UNIVERSITY OF MINNESOTA.

Agricultural Experiment Station

Bulletin No. 127.

SEED LABORATORY REPORT

FOR 1910 AND 1911.

By

W. L. OSWALD,

ASSISTANT IN AGRICULTURAL BOTANY, IN CHARGE OF SEED LABORATORY.

Division of Vegetable Pathology and Botany.

APRIL, 1912.

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1. INTRODUCTION.

By E. M. FREEMAN, Chief of Division of Vegetable Pathology and Botany.

The Seed Laboratory of the Minnesota Agricultural Experiment Station was established under the Division of Botany and Plant Pathology, in January, 1910.

The following is a report of the work of the first two years, together with methods used in the seed-testing work of the laboratory. During the first year, 790 seed-tests were made. In the second year, up to May 10th, 1911, 1485 tests were made, showing an increase of about one hundred per cent.

In the establishment of this laboratory, the experience of the U. S. Seed Laboratory at Washington was freely used. One of the prime requisites of seed laboratories lies in the uniformity of methods; varying results and reports from different laboratories tend to discredit and make unreliable the results of such work. The long experience and success of the Federal Seed Laboratory have proven of very great usefulness in the organization of the Minnesota Seed Laboratory; and every effort has been made to obtain uniformity with this laboratory, in apparatus as well as in methods of testing and reporting.

The object of the Minnesota Seed Laboratory is three-fold: 1st, educational; 2d, experimental; and 3d, the making of seed-tests.

Educational.—The most important feature of any seed laboratory must be educational. No amount of testing or experimental work can amount to much until the farmer appreciates the fact that **good** seed is one of the first requisites of good farming. The Minnesota Seed Laboratory has emphasized this feature. Weed-seed collections have been prepared in a new, inexpensive and attractive form, and distributed at a low cost to farmers of the State. Weed and seed charts and collections have been prepared for exhibitions at fairs, institutes and other farmers' meetings. A bulletin on Home Seed-Testing has been issued, and hundreds of weeds have been identified for farmers throughout the State.

Experimental.—Numerous problems in seed-testing and in the "good seed" work confront not only the farmer but the specialist. Conspicuous among those which have to do with Minnesota seeds are the "Hard Seed" problem in alfalfas and clovers, and unfailing methods in the identification of such grass seeds as quack grass. Problems of acclimatization of foreign weeds, distribution of weeds, origin of weed-seeds in commercial mixtures, etc., are likewise of importance.

Numerous experiments on questions of seeds and weeds of Minnesota are under way. The results will from time to time be published in separate bulletins.

Seed Testing.—The most conspicuous work of the laboratory is the actual testing of seeds. Tests of purity and germination are made for residents of the State free of charge. While the actual financial benefit has been demonstrated in many cases where tests have been made, the greatest benefit lies in the educational value of these tests. A farmer who has benefited by such tests is more than likely to continue having such tests made, or he learns how to make them himself. Furthermore he is apt to tell his neighbor about it.

The following report deals very largely with the seed-testing work of the laboratory.

Seed illustrations in this bulletin were prepared by Mr. F. H. Hillman, Seed Laboratory, U. S. Dept. of Agriculture, Washington, D. C.

Seed Laboratory Report.

By W. L. OSWALD, In Charge of Seed Laboratory.

2. METHODS OF LABORATORY SEED-TESTING.

The methods used in the Minnesota Seed Laboratory are practically the same as those used at the Seed Laboratory of the U. S. Department of Agriculture at Washington, D. C. In making a laboratory test of a sample of seed, the approximate value of the seed is obtained. The laboratory method is more accurate than the home-testing method, for several reasons: First, specially trained men do this work. Second, carefully worked-out methods are employed. Third, special apparatus is available. Fourth, the very large weed-seed collection of the Seed Laboratory makes possible the identification of practically all weed-seeds found in the State.

The object of a laboratory test of seed is to give correct information regarding seed. It is too often true that worthless seed is sown by an unsuspecting person, and as a result the returns are anything but profitable. These tests are made primarily for the citizens of Minnesota. Any one may avail himself of the opportunity of having his seed tested; and if every farmer seized this opportunity, poor seed would disappear from the market. The tests are made free of charge.

The value of a Seed Laboratory test lies, 1st, in the accuracy of the methods and apparatus used; and, 2d, in the training and experience of the men making the test. No accurate estimate of the value of a purity-test can be made without an understanding of the methods used. Differences in reports and results of seed laboratories can be explained only by the methods employed. It is therefore important that in this first report of the Minnesota Seed Laboratory a complete description be given of the methods of testing and reporting, so that the reports of the laboratory may be properly interpreted. Any changes or improvements in these methods will be recorded in subsequent reports.

The method of obtaining the sample sent for a test may first be considered. In case the seed is in a bin or sack, the sample should be so taken as to represent as far as possible the top, bottom and middle of the bin or sack. A good-sized handful is large enough for a sample of most ordinary seeds.

As soon as a sample is received, it is given a laboratory number and then filed. In making a test of seeds, three things are taken into consideration: (1) Purity; (2) Adulteration; (3) Germination.

Purity.

The sample must be thoroughly mixed and accurately divided, to secure a small sample called the "test sample." Owing to the fact that seeds are different in size and weight, Table 1 is used to determine the weight of the test sample of different seeds:

TABLE 1—Weight of Samples Used for Purity Test.

One Gram (about 1/28 of an ounce).
- Red top.
- Blue grass.

Two Grams (about 1/14 of an ounce).
- Timothy.
- Alsike clover.
- White clover.
- Orchard grass.

Three Grams (about 1/9 of an ounce).
- Brome grass.

Five Grams (about 1/6 of an ounce).
- Alfalfa.
- Millet.
- Medium Red clover.
- Mammoth Red clover.

Ten Grams (about 1/3 of an ounce).
- Flax.

Thirty Grams (about one ounce).
- Wheat.
- Oats.
- Rye.
- Barley.
- Buckwheat.

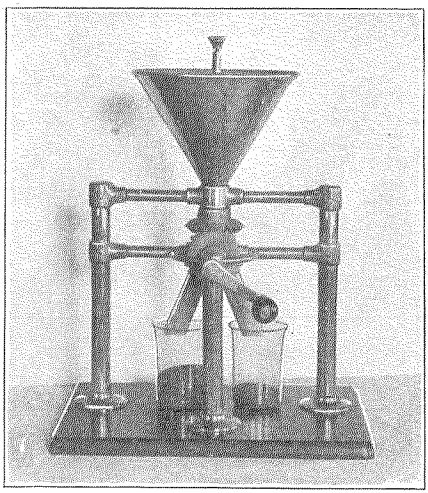


Figure 1—Mixer and Divider used in accurately reducing a sample for a test.

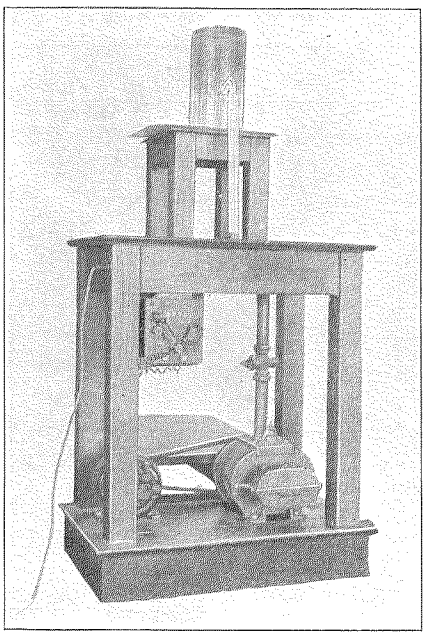


Figure 2—Blower used in separating dirt and light weed-seed from test sample.

Figure 1 shows the apparatus used in mixing and dividing the sample. The farmer's sample is put into the conical-shaped hopper, which is revolved by turning the crank. The small thumb-screw at the top regulates the opening, which lets the seeds out of the hopper onto a V-shaped divider, which sends out half of the seeds into one spout and the other half into the other. This method divides the sample accurately into two equal parts, and at the same time mixes it. If one-half is still too large a quantity it can be divided repeatedly until the right-sized sample is obtained. This mixer will divide a sample of seeds as small as red top or as large as beans. After the test sample has been obtained, it is accurately weighed by the use of either a torsion or chemical balance. After the weight is obtained, the sample is ready for analysis.

The blower, shown in Figure 2, is used to remove much of the inert matter, and the weed-seeds which are lighter than the seed examined. This blower is run by a small dynamo, which sends an air-blast, controlled by a valve, into the bent glass tube. Samples of small seeds, like red top and blue grass, can be as readily cleaned as samples of the larger seeds like wheat or oats. The bottom of the bent glass tube is covered with bolting-cloth of fine mesh. The sample to be cleaned is put in the glass tube which fits into the large glass cylinder. The blast is then gradually turned on, and the dirt and light weed-seeds are sent into the glass cylinder. Most of the foreign matter is thus blown out, leaving a fairly clean sample for analysis. The sample is then placed upon a white working-table and hand-picked into three piles: (1) pure seed; (2) weed and other seeds; (3) inert matter.

Kind Med. Red Clover. #194

Received 2/12/10 Germination

Sent by O. K. K.

Address E. Mann

Remarks

	Made by—	Date	Reported
Identification			
Examination			
Purity test	W.L.O.	2/13/10	2/21/10

Pure seed Per cent.	Inert matter Per cent.	Foreign seed Per cent.	Verified by—	Grams used
98.11	.2	1.69		4

Character of inert matter

Foreign seeds

Chaetochloa viridis	36	White clover	4
Silene noctiflora	18	Alsike clover	42
Rumex crispus	2	Timothy	18
Rumex acetosella	7		

Figure 3—Sample of Record Card used in recording a Purity Test. When reported, the common names of the weed-seeds are used and the approximate number per pound of sample of each weed-seed is given.

That which was blown into the cylinder is similarly divided, and added to the other piles.

After these divisions have been made, each pile is accurately weighed and the percentages worked out. These percentages are then placed on a record-card. After this is done, the pile containing the weed and other seeds is separated—each different seed placed by itself and correctly named and entered on the record-card. The number of each kind of seed found is also recorded.

Figure 3 shows a sample of a record-card used in recording a purity-test. When the report is sent out the common names of the weeds are used, and the approximate number per pound of each weed-seed is reported.

In making the separations in a purity-test, ordinary forceps have been found most convenient, and for most of the identification work the common tripod lens is used.

Adulteration.

Sometimes a test for possible adulteration seems advisable. Seeds such as alfalfa, red clover and Kentucky blue grass are sometimes adulterated with seeds which are similar in appearance to the

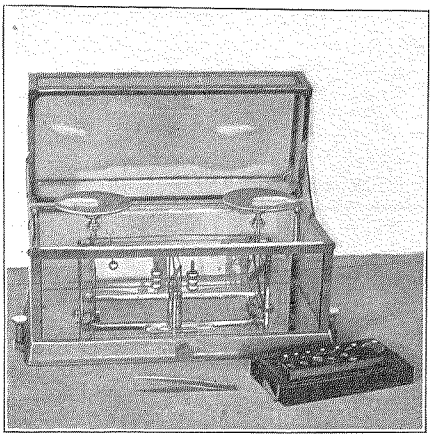


Figure 4—Scales used for accurate weighing in making a test.

commercial seed. For instance; yellow trefoil and sweet clover are used to adulterate alfalfa and red clover, while Canada blue grass is sometimes used for Kentucky blue grass. A test for adulteration consists mainly in working out the percentages of the adulterants.

Germination.

Many things must be taken into consideration in making an accurate germination-test of seeds. As far as possible, a laboratory germination-test should provide approximately the same conditions as the seeds would have when

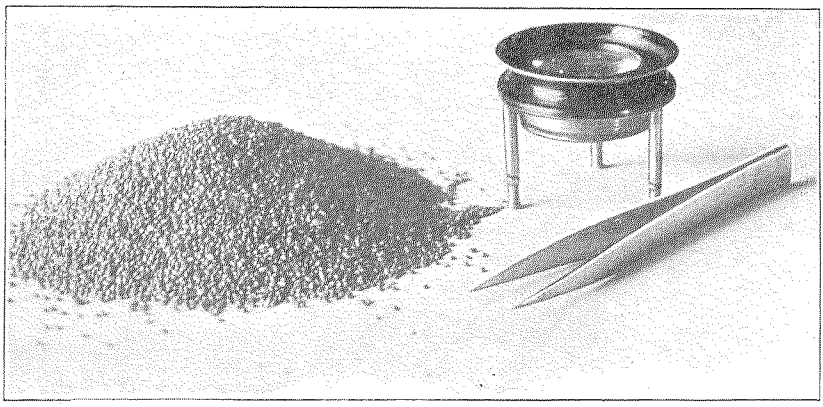


Figure 5—Tripod Lens and Forceps used in making a Purity-Test.

planted as a crop. Heat, air and moisture must first be considered. Different seeds require different conditions for the best results. Large seeds, such as corn, have been found to germinate most successfully between moist folds of Canton flannel; blotters do not give, for these, a sufficient amount of moisture. Medium-sized seeds, such as oats wheat and red clover, are best germinated between moist folds of blotting-paper; while very small seeds, such as red top, white clover and timothy, are placed on top of moist blotting paper. Small seeds get too much moisture if placed between blotters. It is by these methods that the seed-bed used in making germination-tests is varied to bring about the best moisture conditions for each kind of seed.

It has also been found that the temperature used in making germination tests varies with the different seeds. Some seeds need a constant temperature of 68° F. (20° C.), while others germinate best when

left at 68° F. (20° C.) for eighteen hours and 86° F. (30° C.) for eight hours. The most suitable temperature requirements are provided in the germinator described below. Again, all seeds do not require the same length of time to germinate. For instance; wheat takes five days for a complete germination test, while parsley requires 28 days.

The accompanying germination tables of forage-crop seeds and vegetable seeds have been compiled from results worked out at the U. S. Seed Laboratory. They show the proper seed-bed to be used, the proper temperature, and the length of time for the test.

TABLE 2—Showing Seed Bed, Temperature and Length of Time Employed in Testing the Germination of Forage-Crop Seeds.

Kind of Seed.	Seed Bed.	Temperature.		Length of time to complete test.
Alfalfa	Between Blotters	20°C	(68°F)	5 days.
Barley	Between Blotters	20°C	(68°F)	6 days.
Brome Grass	Between Blotters	20°-30°C	(68°-86°F)	10 days.
Buckwheat	Between Blotters	20°-30°C	(68°-86°F)	5 days.
Clover, red	Between Blotters	20°C	(68°F)	5 days.
Clover, alsike	Top of Blotter	20°C	(68°F)	5 days.
Clover, white	Top of Blotter	20°C	(68°F)	5 days.
Corn	Cloth	20°-30°C	(68°-86°F)	5 days.
Cowpeas	Cloth	20°-30°C	(68°-86°F)	8 days.
Flax	Top of Blotter	20°-30°C	(68°-86°F)	6 days.
Millet	Between Blotters	20°-30°C	(68°-86°F)	5 days.
Oats	Between Blotters	20°-30°C	(68°-86°F)	5 days.
Orchard grass	Between Blotters	20°-30°C	(68°-86°F)	14 days.
Rape	Between Blotters	20°C	(68°F)	6 days.
Rye	Between Blotters	20°C	(68°F)	5 days.
Red Top	Top of Blotter	20°-30°C	(68°-86°F)	10 days.
Sorghum	Between Blotters	20°-30°C	(68°-86°F)	6 days.
Timothy	Top of Blotter	20°-30°C	(68°-86°F)	6 days.
Wheat	Between Blotters	20°C	(68°F)	5 days.
Kentucky Blue Grass	Top of Blotter under Bell Jar	20°-30°C	(68°-86°F)	28 days.

TABLE 3—Showing Seed Bed, Temperature and Length of Time Employed in Testing the Germination of Vegetable Seeds.

Kind of Seed.	Seed Bed.	Temperature.	Length of time to complete test.
Asparagus	Between Blotters	20°-30°C (68°-86°F)	14 days.
Beans	Cloth	20°-30°C (68°-86°F)	6 days.
Beets*	Between Blotters	20°-30°C (68°-86°F)	10 days.
Cabbage	Between Blotters	20°C (68°F)	6 days.
Cauliflower	Between Blotters	20°C (68°F)	6 days.
Carrots	Between Blotters	20°-30°C (68°-86°F)	14 days.
Celery	Top of Blotter	20°-30°C (68°-86°F)	18 days.
Citron	Cloth	20°-30°C (68°-86°F)	6 days.
Cucumber	Between Blotters	20°-30°C (68°-86°F)	6 days.
Endive	Top of Blotter	20°C (68°F)	8 days.
Lettuce*	Between Blotters	20°C (68°F)	3 days.
Muskmelon	Between Blotters	20°-30°C (68°-86°F)	6 days.
Onion	Between Blotters	20°-30°C (68°-86°F)	7 days.
Parsley	Between Blotters	20°-30°C (68°-86°F)	28 days.
Parsnip	Between Blotters	20°-30°C (68°-86°F)	14 days.
Peas	Cloth	20°-30°C (68°-86°F)	6 days.
Pepper	Between Blotters	20°-30°C (68°-86°F)	10 days.
Pumpkin	Cloth	20°-30°C (68°-86°F)	6 days.
Radish	Between Blotters	20°C (68°F)	6 days.
Salsify	Between Blotters	20°-30°C (68°-86°F)	10 days.
Spinach	Between Blotters	20°C (68°F)	10 days.
Squash	Cloth	20°-30°C (68°-86°F)	6 days.
Tomatoes	Between Blotters	20°-30°C (68°-86°F)	10 days.
Turnip	Between Blotters	20°C (68°F)	6 days.
Watermelon	Cloth	20°-30°C (68°-86°F)	6 days.

*Soak 6 hours before test is started.

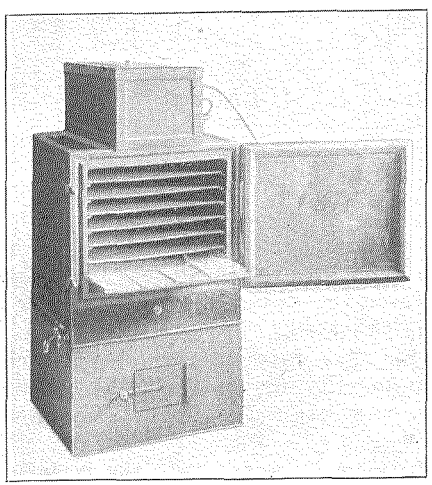


Figure 6—Germinator used in Seed Laboratory.

A duplicate germination test is always made, to insure more accurate results. In the larger seeds, such as corn, wheat and red clover, two tests of one hundred seeds each are used; while in the smaller seeds, such as red top, timothy and alsike clover, two tests of two hundred seeds each are used. After the seeds are placed on the proper seed-bed and ready for the test, they are put into the germinator (Fig. 6).

The germinator is an ovenlike apparatus made of copper, and contains trays on which the samples are placed. A thermostat regulates the flame which heats the water in a jacket surrounding the

No. 199
Kind Med. Red Clover
Sender O. K. K.
Test Begun 2/13/10 Retest
Final Report 2/18/10 Decayed
Temperature Entered
Moldy on day. Soaked hours.

Number of Seeds	100	100
2/16/10	84	90
2/18/10	3	3
	1	1
	90%	
	6%	
	1	1
Hard Seeds	8	4

Figure 7—Sample of Record Card used in recording a Germination Test.

germinator. On the top is an ice-box for use in warm weather. Two counts are generally taken of each test, and the final percentage is recorded on the record-blank. In all the germination work, the blotters and cloths are kept moist, but not dripping wet.

Summary.

A laboratory test shows the following:

1. Percentage of pure seed.
2. Percentage of foreign seed.
3. Percentage of dirt found in seed sample.
4. Names of weed seeds found in sample.
5. Approximate number of weed seeds per pound of sample.
6 Names of other seeds found in sample.
7. Approximate number of other seeds per pound of sample.
8. Percentage of germination of seed.
9. In clovers and alfalfa the percentage of "hard seeds."

3. SOURCE OF SEED SAMPLES.

Owing to lack of publicity, only a few samples were sent in to the Laboratory at first; but gradually the work of seed-testing is finding its way to all parts of the State, and even into other States. The following tables (4 and 5), and Fig. 8, give the data collected in regard to the number and source of seed-samples tested.

Two kinds of sources are noticeable; 1st, farmers' samples, which usually represent seed grown in the locality or on the land of the sender; 2d, seed companies' samples, the origin of which is in most cases not known.

All of the figures, however, are of utmost importance to the farmers of the State, in that they represent the seeds sold and sown in the State.

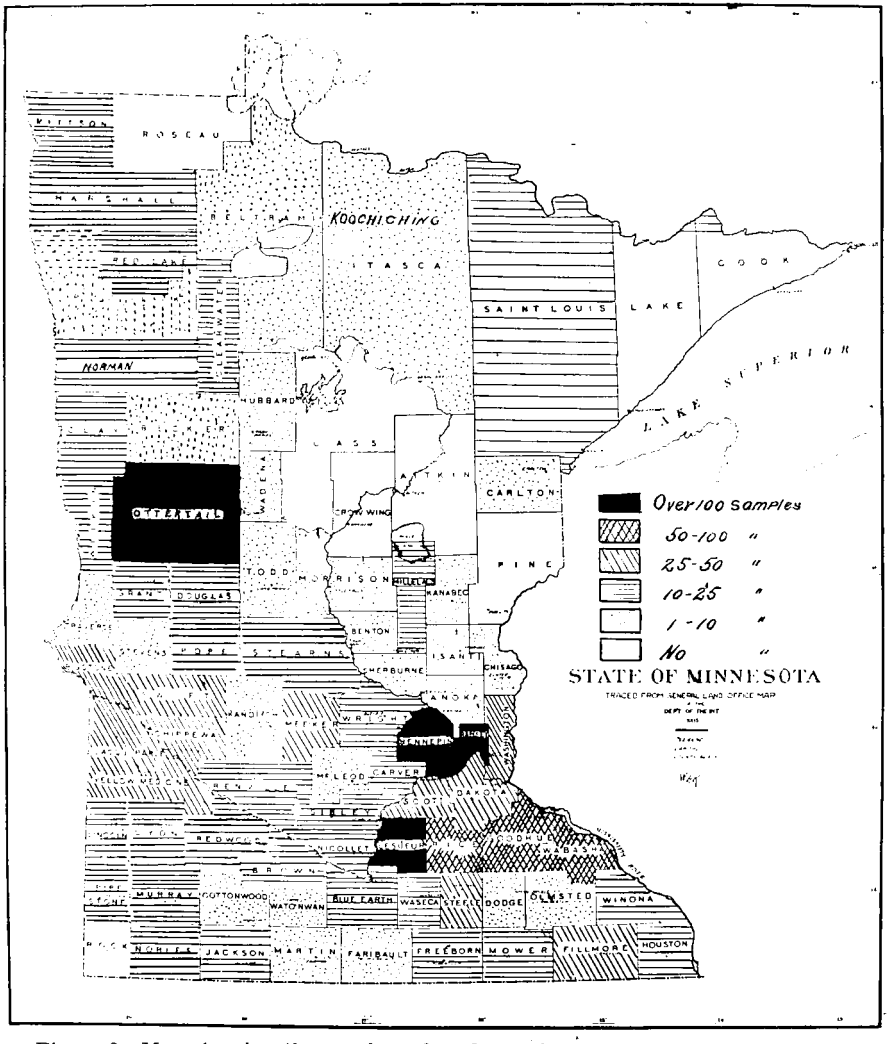


Figure 8—Map showing the number of seed samples sent to Seed Laboratory from the different counties.

TABLE 4—Number of Samples Sent in for Testing from Different Counties.

Hennepin	*496	Wilkin	15	Dodge	6
Ramsey	*246	Pipestone	15	Olmsted	6
Le Sueur	†229	Nicollet	15	Carlton	6
Ottertail	109	Houston	14	Becker	6
Rice	64	Jackson	14	Polk	6
Wabasha	63	Murray	14	McLeod	4
Goodhue	61	Douglas	14	Chisago	4
Meeker	44	Clay	14	Benton	4
Dakota	40	Pope	13	Morrison	4
Steele	38	Kittson	13	Sherburne	3
Big Stone	30	Winona	12	Todd	3
Swift	30	Brown	12	Crow Wing	3
Lac Qui Parle	30	Freeborn	11	Koochiching	3
Chippewa	29	Waseca	11	Wadena	3
Washington	28	Lincoln	11	Hubbard	2
Fillmore	27	Grant	11	Beltrami	2
Scott	25	Lyon	10	Isanti	1
Yellow Medicine	25	Nobles	10	Kanabec	3
Renville	23	Stearns	10	Itasca	1
Blue Earth	23	Mille-lacs	10	Rock	0
Marshall	20	Clearwater	10	Pine	0
Redwood	20	Martin	9	Aitkin	0
Red Lake	19	Kandiyohi	9	Lake	0
St. Louis	19	Faribault	8	Cook	0
Carver	19	Anoka	8	Cass	0
Sibley	16	Watonwan	8	Mahnomen	0
Wright	16	Traverse	8	Rosseau	0
Norman	16	Cottonwood	7		
Mower	15	Stevens	7		

*Many of the samples sent in by Seed Companies.
†Over 200 samples of wheat sent in by a local milling company for germination test.

TABLE 5—Number of Samples Sent to Minnesota Seed Laboratory from Other States.

South Dakota	15	Iowa	9	Illinois	2
North Dakota	12	Wisconsin	7	Canada	12
		Nebraska	7		

4. RESULTS OF SEED TESTING—PURITY TESTS.

The seed-testing work of the Laboratory has proven, first of all, of direct use to the farmer, in the information which is given him concerning a particular sample of seed. It has, moreover, been useful to him in educating him up to a knowledge of the value of pure seed, and of methods of judging pure seed. Furthermore, it has been of considerable value in the data which the results have furnished con-

cerning the distribution of weeds and weed-seeds, the most prevalent weed-seeds of the State, and the general condition of the commercial seeds found in the market today. It is these results that are collected in most of the accompanying tables and figures.

Two thousand two hundred and seventy-five tests for purity have been made during the first two years; the increase during the second year being 100% over the first year. This growth, though rapid, has been a healthy one; since, owing to limited facilities, no special attempt has been made to advertise the work extensively. One of the most striking and encouraging results has been that many, who had tests made in 1910, again sent samples in 1911. It is also noticeable that groups of farmers, in the neighborhood of those farmers who first had tests made, are now sending in samples.

Table 6 shows the percentage occurrence of weed-seeds found in different crop seeds. It also shows, first, the occurrence of each weed-seed in the different crops, and, second, the kinds of weed-seeds found in each farm crop. The following are the most interesting facts disclosed in this table:

(1) Out of the 59 different weed-seeds found in all the tests made, 36 were found in various tests of medium red clover.

(2) Only 4 different varieties were found in rye.

(3) The seeds of lambs-quarters and pepper-grass appeared in 14 of the 16 crop-seeds tested. Dodder-seed appeared only in red clover and alfalfa.

TABLE 6—Showing Percentage Occurrence of Weed-Seeds

Scientific Name.	Common Name.	Wheat.	Oats.	Barley.	Rye.
	(Number of samples)	218	193	97	12
Agropyron spp	Quack and slender wheat grass	6.4	3.1	2.06	16.7
Agrostemma githago	Corn cockle	43	14	3.1	....
Amaranthus spp	Pigweed	....	2.6	3.1	....
Ambrosia artemesiaefolia	Ragweed	.5	1.03	....	....
Ambrosia trifida	Kinghead	.5	.52	1.03	....
Anthemis cotula	Mayweed	....	....	....	....
Avena fatua	Wild oats	26	49.5	49.5	25
Alsine media	Chickweed	....	....	....	....
Achillea millefolium	Yarrow	....	....	....	....
Brassica spp	Mustard	4	1.4	15.5	....
Camelina sativa	False flax	1.4	....	....	....
Carduus arvensis	Canada thistle	....	....	1.03	....
Centaurea spp	Corn flower	....	....	....	....
Cichorium intybus	Wild chicory	....	....	....	....
Carduus lanceolatus	Bull thistle	....	....	....	....
Chaetochloa glauca	Yellow foxtail	19.2	19.7	15.5	....
Chaetochloa viridis	Green foxtail	19.2	21.8	7.2	....
Chenopodium album	Lamb's quarters	28	38.8	22.7	....
Conringia orientalis	Hare's ear mustard	1.4	1.55	1.03	....
Convolvulus arvensis	Wild morning glory	1.4	.52	....	....
Cerastium vulgatum	Mouse-ear chickweed	....	....	....	....
Cuscuta spp	Dodder	....	....	....	....
Daucus carota	Wild carrot	....	....	....	....
Iva xanthiifolia	Marsh elder	....	....	....	....
Juncus tenuis	Rush	....	....	....	....
Lappula lappula	Stick-tight	....	....	....	....
Lepidium spp	Peppergrass	4.6	10.3	6.2	....
Lolium temulentum	Darnel	3.2	2.6	....	....
Lychnis alba	White cockle	.9	....	1.03	....
Medicago lupulina	Yellow trefoil	....	....	....	....
Melilotus alba	Sweet clover	....	....	....	....
Nepita cataria	Catnip	....	....	....	....
Neslia paniculata	Ball mustard	.5	1.55	....	....
Onagra biennis	Evening primrose	....	....	....	....
Oxalis stricta	Wood sorrel	....	....	....	....
Panicum capillare	Witch grass	.5	.52	....	....
Panicum crus-galli	Barnyard grass	1.4	2.07	1.03	....
Plantago lanceolata	Buckhorn plantain	....	....	....	....
Plantago major	Plantain	....	....	....	....
Polygonum convolvulus	Wild buckwheat	36.7	46	39.2	16.7
Polygonum hydropiper	Smartweed	.5	1.03	....	....
Polygonum pennsylvanicum	Pennsylvania smartweed	1.8	2.07	....	....
Polygonum persicaria	Lady's thumb	9.2	9.3	9.3	....
Potentilla monspeliensis	Five finger	.9	1.03	4.1	....
Rosa spp	Wild rose	9	6.2	....	....
Rudbeckia hirta	Brown eyed Susan	....	....	....	....
Rumex acetosella	Sheep sorrel	1.4	....	....	....
Rumex crispus	Curled dock	2.7	4.66	8.25	....
Salsola tragus	Russian thistle	....	....	....	....
Syntherisma sanguinalis	Crab grass	....	....	....	....
Spergula spp	Spurry	....	....	....	....
Sedge spp	Sedge	....	1.03	....	....
Silene noctiflora	Night-flowering catchfly	6.4	6.2	1.03	....
Sisymbrium officinale	Hedge mustard	....	....	....	....
Teucrium canadense	Wood sage	1.8	1.03	1.03	....
Thlaspi arvense	Frenchweed	.9	2.6	1.03	....
Vaccaria vaccaria	Cow cockle	1.8	.52	....	....
Verbena spp	Vervain	....	....	....	....
Vicia spp	Vetch	6	7.25	15.5	16.7

Found in the Different Crop-Seeds Tested for Purity.

Flax.	Timothy.	Medium red clover.	Mammoth clover.	White clover.	Alsike clover.	Brome grass.	Blue grass.	Red top.	Millet.	Alfalfa.	Lawn grass.
90	198	269	19	5	77	26	7	17	26	84	7
2.2	2.02	.....	....	....	....	80.7	....	....	....	1.2	....
2.2	.....	.....	....	....	....	....	....	....	....	1.2	....
22	10.6	16	5.2	....	6.5	....	....	....	46	9.5	....
5.5	.....	9.6	....	....	....	....	....	....	3.8	2.4	....
....	.....	.....	....	....	....	....	....	....	....	....	....
1.1	.5	1.1	....	20	3.9	....	....	5.9	....	1.2	14.3
11	1.5	.....	....	....	....	7.7	....	....	....	....	....
....	.....	.....	....	20	1.3	....	....	....	....	....	....
....	.....	.....	....	....	....	....	....	17.6	....	....	....
11	4.04	2.6	5.2	....	1.3	....	....	....	....	2.4	14.3
28.9	.....	.....	....	....	....	....	....	....	....	....	....
....	.....	1.1	....	....	2.6	....	....	....	....	....	....
....	.....	.....	....	....	....	....	....	....	....	9.5	....
....	.....	.....	....	....	....	....	....	....	....	4.7	....
1.1	.5	2.2	....	....	1.3	3.8	....	....	....	1.2	....
37.8	5.5	14.1	5.2	....	....	7.7	....	....	30.8	8.3	14.3
57.7	20.2	72.5	63.1	....	9.1	11.5	....	....	96.2	33.4	42.9
55.5	31.3	41	57.9	40	14.3	3.8	....	5.9	26.9	42.9	42.9
4.4	.....	.37	....	....	....	....	....	....	....	....	....
....	.....	.....	....	....	....	....	....	....	....	....	....
....	.....	.....	....	....	....	....	28.6	41.2	....	....	14.3
....	.....	1.5	....	....	....	....	....	....	....	3.7	....
....	.....	1.8	10.5	....	....	....	....	....	....	2.4	....
....	.....	.37	....	....	....	....	....	....	3.8	1.2	....
....	.5	.....	....	....	....	....	....	82.4	3.8	....	42.9
....	.....	.....	....	....	....	....	....	....	....	1.2	....
3.3	37.8	4.5	15.8	20	28.6	3.8	14.3	11.7	....	1.2	85.7
....	.....	.37	....	....	1.3	....	....	....	....	1.2	....
....	.....	1.5	....	....	2.6	....	....	....	....	....	....
....	.....	.....	....	....	6.5	....	....	....	....	2.4	....
....	.....	.....	....	....	....	....	....	....	....	7.1	....
1.1	1	1.1	....	....	....	....	....	....	....	....	....
....	.....	.....	....	....	....	....	....	....	....	....	....
....	11.6	3.7	15.8	20	3.9	3.8	....	....	....	....	14.3
....	2.02	1.5	....	....	1.3	....	....	5.9	....	1.2	....
7.8	.5	3.7	5.2	20	2.6	....	....	....	23.1	1.2	....
8.8	1	7.4	15.8	....	....	....	....	....	11.5	5.9	....
....	.....	16.3	15.8	....	2.6	....	....	....	3.8	10.7	14.3
2.2	21.7	24.2	21	40	5.2	3.8	....	5.9	11.5	2.4	57.2
32.2	1.5	1.5	....	....	1.3	11.5	....	....	3.8	5.7	....
3.3	1	1.5	5.2	....	....	....	....	....	....	....	....
1.1	.....	.....	....	....	....	....	....	....	....	....	....
18.9	6	18.2	26.3	....	....	3.8	....	....	23.1	5.9	28.6
2.2	26.8	5.6	10.5	40	17	3.8	....	11.7	....	....	71.5
....	2.02	.....	....	....	....	....	....	....	....	....	....
....	2.02	.....	....	....	....	....	....	....	....	....	....
....	8.07	16.7	68.4	60	45.5	3.8	42.9	....	....	1.2	85.7
1.1	6.5	16	26.3	....	11.7	3.8	14.3	....	....	2.4	14.3
2.2	.....	1.8	....	....	....	....	....	....	11.5	17.9	14.3
....	.....	5.2	....	....	2.6	....	....	....	11.5	2.4	....
....	.....	.....	....	....	2.6	....	....	....	....	....	14.3
2.2	16.7	5.6	5.2	20	5.2	....	42.9	23.5	3.8	....	14.3
2.2	14.3	13	10.5	60	32.5	....	42.9	5.9	....	3.7	28.6
....	.5	.37	....	....	....	....	....	....	....	....	....
....	3.5	.....	....	....	....	....	....	....	....	....	....
....	.5	.37	....	....	....	....	....	....	....	....	....
....	.....	.....	5.2	....	....	....	....	....	....	....	....
3.3	6	2.9	5.2	....	1.3	....	....	....	3.8	....	....
1.1	.5	.....	....	....	....	....	....	....	....	....	....

Notes on Table 7.

In compiling this table, only the six weed-seeds most commonly found in each kind of crop-seed are listed. It does not show the less common seeds found; these, however, can be found in Table 6. Table 7 exhibits the following facts:

(1) In wheat, the most common weed-seed is corn cockle, probably due to the fact that it is hard to separate from wheat.

(2) Wild oats appeared in 26% of the wheat samples examined; in 37% of the oat samples; 49.5% of the barley samples, and in 25% of the rye samples.

(3) Wild buckwheat was found the most commonly in oats (46%). In wheat it appeared in 36.7% of the samples examined; in barley in 39.2% of the samples; in rye in 16.7% of the samples; and in flax in 32.8% of the samples.

(4) False flax was found only in flax-seed.

(5) Quack grass or slender wheat grass was found in 80.7% of the brome grass samples examined. As it is nearly impossible to detect differences between single seeds of quack grass and slender wheat grass, both of the names are given in this table. The spikelets of the two grasses, however, are easily distinguished from each other. Many of the quack-grass spikelets appeared in the samples of brome grass examined. Table 6 also shows quack grass found in wheat, oats, barley, rye, flax, timothy and alfalfa.

(6) Green foxtail and lambs-quarters are the most common weeds found in crop seed.

(7) Green foxtail appeared in 96.2% of the millet samples examined.

(8) Wild mustard is found among the six most common weed-seeds in oats and barley. Table 6, however, shows it appearing in other crop seeds.

(9) Russian thistle appeared most frequently in alfalfa seed. Buckhorn plantain appeared in 10.7% of the alfalfa samples; it is common in domestic as well as foreign seed. It is probable that much of the alfalfa tested was not Minnesota grown. Table 6 shows that dodder was found in 3.7% of the alfalfa samples examined.

(10) Sheep sorrel was the most common weed found in alsike and white clover.

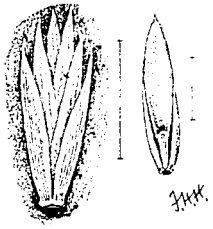
TABLE 7—Most Common Weed-Seeds Found in Seeds Tested.

Kind of Seed Tested.	No. of Samples tested.	Six most common weed-seeds found in order of occurence.	Percentages of Samples in which found.
Wheat	218	1. Corn cockle	43
		2. Wild buckwheat	36.7
		3. Lambs quarters	28
		4. Wild oats	26
		5. Yellow foxtail	19.2
		6. Green foxtail	19.2
Oats	103	1. Wild buckwheat	46
		2. Lambs quarters	38.8
		3. Wild oats	37
		4. Green foxtail	21.8
		5. Yellow foxtail	19.7
		6. Wild mustard	14
Barley	97	1. Wild oats	49.5
		2. Wild buckwheat	39.2
		3. Lambs quarters	22.7
		4. Vetch	15.5
		5. Wild mustard	15.5
		6. Yellow foxtail	15.5
Rye	12	1. Wild oats	25
		2. Quack grass or slender wheat grass	16.7
		3. Wild buckwheat	16.7
		4. Vetch	16.7
Flax	90	1. Green foxtail	37.7
		2. Lambs quarters	35.5
		3. Yellow foxtail	37.8
		4. Wild buckwheat	32.2
		5. False flax	29.9
		6. Pigweed	22
Timothy	198	1. Pepper grass	37.8
		2. Lambs quarters	31.3
		3. Five finger	26.8
		4. Plantain	21.7
		5. Green foxtail	20.2
		6. Sedge	16.7
Alfalfa	84	1. Lambs quarters	42.9
		2. Green foxtail	33.4
		3. Russian thistle	17.9
		4. Buckhorn plantain	10.7
		5. Pigweed	9.5
		6. Corn flower	9.5
Med. Red Clover	260	1. Green foxtail	72.5
		2. Lambs quarters	41
		3. Plantain	24.2
		4. Lady's thumb	18.2
		5. Sheep sorrel	16.7
		6. Buckhorn plantain	16.3
Mammoth Clover	19	1. Sheep sorrel	68.4
		2. Green foxtail	63.1
		3. Lambs quarters	57.9
		4. Lady's thumb	26.3
		5. Curled dock	26.3
		6. Plantain	21

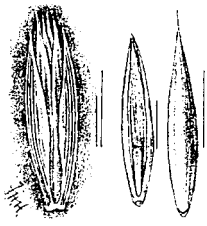
TABLE 7—Most Common Weed-Seeds Found in Seeds Tested—Continued.

Kind of Seed Tested.	No. of Samples tested.	Six most common weed-seeds found in order of occurrence.	Percentages of Samples in which found.
Alsike Clover	77	1. Sheep sorrel	45.5
		2. Night flowering catchfly	32.5
		3. Pepper grass	28.6
		4. Five finger	17
		5. Lambs quarters	14.3
		6. Curled dock	11.7
White Clover	5	1. Sheep sorrel	60
		2. Night flowering catchfly	60
		3. Five finger	40
		4. Plantain	40
		5. Lambs quarters	40
		6. Mayweed	20
Millet	26	1. Green foxtail	96.2
		2. Pigweed	46
		3. Yellow foxtail	30.8
		4. Lambs quarters	26.9
		5. Witch grass	23.1
		6. Lady's thumb	23.1
Red Top	17	1. Rush	82.4
		2. Mouse-ear chickweed	41.2
		3. Sedge	23.5
		4. Yarrow	17.6
		5. Peppergrass	11.7
		6. Five finger	11.7
Brome grass	26	1. Quack grass or slender wheat grass	80.7
		2. Green foxtail	11.5
		3. Wild buckwheat	11.5
		4. Mayweed	7.7
		5. Yellow foxtail	7.7
		6. Lambs quarters	3.8
Kentucky Blue Grass	7	1. Sheep sorrel	42.9
		2. Sedge	42.9
		3. Night flowering catchfly	42.9
		4. Shepherd's purse	28.6
		5. Chickweed	28.6
		6. Mouse-ear chickweed	28.6
Lawn grass mixtures	7	1. Pepper grass	85.7
		2. Sheep sorrel	85.7
		3. Five finger	71.5
		4. Plantain	57.2
		5. Green foxtail	42.9
		6. Lambs quarters	42.9

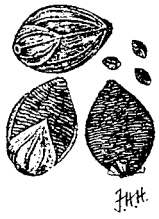
Seeds of Some of Minnesota's Most Common Weeds.



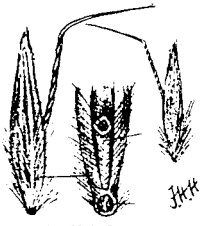
Quack Grass.



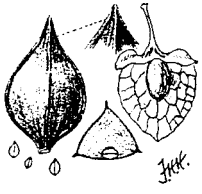
Slender Wheat Grass.



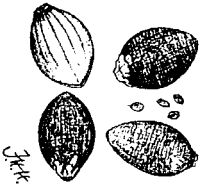
Yellow Foxtail.



Wild Oats.

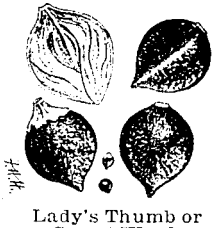


Curled Dock.



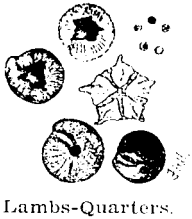
Green Foxtail.

Corn Cockle.



Lady's Thumb or Smart Weed.

Sheep Sorrel.

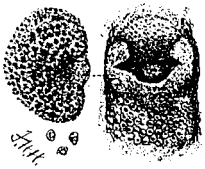


Lambs-Quarters.

Pigweed.

Russian Thistle.

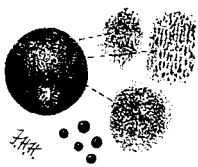
Seeds of Some of Minnesota's Most Common Weeds.



White Cockle.

French Weed.

Peppergrass.



Wild Mustard.

Shepherd's Purse.

Yellow Trefoil.

Sweet Clover.

Ragweed.

Kinghead.

Burdock.

Canada Thistle.

Bull Thistle.

TABLE 8—Summary of Purity-Tests for 1910 and 1911, Showing a Comparison with U. S. Standards.

Name of Seed.	Sender.	No. of Samples.		Average % of Purity.		U. S. Standard of Purity.	% of Samples above Standard.		% of Samples below Standard.	
		1910	1911	1910	1911		1910	1911	1910	1911
Wheat	Farmers..	79	116	96.66	98.77	99	49.37	75.86	50.63	24.14
	Seedsmen	0	0	.....	.....	.....	.....	.....	.....	.....
Oats	Farmers..	70	107	96.5	96.75	99	34.3	44.86	65.7	55.14
	Seedsmen	3	2	100	99	.....	100	100	0	0
Barley	Farmers..	36	55	97	97.01	99	33.33	43.63	66.67	56.37
	Seedsmen	2	0	100	.....	.....	100	.....	0	.....
Rye	Farmers..	5	5	98.5	99.2	99	60	60	40	40
	Seedsmen	0	0	.....	.....	.....	.....	.....	.....	.....
Flax	Farmers..	14	57	90.93	94.33	*	.....	.....	.....	.....
	Seedsmen	1	9	100	98.11	.....	.....	.....	.....	.....
Alfalfa	Farmers..	5	21	96.4	97.62	98	20	71.43	80	28.57
	Seedsmen	15	35	96.86	98.66	.....	66.67	88.57	33.33	11.43
Med. Red Clover	Farmers..	56	114	92.57	95.40	98	57.14	45.61	42.86	54.39
	Seedsmen	35	56	97	98.01	.....	57.15	83.9	42.85	16.10
Mam. Red Clover	Farmers..	3	0	95.3	.....	98	33.33	.....	66.67	.....
	Seedsmen	8	7	97.75	97.45	.....	87.5	57.14	12.5	42.86
White Clover	Farmers..	0	0	.....	.....	95	.....	.....	.....	.....
	Seedsmen	2	2	96	95.5	.....	50	100	50	0
Alsike Clover	Farmers..	9	19	86.9	94.6	95	44.44	88.25	55.56	11.75
	Seedsmen	18	24	95.83	96.79	.....	83.33	87.5	16.67	12.5
Timothy	Farmers..	39	90	96.62	96.01	98	61.54	72.22	38.46	27.78
	Seedsmen	17	38	98.36	98.87	.....	82.36	94.74	17.64	5.26
Brome Grass	Farmers..	2	2	95.5	97.5	90	100	100	0	0
	Seedsmen	6	0	75.9	.....	.....	33.33	.....	66.67	.....
Red Top	Farmers..	3	0	87.7	.....	*	.....	.....	.....	.....
	Seedsmen	5	8	82.2	92.4	.....	.....	.....	.....	.....
Millet	Farmers..	2	2	97	99	99	0	100	100	0
	Seedsmen	10	13	98.2	97.2	.....	30	38.46	70	61.54
Kentucky Blue Grass	Farmers..	0	0	.....	.....	90	.....	.....	.....	.....
	Seedsmen	4	1	88	95	.....	50	100	50	0

The Purity Standards used in this table were obtained from the 1896 Yearbook of the United States Department of Agriculture.

*No standards given.

Table 8 gives a summary of the general results of the purity tests for 1910 and 1911 in comparison with U. S. Standards. A comparison is also made between samples sent in by farmers and seedsmen. The following are the most important results:

(1) The samples sent in by seedsmen have higher average of purity than those sent in by the farmer. This is probably due to the fact that seedsmen possess better machinery for cleaning the seed.
(2) There was a higher average of purity in 1911 than in 1910.
(3) The number of tests below the standard of purity is strikingly large.

Adulterations in Commercial Seed.

The market seeds most commonly adulterated are alfalfa, red clover, Kentucky blue grass and red top. The federal seed laboratory has been actively engaged for years in investigating this phase of the seed question, and to its efforts it is largely due that adulterations are greatly decreasing in number.

The most common method of adulteration is the admixture of weed-seeds similar in appearance to the crop-seeds. Alfalfa seed, for instance, is sometimes adulterated with the seeds of sweet clover, yellow trefoil and bur clover. Sweet clover is a common roadside weed in this State, and seeds abundantly; and the seeds are so similar to alfalfa that the average buyer cannot detect the difference. The seeds of sweet clover, however, can be easily distinguished from those of alfalfa by one trained in observing the differences between them. Yellow trefoil is not as common in Minnesota as sweet clover. It is not grown in the United States to any extent, but in Europe, especially on the poorer soils, it is raised as a forage crop. It is a low, spreading plant, very unlike sweet clover. The seeds of yellow trefoil, like those of sweet clover, are very similar in appearance to the seed of alfalfa, but are quite readily distinguished by a seed-expert.

The bur clovers are native of Chile. The seeds of these clovers are also used as adulterants of alfalfa, owing to similarity in shape and color. Trefoil and sweet clover are also sometimes used in adulterating red clover.

Fig. 10 and Fig. 11 show sweet clover and yellow trefoil in medium red clover and alfalfa.

The most common adulteration in Kentucky blue grass seed is Canada blue grass. The similarities between these two seeds are even greater than those existing between alfalfa and its adulterants. Only experts can detect this adulteration.

Timothy seed is often used to adulterate red top. Of course any careful observer, not necessarily an expert, can detect this adulteration.

No person intending to grow alfalfa, clover or red top should sow these crops without being sure that the seed is pure.

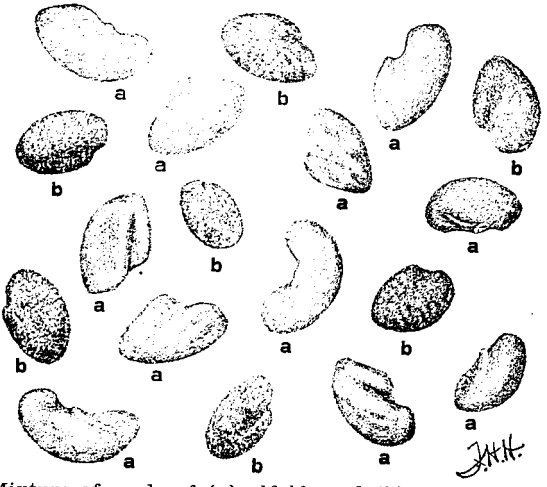


Figure 10—Mixture of seeds of (a) alfalfa and (b) sweet clover. The elliptical form of the sweet clover seeds, which have the scar notch near one end, together with their uneven surfaces, serves to distinguish them from the more nearly kidney-shaped and smoother alfalfa seeds. (Enlarged. After Hillman.)

Figure 11—Mixture of seeds of (a) red clover and (b) yellow trefoil. The clover seeds are more or less triangular, those of trefoil, oval, and usually with a distinct projection beside the scar notch. (Enlarged. After Hillman.)

Dodder.

Dodder is a parasitic plant which starts from a seed like other plants and then winds itself around the plant of alfalfa or clover, sending parasitic roots or suckers into the tissues of the plant. It then breaks away from the ground and lives entirely upon the plant to which it has attached itself, thriving upon the juices of the plant until it has completely killed it, or at least reduced it to a very weak condition. Dodder has no leaves, and appears like a mass of entangled twining stems.

Three varieties of dodder-seed are likely to be found in alfalfa and red clover—the large and small-seeded alfalfa dodder and field dodder. The alfalfa dodders never appear in red clover.

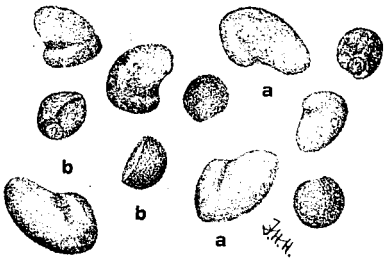


Figure 12 shows the relative size of the seeds of (a) red clover and (b) field dodder. (Enlarged. After Hillman.)

Dodder at present is not a very common weed in Minnesota, but in the Western and Southern States it grows abundantly, also in Europe. It is not, however, by any means entirely absent from this State, and it seems to be increasing gradually. As much of our alfalfa and clover seed comes from the Western States and from Europe, great care should be exercised to see that no dodder is planted with alfalfa and red clover. Minnesota ought to establish and maintain a reputation for dodder-free seed; it would be worth much to the farmers in the increased value of their seed. Now is the time to prevent the introduction of the dodders.

5. RESULTS OF SEED TESTING—GERMINATION TESTS.

The purity of a seed-sample is only half of the story. Not only must seed be pure, but it must be capable of growing and producing vigorous plants. A test for germination is therefore necessary. The value of a seed which germinates only 50% is not more than one-half that of a sample with a germination percentage of 100. Seed to which old dead seed has been added is just as much adulterated as seed with which some worthless weed-seed has been mixed.

In the following tables of germination-tests, the latter are collected into three groups: (a) Grain and grass crops; (b) Alfalfa and clovers; (c) Vegetable seeds.

TABLE 9—Showing the Weed Seeds, in Order of Occurrence, Found in All of the Samples Tested for Purity.

1	*Chaetochloa viridis*	Green foxtail
2	*Chenopodium album*	Lambs-quarters
3	*Polygonum convolvulus*	Wild buckwheat
4	*Chaetochloa glauca*	Yellow foxtail
5	*Avena fatua*	Wild oats
6	*Lepidium apetalum*	Pepper grass
7	*Polygonum persicaria*	Lady's thumb
8	*Silene noctiflora*	Night-flowering catch-fly
9	*Plantago major*	Plantain
10	*Rumex acetosella*	Sheep sorrel
11	*Agrostemma githago*	Corn cockle
12	*Amaranthus retro flexus*	Pigweed
13	*Rumex crispus*	Curled dock
14	*Brassica spp*	Mustard
15	*Sedge spp*	Sedge
16	*Plantago lanceolata*	Buckhorn plantain
17	*Agropyron spp*	Quack grass
18	*Panicum crus-galli*	Barnyard grass
19	*Rosa spp*	Wild rose
20	*Vicia spp*	Vetch
21	*Onagra biennis*	Evening primrose
22	*Ambrosia artemisaefolia*	Rag weed
23	*Panicum capillare*	Old Witch grass
24	*Camelina sativa*	False flax
25	*Salsola tragus*	Russian thistle
26	*Verbena spp*	Vervain
27	*Syntherisma sanguinalis*	Crab grass
28	*Juncus tenuis*	Rush
29	*Lolium temulentum*	Darnel
30	*Teucrium canadense*	Woodsage
31	*Polygonum hydropiper*	Smartweed
32	*Conringia orientalis*	Hare's ear mustard
33	*Anthemis cotula*	May weed
34	*Oxalis stricta*	Wood sorrel
35	*Carduus lanceolatus*	Bull thistle
36	*Thlaspi arvense*	French weed
37	*Cerastium vulgatum*	Mouse-ear chick weed
38	*Daucus carota*	Wild carrot
39	*Lychnis alba*	White cockle
40	*Centaurea spp*	Corn flower
41	*Cuscuta spp*	Dodder
42	*Medicago lupulina*	Yellow trefoil
43	*Carduus arvensis*	Canada thistle
44	*Melilotus alba*	Sweet clover
45	*Nepeta cataria*	Catnip
46	*Vaccaria vaccaria*	Cow cockle
47	*Cichorium intybus*	Wild chicory
48	*Alsine media*	Chick weed
49	*Rudbeckia hirta*	Brown-eyed Susan
50	*Spergula arvensis*	Spurry
51	*Polygonum pennsylvanicum*	Penn. Smartweed
52	*Neslia paniculata*	Ball Mustard
53	*Convolvulus arvensis*	Wild morning glory
54	*Helianthus spp*	Wild sunflower
55	*Lappula lappula*	Stick tight
56	*Ambrosia trifida*	Kinghead
57	*Iva xanthiifolia*	Marsh elder
58	*Achillea millefolium*	Yarrow
59	*Sisymbrium officinale*	Hedge mustard
60	*Arctium lappa*	Burdock
61	*Melilotus indica*	Small melilot

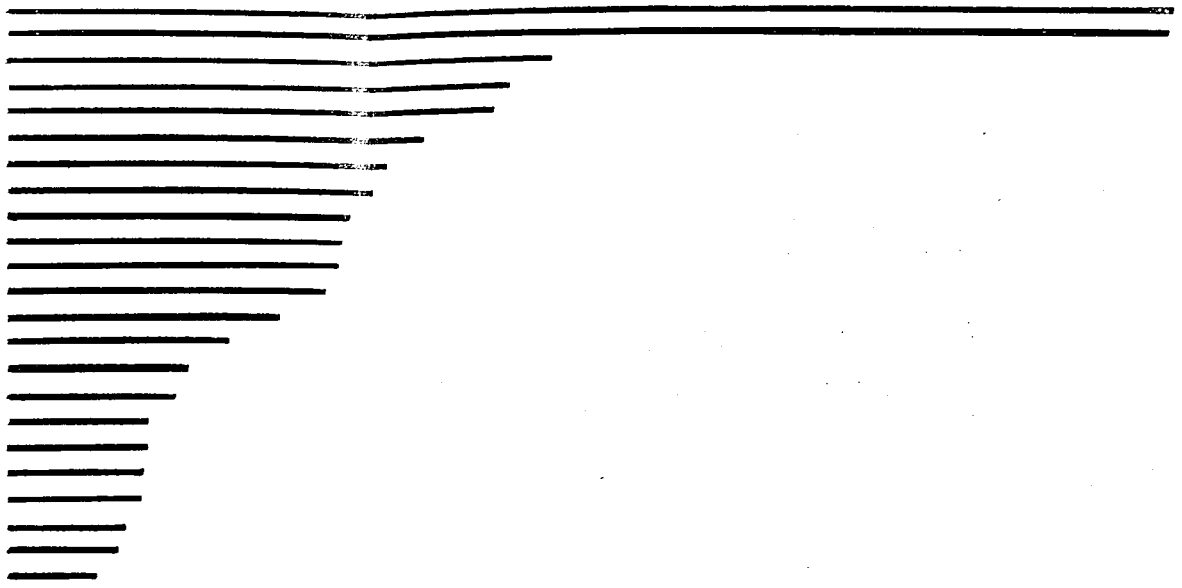


Table 9 shows graphically the occurrence of weed-seeds in the seeds tested at the Seed Laboratory. It is noticeable that the worst weeds are not most common in the first ten with the exception of wild oats. The second ten contain some bad weeds, such as corn cockle, mustard, curled dock, and the very bad weed, quack grass. The appearance of buckhorn plantain is due to the fact that seed grown outside of the State has been sent in for tests, or imported into our markets, since the plant seldom seeds in this State. It is worthy of note, and an encouraging fact, that the most serious weeds (with the exception of quack grass already noted) are well down toward the bottom of the list. It is furthermore a very important and significant fact that no seed of the perennial sow thistle has been found in any of the seed examined to date, although the weed is a very common and greatly feared pest in some parts of the State.

TABLE 10—Germination Test of Grain and Grass Seeds, 1910 and 1911.

Name of Seed.	Sender.	No. of Samples.		Av. % of Germination.		U. S. Standard of Germination.	No. of Samples above Standard.		No. of Samples below Standard.	
		1910	1911	1910	1911		1910	1911	1910	1911
Wheat	Farmers	83	371	93.24	96.89		86.75	96.5	13.25	3.5
	Seedmen	0	0			90-95				
Oats	Farmers	77	129	97.53	94.86		97.4	90.7	2.6	9.3
	Seedmen	3	4	95.33	99.25	90-95	100	100	0	0
Corn	Farmers	105	116	73.53	84.74		42.86	85.45	57.14	14.55
	Seedmen	35	33	66.12	89.42	90-95	14.29	60.61	85.71	39.39
Barley	Farmers	42	60	88.05	95.65		83.34	93	16.66	7
	Seedmen	2	1	92	100	90-95	100	100	0	0
Timothy	Farmers	38	107	72.6	81.51		68.42	69.1	31.58	30.9
	Seedmen	31	30	90.9	83.23	85-90	93.55	80	6.45	20
Flax	Farmers	18	76	83	93.73					
	Seedmen	5	0	94.8		*				
Rye	Farmers	6	5	95.16	91.8		83.5	80	16.5	20
	Seedmen	0	0			90-95				
Emmer	Farmers	2	1	95	99					
	Seedmen	0	0			*				
Brome Grass	Farmers	1	2	28	30.5		0	0	100	100
	Seedmen	4	3	74.75	24.33	75-80	25	0	75	100
Millet	Farmers	2	1	87	95		50	100	50	0
	Seedmen	9	14	84.22	86	85-90	88.88	64.29	11.12	35.71
Sorghum	Farmers	1		51			0		100	
	Seedmen	3	7	61.66	81.43	85-90	0	28.5	100	71.5
Red Top	Farmers	2	0	55.5						
	Seedmen	6	6	58.5	46.66	*				
Rape	Farmers	1	1	4	97		0	100	100	0
	Seedmen	0	4		91.5	90-95		75		25
Orchard Grass	Farmers	0	0							
	Seedmen	1	1	28	69	*				

The germination standards in this table were obtained from the 1896 Yearbook of the U. S. Department of Agriculture.
*No standards given.

Table 10—The following are the most noticeable facts shown as the results of germination tests of grain and grass seeds—1910 and 1911:

1. More tests made for farmers than for seedsmen.
2. That on the average the farmer's corn tested better than seedsmen's corn.
3. That seedsmen's timothy had a higher germination than the timothy sent in by farmers.
4. That on the average all germination tests had a higher average in 1911 than in 1910.
5. That brome grass had a very low percentage of germination.

Table 11 gives the results of all the germination tests made of alfalfa and clovers—1910 and 1911. With the exception of medium red clover, the seedsmen sent in more samples for testing than the farmers. In nearly every case the average germination of the samples sent in by the farmer was somewhat lower than with those of the seedsmen. The average germination of nearly all the clovers and alfalfas was lower in 1911 than in 1910.

Table 12 shows that the germination of vegetable seeds is much below standard. The greatest number of the sample of vegetable seeds were sent in by seedsmen. In quite a number of varieties of seed it will be seen that the average germination of the seed sent in by farmers is higher than the seed sent in by seedsmen.

TABLE 11—Germination Test of Alfalfa and Clovers, 1910-1911.

Name of Seed.	Sender.	Number of Samples.		Average % of Germination.		Percent of "Hard Seeds."		U. S. Standard of Germination	% of Samples above Standard.		% of Samples below Standard.	
		1910	1911	1910	1911	1910	1911		1910	1911	1910	1911
Alfalfa.....	Farmer....	9	23	80.77	73.56	11.44	23.52	85-90%	33.33	39.13	66.67	60.87
	Seedsmen..	10	67	82.90	80.04	14.20	15.25	.....	70	46.67	30	53.33
Medium Red Clover	Farmer....	55	125	86.14	82.54	11.88	11.37	85-90%	70.9	55.2	29.1	44.8
	Seedsmen..	32	52	86.44	86.03	9.68	8.88	.....	71.87	75	28.13	25
Mammoth Clover..	Farmer....	1	3	91	83.66	5	6.67	85-90%	100	66.67	0	33.33
	Seedsmen..	7	8	88.14	90	6.71	7.62	.....	85.7	100	14.3	0
White Clover.....	Farmer....	1	0	71	.....	20	.....	75-80%	0	.....	100	.....
	Seedsmen..	18	6	65.17	79.66	21.91	16.33	.....	11.11	66.67	88.89	33.33
Alsike Clover.....	Farmer....	11	25	81.73	79.2	14.58	11.68	75-80%	91	68	9	32
	Seedsmen..	35	22	84.09	85	12.17	11.77	.....	91.43	95.5	8.57	4.5

The germination standards used in this table were obtained from the 1896 Yearbook of the United States Department of Agriculture.
See Page 156.

TABLE 12—Germination Tests of Vegetable Seeds, 1910 and 1911.

Name of Seed.	Sender.	No. of Samples.	Ave. % of Germination.	U. S. Standard of Germination	% of Samples above Standard.	% of Samples below Standard.
Asparagus	Farmer	0				
	Seedsmen	2	55.5	80-85	0	100
Bean	Farmer	4	79		75	25
	Seedsmen	2	65	90-95	0	100
Beet	Farmer	1	55	*		
	Seedsmen	7	67.71			
Cabbage	Farmer	0				
	Seedsmen	19	81.75	90-95	36.84	63.16
Carrot	Farmer	0				
	Seedsmen	3	51.66	80-85	0	100
Celery	Farmer	0	0			
	Seedsmen	2	20	60-65	0	100
Endive	Farmer	0				
	Seedsmen	2	70	*		
Egg Plant	Farmer	0				
	Seedsmen	2	37	75-80	0	100
Kale	Farmer	0		*		
	Seedsmen	1	59			
Lettuce	Farmer	0				
	Seedsmen	55	85.38	85-90	83.64	16.36
Mangel-Wurzel	Farmer	0		*		
	Seedsmen	3	82			
Muskmelon	Farmer	1	74		0	100
	Seedsmen	4	79.75	85-90	50	50
Onion	Farmer	13	79.76		53.8	46.2
	Seedsmen	14	71.4	80-85	35.71	64.29
Parsnip	Farmer	1	94		100	0
	Seedsmen	1	61	70-75	0	100
Pepper	Farmer	0				
	Seedsmen	1	73	*		
Peas	Farmer	2	94.5		50	50
	Seedsmen	14	69.97	93-98	21.43	78.57
Parsley	Farmer	0				
	Seedsmen	1	45	70-75	0	100
Popcorn	Farmer	2	97			
	Seedsmen	0		*		
Radish	Farmer	0				
	Seedsmen	2	45	90-95	0	100
Salsify	Farmer	0				
	Seedsmen	2	95.5	75-80	100	0
Spinach	Farmer	0				
	Seedsmen	6	49.66	80-85	0	100
Squash	Farmer	0				
	Seedsmen	5	51.4	85-90	0	100
Sweet Corn	Farmer	7	91		85.71	14.29
	Seedsmen	10	74.3	85-90	60	40
Tomato	Farmer	0				
	Seedsmen	3	78	85-90	34	66
Turnip	Farmer	0				
	Seedsmen	1	94	90-95	100	0
Watermelon	Farmer	0				
	Seedsmen	3	58.33	85-90	0	100

The germination standards used in this table were obtained from the 1896 Yearbook of the United States Department of Agriculture.

*No standards given.

See page 156.

TABLE 13—Per Cent of Purity and Germination of Seeds.

Seed.	Purity %	Germination %
Alfalfa	98	85-90
Asparagus	99	80-85
Barley	99	90-95
Beans	99	90-95
Beet	99	*150
Blue grass, Canadian	90	45-50
Blue grass, Kentucky	90	45-50
Brome, awnless	90	75-80
Buckwheat	99	90-95
Cabbage	99	90-95
Carrot	95	80-85
Cauliflower	99	80-85
Celery	98	60-65
Clover, alsike	95	75-80
Clover, crimson	98	85-90
Clover, red	98	85-90
Clover, white	95	75-80
Collard	99	90-95
Corn, field	99	90-95
Corn, sweet	99	85-90
Cotton	99	85-90
Cowpea	99	85-90
Cress	99	85-90
Cucumber	99	85-90
Eggplant	99	75-80
Fescue, meadow	95	85-90
Lettuce	99	85-90
Kaffir corn	98	85-90
Melon, musk	99	85-90
Melon, water	99	85-90
Millet, common (Setaria italica)	99	85-90
Millet, hog (Panicum miliaceum)	99	85-90
Millet, pearl	99	85-90
Mustard	99	90-95
Oats	99	90-95
Okra	99	80-85
Onion	99	80-85
Parsley	99	70-75
Parsnip	95	70-75
Peas	99	93-98
Pumpkin	99	85-90
Radish	99	90-95
Rape	99	90-95
Rye	99	90-95
Salsify	98	75-80
Sorghum	98	85-90
Spinach	99	80-85
Spurry	99	85-90
Squash	99	85-90
Timothy	98	85-90
Tomato	98	85-90
Turnip	99	90-95
Tobacco	98	75-80
Wheat	99	90-95

*Each beet fruit, or "ball" is likely to contain from two to seven seeds. One hundred balls should yield at least 150 sprouts.

This table (13), showing standard of purity, was taken from the 1896 Yearbook of the United States Department of Agriculture.

Table 13, showing the per cent of purity and germination of seeds, is published for future reference and for the farmer's convenience in estimating the value of his seed. It is, of course, to be expected that seasons will occur in which practically all of the seed of a locality will fall below standard; nevertheless it is important to know what the standard ought to be under favorable conditions.

Tables 14 and 15 show the approximate number of seeds per pound of the crop-seeds and some of the weed-seeds, and were prepared at the Minnesota Seed Laboratory. In each case average-sized seeds were used. Accurate seeding methods in farm practice must eventually be based on such figures as these. They furnish a valuable means of checking the actual germination percentage in the field. For instance, if a certain number of pounds of clover are sown evenly on one acre, the number of plants per square foot can be easily figured. The results in the field can then be checked up, and the percentage of germination and growth to maturity can be figured. It is probable that, by providing the best possible seed-bed, the amount of seed necessary can be accurately determined.

TABLE 14—Shows the Approximate Number of Seeds per Pound of the Various Crop Seeds.

	No. of Seeds
Red Top	5,045,600
Kentucky Blue Grass	4,123,545
Timothy	1,209,575
White Clover	863,980
Alsike Clover	755,982
Medium Red Clover	283,494
Alfalfa	226,795
Common Millet	221,264
Brome Grass	146,319
Flax	98,606
Barley (six row)	25,200
Rye	25,060
Oats	24,786
Wheat (Blue Stem)	15,119
Wheat (Durum)	12,777
Corn (Minn. No. 13)	1,088

TABLE 16—Legal Number of Pounds per Bushel in Minnesota.

Corn in ear	70*
Beans, peas, wheat, clover seed, Irish potatoes and alfalfa	60
Sorghum seed	57
Shelled corn and rye	56
Buckwheat, hemp seed, rape seed	50
Barley, millet and Hungarian grass seed	48
Timothy seed	45
Oats	32
Blue grass, orchard grass and red top seed	14

These weights were obtained from the Revised Laws of Minnesota, 1905, Chap. 50, No. 2728. Alfalfa was not included in the list, but 60 lbs. per bushel is commonly adopted.

*The usually adopted weight of corn in ear from time crop is harvested to Jan. 1st is 72 lbs. per bu.

TABLE 15—Shows the Approximate Number of Each of the Following Weed-Seeds per Pound.

Scientific Name.	Common Name.	No. of Seeds.
Cuscuta epithymum	Clover dodder	1,814,360
Plantago major	Plantain (common)	1,814,360
Thlaspi arvense	Frenchweed	647,985
Chenopodium album	Lamb's quarters	604,786
Camelina sativa	False flax	566,987
Carduus arvensis	Canada thistle	566,987
Silene noctiflora	Night-flowering catchfly	412,354
Medicago lupulina	Trefoil (yellow)	348,915
Plantago lanceolata	Buckhorn plantain	348,915
Polygonum persicaria	Lady's thumb	312,820
Salsola tragus	Russian thistle	266,817
Melilotus alba	Sweet clover	251,994
Brassica arvensis	Wild mustard	215,995
Chaetochloa viridis	Green foxtail	206,177
Carduus lanceolatus	Bull thistle	174,457
Ambrosia artemisiaefolia	Rag weed	156,755
Agropyron repens	Quack grass	137,148
Polygonum convolvulus	Wild buckwheat	119,365
Agrostemma githago	Corn cockle	45,359
Avena fatua	Wild oats	25,493

Table 15 is used in making Seed Laboratory tests. Percentages by weight are obtained in making the purity test, and by means of this table the number of seeds of the common weed-seeds in a pound of the tested seed can be computed.

"Hard Seeds" of the Clovers and Alfalfas.

A germination test of clover and alfalfa nearly always shows either a small or large percentage of seeds which at the end of the test have not germinated and still have not decayed. They have practically remained the same throughout the entire test. Such seeds are called "hard seeds." They have exceptionally hard seed-coats, through which the moisture cannot penetrate. If at any time the seed-coat is scratched or broken, the seed will germinate readily. The hard seed is apparently a good seed, except that its coat is too hard either to allow water to penetrate or to allow the plant to swell sufficiently to burst the coat.

The "hard seed" problem is still in the experimental stage. It is not definitely known what percentage will grow when planted, or if any will grow. However, the presence of a large percentage of "hard seeds" is of practical importance, for a good stand cannot be expected when such seeds are sown, since they certainly will not germinate at the time the other seeds germinate. Table 11 shows the germination tests of alfalfa and clover. From this table it can be observed that the average percentage of "hard seeds" in alfalfa was 16.125%;

in medium red clover 10.45%; in mammoth clover 6.5%; in white clover 19.41%; and in alsike clover 12.55%. Some tests of alfalfa at the Minnesota Seed Laboratory show from 50 to 75% of "hard seeds."

Alfalfa and clover seed, even if it is free from dirt and weed seeds and bright in color, is not always profitable seed to buy; for a germination test often reveals a large percentage of "hard seeds."

6. WEED-SEED COLLECTION.

Beside the actual work of seed testing, the Seed Laboratory has been carrying on an educational campaign for pure seed. It is obvious that the farmer ought to know the weed-seeds as well as his crop-seeds, so that when seed is to be purchased he may be able to examine it intelligently and detect any noxious weed-seeds. In order to recognize the weed-seeds, a farmer must have samples with which to compare them. To meet this need, an inexpensive weed-seed case has been devised, which contains twenty-four weed-seeds commonly found in crop-seed. The accompanying cut, Figure 31, illustrates this case. Two series have been prepared, each containing twenty-four weed-seeds. The seeds in the small pockets are loose, so that they can be examined easily in all positions. They will not mix unless the case is broken. It is the aim of the Seed Laboratory to prepare different series from time to time, until all, at least of the common weed-seeds found mixed with Minnesota crop-seeds, will be available in this form.

The cases are sold to residents of the State for 50c a series. On the back of each are found the botanical names of the seeds found in it; also the following directions for home seed-testing:

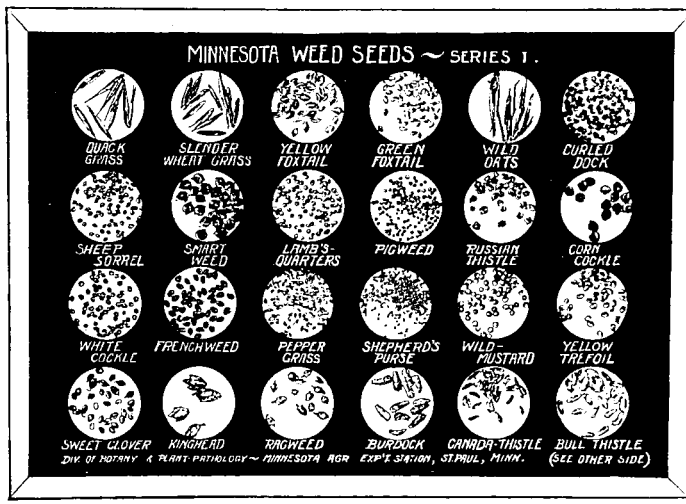


Figure 13—Weed-Seed Case, Series 1.

Purity Test.

1. Get an average sample from bin or sack.
2. Divide it until a small sample is obtained.
3. Separate this into pure seed, weed seeds and dirt.
4. Estimate percentage of each.
5. Determine weed-seeds.
6. Seeds you do not know send to the Seed Laboratory, Minnesota Experiment Station, St. Paul, Minnesota, for identification.

Germination Test.

1. Count out one hundred seeds.
2. Place between folds of moist canton flannel (corn, peas, etc.), or blotting paper (wheat, clover, etc.).
3. Place these between two plates.
4. Keep temperature at about average room temperature (68° F.).
5. Count sprouts at end of 3d and 6th days, and determine percent of germination.
6. Tests of individual ears of corn should be made. Write to Minnesota Experiment Station, St. Paul, Minn., for information.

Contents of Seed Cases.

Series I Contains the Following Weed Seeds:

Quack grass (*Agropyron repens*).
Slender wheat grass (*Agropyron tenerum*).
Yellow foxtail (*Chaetochloa glauca*).
Green foxtail (*Chaetochloa viridis*).
Wild oats (*Avena fatua*).
Curled dock (*Rumex crispus*).
Sheep sorrel (*Rumex acetosella*).
Smartweed (*Polygonum persicaria*).
Lamb's-quarters (*Chenopodium album*).
Pigweed (*Amaranthus retroflexus*).
Russian thistle (*Salsola tragus*).
Corn cockle (*Agrostemma githago*).
White cockle (*Lychnis alba*).
Frenchweed (*Thlaspi arvense*).
Peppergrass (*Lepidium apetalum*).
Shepherd's purse (*Bursa bursa-pastoris*).
Wild mustard (*Brassica arvensis*).
Yellow trefoil (*Medicago lupulina*).
Sweet clover (*Melilotus alba*).
King'head (*Ambrosia trifida*).
Ragweed (*Ambrosia artemisiae folia*).
Burdock (*Arctium lappa*).
Canada thistle (*Carduus arvensis*).
Bull thistle (*Carduus lanceolatus*).

Series II Contains the Following Weed Seeds:

Crab grass (*Syntherisma sanguinalis*).
Witch grass (*Panicum capillare*).
Barnyard grass (*Panicum crus-galli*).
Darnel (*Lolium temulentum*).
Smartweed (*Polygonum pennsylvanicum*).
Wild buckwheat (*Polygonum convolvulus*).
Night-flowering catchfly (*Silene noctiflora*).
Cow cockle (*Vaccaria vaccaria*).
Purslane (*Portulaca oleracea*).
False flax (*Camelina sativa*).
Black mustard (*Brassica nigra*).
Five finger (*Potentilla monspeliensis*).
Wild rose (*Rosa spp.*).
Mallow (*Malva rotundifolia*).
Evening primrose (*Onagra biennis*).
Dodder (*Cuscuta spp.*).
Stick-tight (*Lappula lappula*).
Blue vervain (*Verbena hastata*).
Catnip (*Nepeta cataria*).
Buckhorn plantain (*Plantago lanceolata*).
Marsh elder (*Iva xanthiifolia*).
Mayweed (*Anthemis cotula*).
Prickly lettuce (*Lactuca scariola*).
Perennial sow-thistle (*Sonchus arvensis*).

The steadily increasing demand for these weed seed cases is encouraging for it shows an increasing desire on the part of the farmers to avail themselves of this opportunity to know more about pure seed.