in use in New Zealand is based on the Canadian scheme.

[illegible] problems presented by the [illegible] certification in America has resulted in improved quality and increased yields in crop [illegible] potatoes.

The principal problems of potato certification in America include the isolation of high-yielding strains, a decrease in the disease-content, the uniformity of standards, improvement of the inspection service, protection of certified seed from fraud, advising the crop efficiently, supervision of the tests, and inspection of the certified areas. All of these problems are requiring considerable attention at the present time.

VIII. CONCLUSIONS

As soon as [illegible] the [illegible] article of trade and of [illegible], the need for some system of official regulation of their disease troubles, varietal purity and productiveness developed.

During the thirty years of actual progress in seed potato certification this result has been established. The movement is still young and we should not be too critical of its limitations. In the control of the virus diseases alone it has strongly combatted a situation which had been allowed to spread for scores of years unchallenged.

A movement without problems is static and impotent. Seed certification has many problems. In the continued vitality and growth of their solution lies the future and the hope of the industry.

IX. BIBLIOGRAPHY

1. Stuart, William. The Potato, J. B. Lippincott Co., Philadelphia, p. 361-372. 1913.
2. Bagnall, John. Do Potato Varieties Degenerate in Warm Climates? Jour. Heredity, IX, 3: 133-134. 1918.
3. Coleridge, H. R. Seed Potato Situation on Long Island. Proceed. Potato Assoc. America, 1:17-19. 1914.
4. Cook, Lyal T. Seed Potato Situation in New Jersey. Pro. Pot. Assoc. Amer., 1:33-39. 1914.
5. Johnson, T. C. Seed Potato Situation in Virginia. Pro. Pot. Assoc. Amer., 1:26-31. 1914.
6. Stuart, Wm. Remarks on Seed Potatoes. Pro. Pot. Assoc. America, 1:31-33. 1914.
7. Stuart, Wm. Seed Potatoes and How to Produce Them. U. S. Dept. Agr., F. B. 1352:1-5. 1923.
8. Orton, W. A. The Potato Fusarium Situation in Europe and America. Phytopath., II, 1:33. 1912.
9. Orton, W. A. Leaf Roll, curly leaf and other new potato diseases. Phytopath., III, 1:69. 1913.
10. Orton, W. A. Inspection and certification of potato seed stock. Phytopath., IV, 1:39-40. 1914.
11. Anon. Constitution and By-Laws of the National Potato Association of America. Pro. Pot. Assoc. Amer., 1:7-10. 1914.
12. Orton, W. A. Improvement of Potato Seed Stocks Through Official Inspection and Certification. Pro. Pot. Assoc. Amer., 1:37-43. 1914.

13. Orton, W. A. The Potato Study Trip of 1914. Phytopath., IV, 6:412-413. 1914.

14. Anon. Report of the Conference on State Standards for Seed Potato Certification and Inspection. Files, Bureau Plant Industry, U. S. Dept. Agr. 1916.

15. Barrus, M. F. Discussion of Seed Potato Certification. Pro. Pot. Assoc. Amer., 3:56-64. 1916.

16. Barrus, M. F. Report of Committee on Seed Improvement and Certification. Pro. Pot. Assoc. Amer., 4:97-107. 1917.

17. Tolaas, A. G. Report of Committee on Potato Improvement and Certification. Pro. Pot. Assoc. Amer., 8:58-60. 1921.

18. Tolaas, A. G. Report of Committees on Potato Seed Improvement and Certification. Pro. Pot. Assoc. Amer., 9:45-54. 1922.

19. Tolaas. A. G. Report of Committee on Seed Potato Improvement and Certification. Pro. Pot. Assoc. Amer., 10:50-75. 1923.

20. Werner, H. O. Report of Seed Improvement and Certification Committee. Pro. Pot. Assoc. Amer., 11:150-156. 1924.

21. Martin, Wm. H. Report of Seed Certification Committee. Pro. Pot. Assoc. Amer., 12:147-157. 1925.

22. Martin, Wm. H. Report of Seed Certification Committee. Pro. Pot. Assoc. Amer., 13:141-154. 1926.

23. Martin, Wm. H. Report of Seed Certification Committee. Pro. Pot. Assoc. Amer., 14:236-243. 1927.

24. Martin, Wm. H. Report of Seed Potato Certification Committee. Pro. Pot. Assoc. Amer., 15:312-319. 1928.

25. Gussow, H. T. Report, Division of Botany. Dom. Dept. Agr., Sessional Paper 13:959-960. 1919.

26. Gussow, H. T. Report, Division of Botany. Dom. Dept. Agr., Sessional Paper 13:1110-1119. 1917.

27. Partridge, George. Report, Division of Botany. Dom. Dept. Agr., to Mar. 31, 1921:5-12. 1921.

28. Gussow, H. T. Report, Dominion Botanist. Dom. Dept. Agr., to Mar. 31, 1922: 10-14. 1922.

29. Tucker, John. Report, Dominion Botanist. Dom. Dept. Agr., for the year 1927, V:233-247. 1929.

30. Maid. C. W. Report, Committee on Re-Organization. Pro. Pot. Assoc. Amer., 3:33-33. 1913.

31. Gussow, H. T. Report, Dominion Botanist. Dom. Dept. Agr., for the year 1933: 19-33. 1933.

32. Gussow, H. T. Report, Dominion Botanist. Dom. Dept. Agr., for the year 1934: 11-13. 1935.

33. MacLeod, D. J. Problems Confronting the Certification Authorities in Canada. Pro. Pot. Assoc. Amer., 12:74-77. 1933.

35. Munro, J. B. Development of the Potato Industry in British Columbia. Pot. Jour, III, 5:130-132. 1926.

36. Peppin, S. G. The Seed Potato Situation in Prince Edward Island. Pot. Jour., III, 2:62-64. 1926.

37. Gussow, H. T. Report, Dominion Botanist. Dom. Dept. Agr., for the year 1935: 15-17. 1936.

38. MacLeod, H. S. Potato Certification in British Columbia. Pro. Pot. Assoc. Amer., 15:365-372. 1928.

39. Anon. Yearbook of Agriculture, U. S. Dept. Agr., p 810-811. 1936.

40. Orton, W. A. Lessons for American Potato Growers From German Experiences. U. S. Dept. Agr., Bul. 47. 1913.

41. Burkle, Werner. Saatenanerkennung und Samenkontrolle in der verschiedenen Landern der Erde, Inaugural- Dissertation zur Erlangung der Doktorwurde, Vereinigten Friedrichs- Universitat Halle-Wittenberg. 1937.

42. Appel, Otto. Leaf Roll Diseases of the Potato. Phytopath., V, 3:139-148. 1915.

43. Quanjer, H. M. New Work on Leaf Curl and Allied Diseases in Holland. Report, Inter. Pot. Confer., :127-132. 1921.

44. Cotton, A. D. The Situation With Regard to Leaf curl and Mosaic in Britain. Report, Int. Pot. Confer:133-136. 1921.

45. McIntosh, Thomas. The Inspection of Potato Varieties in Scotland. Pot. Jour., III, 5:130-132. 1926.

46. Anon. Potatoes For Seed in the Irish Free State. Jour. Min. Agr., 34:506-509. 1927.

47. Murphy, Paul A. Potato Growing in Ireland. Pot. Jour., III, 8:41-44. 1926.

48. Tucker, John. Canadian Certified Seed Potatoes. Dom. Dept. Agr., Pamp. 84 N. S. 1927.

49. Anon. Rules and Regulations Governing the Growing of Certified Seed Potatoes in Colorado. Colo. Agr. Col. Mimeo. 1929.

50. Anon. Seed Potato Regulations for 1929. Idaho Co. Agr. Ext., Cir. 31. 1929.

51. Bennett, E. R. Growing the Idaho Potato. Idaho Agr. Col., Ext. Bul. 89 (revised):43-47. 1932.

52. Anon. Requirements for Seed Potato Certification. Kentucky Col., Agr., Mimeo. 1930.

53. Anon. Certified Seed Inspection. Maine Dept. Agr., Mimeo. 1930.

54. Anon. Certification of Seed Potatoes. Maryland Col. Agr., Ext. Cir. 63. 1930.

55. Moore, M. C. Michigan Seed Potato Inspection and Certification Service. Mich. State Col., Leaflet. 1930.

56. Tolaas, A. G. Seed Potato Inspection and Certification Law and Rules and Regulations. Minn. Dept. Agr., Bul. 50, 1929.

57. Anon. Potato Certification 1930. Montana Potato Improvement Assoc., Mimeo. 1930.

58. Anon. Certification Rules for 1929. Nebraska Pot. Growers Coop. Assoc. Pamp. 1930.

59. Anon. New Hampshire Seed Potato Certification Rules. N. H. Agr. Exp. Sta., Press Bul. 1. 1930.

60. Anon. Inspection and Certification Rules for 1930. New Jersey Dept. Agr., Cir. 164. 1930.

61. Anon. Standard for Certified Seed Potatoes. New York Seed Imp. Coop. Assoc. Mimeo. 1929.

62. Gillig, E. M. North Dakota Certified Seed Potatoes. N. D. Agr. Exp. Sta., Cir. 31 (Fourth Revision). 1929.

63. Anon. Seed Potato Certification. Ohio. Cert. Seed Pot. Growers Assoc. Booklet. 1929.

64. Hysloy, G. R. Potato Certification for 1939. Oregon Agr. Col., Cir. 243. 1939.

65. Lauer, K. W. Seed Potato Certification in Pennsylvania. Pa. Dept. Agr., Circ. Bul. 471. 1939.

66. Anon. Pot to Seed Certification. South Dakota Pot. Growers Assoc. Cir. 7. 1938.

67. Anon. Inspection and Certification Rules. Vermont Dept. Agr., Mimeo. 1939.

68. Gilbert, A. H. and Bailey, H. L. Certified Seed Potato Growing in Vermont. Vt. Dept. Agr., Bul 34. 1935.

69. Anon. Laws and Regulations Pertaining to Seed Inspection and Certification. Washington Dept. Agr., Booklet. 1930.

70. Anon. Wisconsin Standards for Grading, Packing and Certification of Potatoes. Wis. Dept. Mkts., Booklet. 1937.

71. Anon. Certified Seed Potatoes. Wyoming Col. Agr., Mimeo. 1938.

72. Anon. Standard for Registered-Certified Seed Potatoes. N. Y. Seed Imp. Coop. Assoc. Mimeo. 1939.

73. Hastings, R. C. Potato Grade Inspection Service. N. D. Agr. Exp. Sta., Cir. 38. 1939.

74. Anon. Certified Seed Report. Bureau Agr. Econ., U. S. Dept. Agr., January 31, Mimeo. 1939.

75. Anon. Marketing of Potatoes Act. Northern Ireland, Ministry, Agr., Cir. 259. 1938.

76. Hadfield, J. W. Certification of Seed Potatoes. New Zeland, Dept. Agr., Mimeo. 1939.

77. Anon. Scheme for the Inspection of Growing Crops of Potatoes, 1930. Dept. Agr. for Scotland, Cir. 182. 1930.

78. Schlumberger- Sauererkrankung und Pflanzenkrankheit im Jahre 1930. Nachrichtenblatt fur der Deutschen Pflanzenschutzdienst, 9, 7 : 81-90. 1930.

79. Dubois, C. H. Producteurs de Semences de Pommes de Terre. Centre National d' Experimentation Agricole sur la Pomme de Terre, Rennes. 1936.

80. Martin, W. H. Report Seed Pot to Certification Committee 1929. Pro. Pot. Assoc. Amer, 16:205-207. 1929.

81. Anon. The Importance of Good Appearance in Certified Seed. Pa. Dept. Agr., Seed Pot. Cir. 33. 1935.

82. Moore, H. C. Better Potatoes for Michigan. Mich. State Col., Ext. Bul. 49. 1932.

83. Moore, H. C. Evidence That Certified Seed Is Improved Seed. Pro. Pot. Assoc. Amer., 11:38-40. 1934.

84. Hardenburg, E. V. Potatoes in New York. Cornell Agr. Exp. Sta., Ext. Bul. 141. 1930.

85. McClintock, J. A. Certified Irish Potato Seed. Tenn. Agr. Exp. Sta., Cir. 7. 1927.

86. Wedgeworth, H. H. and Others. Certified Irish Potato Seed. Miss. Agr. Exp. Sta., Cir. 30. 1933.

87. Wilkinson, Albert E. For the Largest Yields and Greatest Profit, Use Certified Seed. Amer. Pot. Jour., VII, 3:75-76. 1930.

88. Stuart, Wm. The Potato, J. B. Lippincott Co., Philadelphia, p. 418-419. 1923.

89. Krantz, F. A. and Tolaas, A. G. Variations in Yield Between Seed Stocks of a Variety. Pro. Pot. Assoc. Amer., 11:45-48. 1934.

90. Myers, C. H. How to Improve the Yield and Quality of Seed Potatoes by Selection and to Maintain Such Improvement. Pro. Pot. Assoc. Amer., 11:5-14. 1934.

91. Livermore, J. R. Some of the Problems of Hill Selection of Potatoes. Pro. Pot. Assoc. Amer., 14:38-43. 1927.

92. Macoun, W. T. The Potato in Canada. Dom. Dept. Agr., Bul. 90:31. 1918.

93. McCulloch, W. K. Seed Potato Improvement. Report, Dominion Botanist. Dom. Dept. Agr., for the Year 1927, V:308-309. 1928.

94. Harrington, F. M. Strains of Seed Potatoes. Pro. Pot. Assoc. Amer., 13:18-22. 1926.

95. Edmundson, W. C. Strains of Seed Potatoes. Pro. Pot. Assoc. Amer., 14:49-51. 1927.

96. Anon. Forty-second Annual Report. Cornell Agr. Exp. Sta., II:42-43. 1929.

97. Darrus, M. F. The Value of the Seed Source or Sample Plot in Certification of Potatoes. Pro. Pot. Assoc. Amer., 12:62-64. 1925.

98. Folsom, Donald and Schultz, E. S. Methods of Conducting the Seed Plot and Its Importance in Potato Improvement Work. Pro. Pot. Assoc. Amer., 12:64-70. 1925.

99. Harrington, F. M. Tuber-unit Planting. Pro. Pot. Assoc. Amer., 14:11-13. 1927.

100. Ashegaard, E. D. Advantages of Growing Seed Potatoes on the Tuber-Unit Basis. Pro. Pot. Assoc. Amer., 14:7-11. 1927.

101. Bonde, Reimer and Folson, Donald. Second and Concluding Test in Maine of a Horse-Drawn Tuber-Unit Planting Machine. Pro. Pot. Assoc. Amer., 14:19-26. 1927.

102. Fernow, K. H. Benefits Derived by New York State Growers from the Florida Seed Source Test. Pro. Pot. Assoc. Amer., 13:15-19. 1936.

103. Riebsut, G. L. Sources of Certified Seed Potatoes. Pro. Pot. Assoc. Amer., 13:23-25. 1936.

104. Blodgett, F. M. and Fernow, Karl. Testing Seed Potatoes for Mosaic and Leaf Roll. Phytopath., 11:53-59. 1931.

105. Stuart, Wm. The Tuber Index Method of Seed Potato Improvement. Pro. Pot. Assoc. Amer., 15:135-140. 1929.

106. Werner, H. O. The Tuber Index Method in Relation to Seed Potato Certification. Pro. Pot. Assoc. Amer., 15:140-150. 1929.

107. Hotila, J. E. Production of Elite Potato Seed Stock. Pro. Pot. Assoc. Amer., 15:187-199. 1929.

108. Hotila, J. E. and Coons, G. H. Elite Potato Seed Produced to Avoid Disease. Mich. Agr. Exp. Sta., Quarterly Bul. XI, 3:133-137. 1929.

109. Milward, J. G. Mosaic Control by Tuber Indexing Method as applied to the Triumph Variety. Pro. Pot. Assoc. Amer., 15:88-91. 1929.

110. Gillig, E. M. Special Seed Plot Methods and Their Values in the Red River Valley. Pro. Pot. Assoc. Amer., 15:135-140. 1928.

111. Harrington, F. M. Tuber Index Work. Pro. Pot. Assoc. Amer., 15:352-358. 1928.

112. Schultz, E. S. and Folsom, Donald. Recent Potato Virus-Disease Information Contributing to the Production of Better Seed Potatoes. Pro. Pot. Assoc. Amer., 15:203-227. 1928.

113. Parnow, M. H. Some Factors Other Than the Standards Affecting Uniformity in Certified Seed Potatoes. Pro. Pot. Assoc. Amer., 13:25-27. 1926.

114. Werner, H. O. Relation of Environmental Factors to Productiveness of Seed Potatoes. Pro. Pot. Assoc. Amer., 12:10-32. 1925.

115. Werner, H. O. Further Report on Environmental Relations to Quality in Seed Potatoes. Pro. Pot. Assoc. Amer., 13:58-69. 1926.

116. Goss, R. W. and Werner, H. O. The Need of A More Rational Basis for Certification. Pro. Pot. Assoc. Amer., 15:150-155. 1928.

117. Bailey, H. L. Certified Seed Potato Inspection. Vt. Dept. Agr., Biennial Report, 1926-1928:70-79. 1928.

118. Taylor, H. P. and Others. Report of Committee on Uniform Rules and Regulations to Govern Certification of Seed Potatoes. California Comm. Hort., Bul. 8, 6: 304-307. 1919.

119. Martin, W. H. Seed Lot to Certification Conference. Pot. News Bul., II, 7:201-203.

120. Folsom, Donald. Is Uniformity of Lot to Seed Certification Rules Possible and Desirable? Amer. Pot. Jour., 3, 12:377-382. 1926.

121. Martin, W. H. The Freehold Seed Lot to Certification Conference. Amer. Pot.Jour., III, 7:207-213. 1926.

122. Turner, H. O. Irritation Certification Tags. Pot. News Bul., II, 5:65-66. 1925.

123. Peacock, Walter M. Protecting Certified Seed Against Fraud. Pot. News Bul., II, 8:213-222. 1925.

124. Clark, Alexis and Doyle, C. W. Certification of Seed Lot Sees. Pot. News Bul., II, 8:227-230. 1925.

125. Doluas, A. G. Administration of Seed Lot to Certification. Pro. Pot. Assoc. Amer., 12:70-74. 1925.

126. Jones, Seymour. Laws Providing for Grades and Inspection of Potatoes in the State of Oregon. Ore. State Market Agent, Circular. 1926.

127. Anon. Seed Lot to Certification Act. Ia. Dept. Agr., Seed Lot to Cir. 70. 1926.

128. Close, C. L. Certified Seed Lot to Buying and Selling Pools in the United States. Pro. Pot. Assoc. Amer., 15:349-357. 1928.