

GEORGIA COASTAL PLAIN EXPERIMENT STATION
TIFTON, GEORGIA

June, 1921

Extension Bulletin

Series I, No. 178-A

Colorado Agricultural College

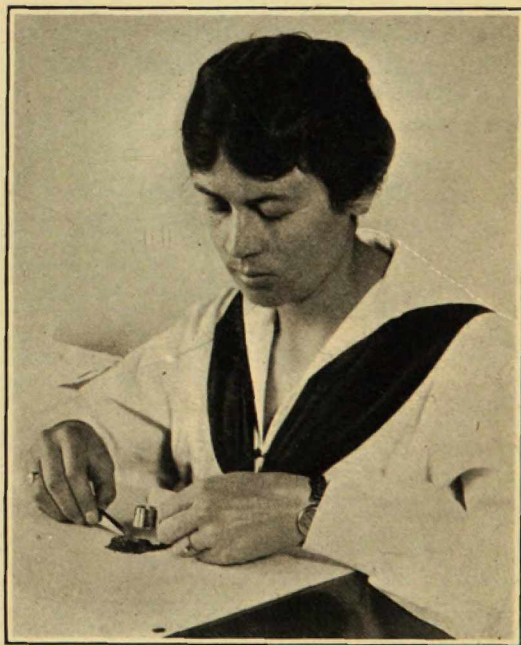
EXTENSION SERVICE

Fort Collins, Colorado

A. E. LOVETT, Acting Director

PRACTICAL SEED TESTING

BY A. K. PEITERSEN AND ANNA M. LUTE



CO-OPERATIVE EXTENSION SERVICE IN AGRICULTURE AND HOME
ECONOMICS--COLORADO AGRICULTURAL COLLEGE AND U. S.
DEPARTMENT OF AGRICULTURE CO-OPERATING

Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914

Colorado Agricultural College

FORT COLLINS, COLORADO

THE STATE BOARD OF AGRICULTURE

	Term Expires
HON. H. D. PARKER	Greeley, 1923
MRS. AGNES L. RIDDLE	Denver, 1923
HON. J. C. BELL	Montrose, 1925
HON. E. M. AMMONS	Denver, 1925
HON. W. L. GIFFORD	Durango, 1927
HON. J. B. RYAN	Rocky Ford, 1927
HON. A. A. EDWARDS, President of the Board	Ft. Collins, 1929
HON. J. S. CALKINS	Westminster, 1929

PRESIDENT CHAS. A. LORY }
GOVERNOR OLIVER H. SHOUP } Ex-Officio

L. M. TAYLOR, Secretary

G. A. WEBB, Treasurer

EXECUTIVE COMMITTEE

A. A. EDWARDS, Chairman

E. M. AMMONS

H. D. PARKER

EXTENSION SERVICE

OFFICERS

CHAS. A. LORY, M. S., LL. D., D. Sc.	President
A. E. LOVETT, B. S.	State Leader County Agents and Acting Director
F. A. ANDERSON	Assistant to Director
L. M. TAYLOR	Secretary

EXTENSION STAFF

R. H. FELTS, B. S. A.	Assistant State Leader County Agents
E. D. SMITH	Assistant State Leader County Agents
R. W. SHAFER, B. S.	Assistant State Leader County Agents
MAUDE E. SHERIDAN, Pd. M.	State Leader Boys' and Girls' Clubs
W. R. FREEMAN, B. S.	Assistant State Club Leader
*MIRIAM M. HAYNES, B. S.	State Leader Home Demonstration Agents
ERMA DOUGLAS, B. S.	Assistant State Leader Home Demonstration Agents
D. A. JAY, B. S.	Specialist in Animal Husbandry
A. E. McCLYMONDS, B. S.	Specialist in Agronomy
F. J. CHASE, B. S.	Farm Management Demonstrator
MAVEA ALLEN, B. S., M. S.	Poultry Specialist
W. F. HEPPE, M. Sc.	Field Agent in Marketing
RALPH L. CROSMAN, B. S.	Editor of Publications

COUNTY AGENTS

A. W. AICHER, B. S.	Elbert County, Kiowa	L. P. McCANN, B. S., M. S. A.	Mesa County, Grand Junction
D. C. BASCOM, B. S.	Larimer County, Fort Collins	R. H. MILLER, B. S.	Douglas County, Castle Rock
G. G. CLARK, B. S.	Montezuma County, Cortez	J. E. MORRISON, B. S.	Logan County, Sterling
O. L. DAVIS, B. S.	Moffat County, Craig		Morgan County, Fort Morgan
W. F. DROGE, B. S.	Otero County, Rocky Ford	S. L. OWENS, B. S.	Huerfano County, Walsenburg
G. R. GREAVES, B. S.	La Plata County, Durango	C. A. PEDERSEN	Prowers County, Lamar
C. D. HYATT, B. S. A., Rio Grande County, Monte Vista		WM. O. SAUDER, B. S.	Saguache County, Center
WALDO KIDDER, B. S.	Adams County, Brighton	W. H. SAWHILL	Pueblo County, Pueblo
B. H. KING, B. S.	Montrose County, Montrose	A. J. TAYLOR, B. S.	Fremont County, Canon City
M. E. KNAPP, B. S.	Weld County, Greeley	A. H. TEDMON, B. S.	Arapahoe County, Littleton
A. A. KROLL, B. S., Grand County, Hot Sulphur Springs		SCOTT WISNER, B. S., D. V. S.	Lincoln County, Hugo
J. C. HALE, B. S., El Paso County, Colorado Springs		F. D. YEAGER, B. S.	Boulder County, Longmont

HOME DEMONSTRATION AGENTS

.....	El Paso County, Colorado Springs	SUSANNE THOMPSON, B. S.	Logan County, Sterling
-------	----------------------------------	------------------------------	------------------------

COUNTY CLUB LEADERS

EDWINA RAMSEY, A. B.	Denver County, Denver	W. S. HILL	Larimer County, Fort Collins
J. T. ROBERTSON, B. S.	Arapahoe County, Littleton	AMELIA ALEXANDER	Kit Carson County, Flagler
EMMA FULL	Boulder County, Longmont		

*On leave until September first.

PRACTICAL SEED TESTING

BY A. K. PEITERTSON AND ANNA M. LUTE

The use of high grade seeds of farm crops is vital to successful farming. Weed seeds planted are paid for at the price of crop seed; are sown and cultivated at the same cost as crop seeds. In return they are either scattered on the field to reduce the next crop or remain in the harvested crop and reduce its value.

Actual counts of seeds from individual plants show that no farmer can afford to plant weed seeds. A single plant of green foxtail produced 140,000 seeds, a plant of lamb's quarters produced 600,000, a single tumbleweed produced 6,000,000. The most pernicious weeds have been introduced in farming communities through their occurrence in crop seeds. Because of the enormous number of seeds produced by weeds every farmer should have his seed tested to see that it is reasonably free from such seeds. In addition to examination of seed for weed seeds it should also be tested for germination, for upon viability of seed depends the stand and hence the yield.

Seed testing is of interest especially to the young people in the home and school. There is much of beauty among seeds, there is infinite variety, there are resemblances that soon bring to the observing boy or girl botanical relationships. The constant recurrence of seeds of cosmopolitan plants, the occasional occurrence of a large number of others, the fact that the origin of seed can very frequently be judged from its weed content opens a new field to the growing mind. Varied requirements for germination, variety of behavior while germinating and the fact that certain plant diseases can be detected in the very young seedling lend interest to that part of the work.

The making of accurate detailed purity tests of seeds is the work of a specialist with special equipment. The making of practical tests that will give a good estimate of the quality of a given sample of seed may be learned by a careful student with very simple equipment.

The chief requisite is a good hand lens. A lens that gives satisfactory working distance, a sharp delineation and magnification of six times may be purchased for less than five dollars. Such a lens adds greatly to the ease and efficiency of the work. A less expensive lens may be used if a good lens is not available.

A second requisite is suitable forceps. Satisfactory ones may be purchased in various stores. Care should be taken to see that the spring is not too stiff. The points may be sharpened in accordance with individual preference and experience by rubbing on fine emery board, such as is used for manicuring purposes.

A third requisite is seeds for comparison. The Colorado Seed Laboratory has three sets of such seeds as follows:

1. Twenty-four common weed seeds.
2. Twenty-four forage crop seeds.
3. Twenty-four cereal crop seeds.

Each of the above may be had for seventy-five cents per set.

A set of one hundred seeds in vials may be obtained from the United States Department of Agriculture.

Illustrations of weed seeds are also valuable aids. They may be obtained from the United States Department of Agriculture and also from various state experiment stations.

It is convenient to have some large sheets of smooth white paper and cards about the size and quality of postal cards.

MAKING THE PURITY TEST

1. Preparing the table for work. An arm rest (See figure number 1) may be made in schools having facilities for manual training. A good size has top $11\frac{1}{2} \times 17$ inches, height 6 inches, slope $11\frac{1}{2}$ inches.

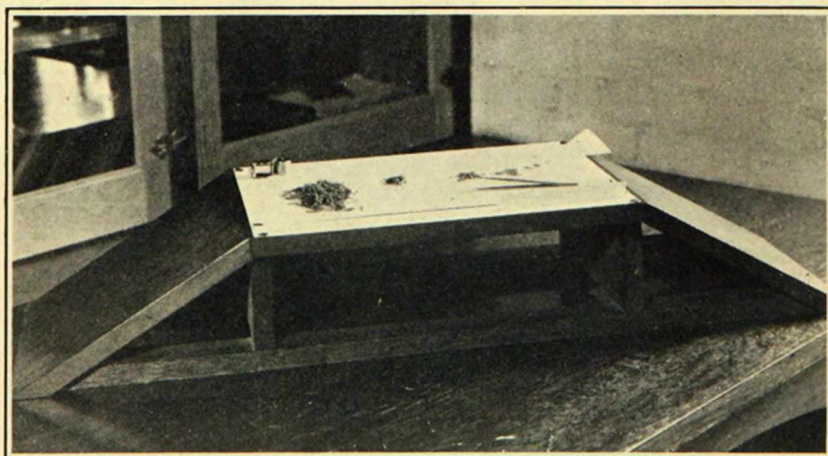


FIGURE 1. Suitable equipment for making purity tests; arm-rest, lens, forceps and cards. Showing also completed purity test, at the left pure seed, center inert matter and at the right six kinds of weed seeds

Such a working table affords support for the forearm, and elevates the working surface to a convenient height for close work with the lens. The top should be covered with two sheets of smooth white paper, held in place with thumb tacks. The sheets should be so placed that the front edge of the upper sheet is approximately one and one-half inches back of the edge of the lower sheet. (See figure 1).

If the arm rest can not be had two sheets of paper may be similarly arranged and fastened with thumb tacks on a table. A card folded for use as a funnel and a triangle cut from the same quality of card are aids in taking seeds from board or table for weighing and for final disposition. (See figure 2.)

2. The next step is to secure a representative sample. If an alfalfa test is to be made, seed from various parts of the bin or bag should be made into a composite sample by thorough mixing. A drinking glass one-fourth full (two ounces or fifty grams if scales are at hand) should be placed on the paper prepared and then divided into halves, fourths and finally eighths, by using the card triangle. (Figure 3).

3. The seven-eighths not to be used for purity test should be returned to the glass or other convenient receptacle, the one-eighth should be placed near the center of the working surface prepared and carefully separated into four parts:

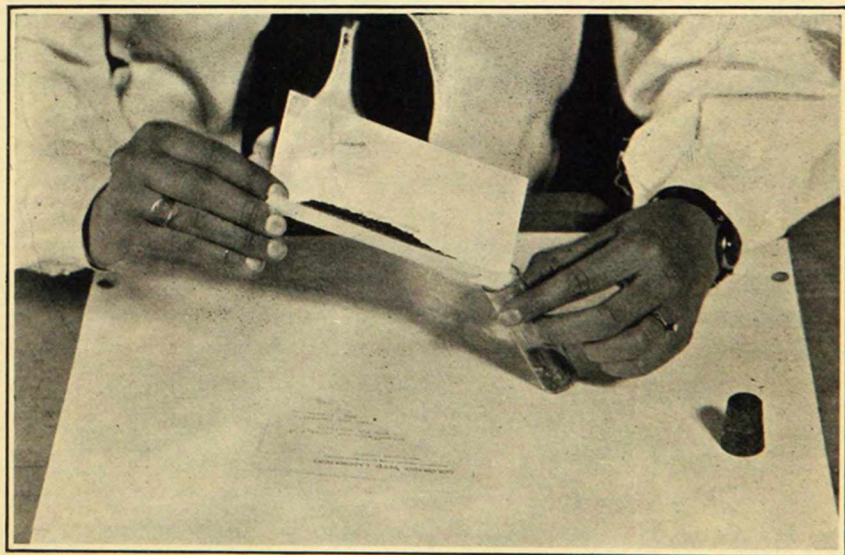


FIGURE 2. Card triangle for moving seed (on table) and folded card for pouring seed (in hand).

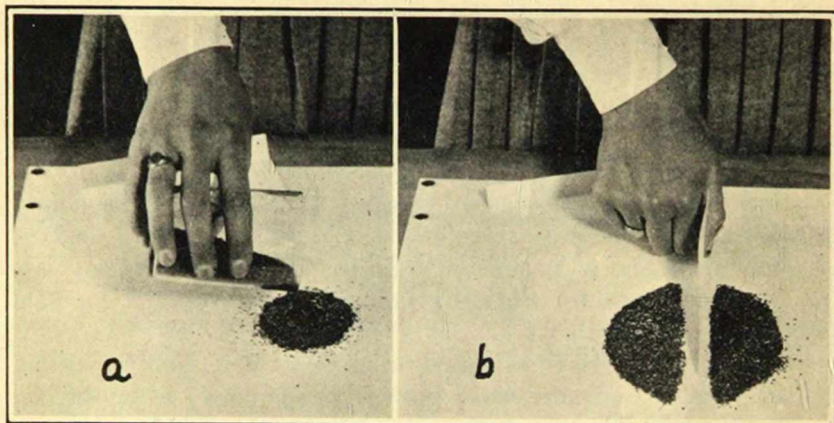


FIGURE 3. a. Pouring alfalfa sample on board or table. b. Dividing sample with card triangle.

a. Pure seed, in this case alfalfa, including broken seed larger than one-half.

b. Inert matter, including seeds less than half, stems, dirt, in fact all material that is not seeds.

c. Weed seeds.

d. Crop seeds other than pure seed.

This separation should be made first without the lens, then corroborated and corrected with the aid of the lens.

4. The next step is to separate the weed seeds into the various species and identify them by comparison with properly identified seeds and with good illustrations. Seeds that cannot be identified may be sent to the Colorado Seed Laboratory for identification and later be added to the collection of named seeds.

If scales are available the percentages of the four portions may be computed; if not, an estimate can be made of the number of weed seeds in comparison with the number of pure seeds in the sample.

5. The final step is to examine the seven-eighths of the original sample carefully for dodder or other especially noxious weed seeds.

If the sample used is approximately five grams each weed seed found in it represents ninety in a pound of seed. From the amount of seed sown per acre the stand of weeds to be expected may readily be computed.

It is helpful to know what weed seeds may be expected in various crop seeds. The following brief list with descriptions gives some of the more common weeds found in Colorado seeds.

WEED SEEDS COMMON IN ALFALFA

Dodder—Varying in color from the yellows and browns of alfalfa seed to grey and pinkish. The small seeded dodder frequently occurs in pairs. The larger seeded ones are usually conspicuous by having one rounded side (practically a hemisphere), the other variously angular or indented.

Perennial Peppergrass—Seeds conspicuously brown, about the size of medium-sized alfalfa seeds, somewhat flattened, rounded at one end, tapering toward the other.

Russian Thistle—Color from bright yellow, through dull grey to grey with rose or pink tinge. Embryo spirally coiled, seed top-shape.

Pigweed, Tumbleweed—Seed black, shiny, circular.

Lamb's Quarters—Seed circular in outline, lenticular in side view, dull black or grey.

Green Foxtail—Seed green, tapering toward both ends, one surface convex the other flat, surface transversely ridged.

Sweet Clover—Color and size similar to alfalfa, shape more regular, surface very dull.

Salt Bush—The one seeded fruit resembles a small grey fan, the seed may be grey or black, showing the embryo through a very thin seed coat.

WEED SEEDS COMMON IN CEREALS

Wild Oats—Size and shape similar to cultivated oats, frequently very dark in color, awn conspicuous, decided cup at base of seed.

Black Bindweed—Seeds usually black, occasionally white, triangular.

Sunflower—Seeds flattened, grey, usually black, striped, narrowing toward one end.

Lamb's Quarters—See under Weeds in Alfalfa Seed.

Pigweed—See under Weeds in Alfalfa Seed.

Tumbleweed—See under Weeds in Alfalfa Seed.

The amount of seed used for making purity tests has been worked out on a basis considering both the time required to examine properly a given bulk of seed and the probable error involved in using too few seeds. The following table of amounts used for purity test considers a sample small enough to be examined in a reasonable length of time, large enough to reduce the probable error to a practical minimum.

SEEDS	Amount used for test	SEEDS	Amount used for test
Beans	50 grams	Alfalfa	5 grams
Corn	50 grams	Millet	5 grams
Peas	50 grams	Red Clover	5 grams
Barley	30 grams	Awnless Brome Grass	3 grams
Emmer	30 grams	Meadow Fescue	3 grams
Oats	30 grams	Rye Grass	3 grams
Rye	30 grams	Alsike Clover	2 grams
Speltz	30 grams	Timothy	2 grams
Proso Millet	10 grams	Blue Grass	1 gram
		Red Top	1 gram

THE GERMINATION TEST

Equipment:

1. Granite cake pans approximately nine inches in diameter.
2. Strips of cheap canton flannel approximately six by eighteen inches. Such strips are more satisfactory when torn lengthwise because the edges do not roll.
3. Strips of blotting paper the same size.
4. Sand or soil box.



FIGURE 4. Scattering seeds from a small vial on moist blotting paper.

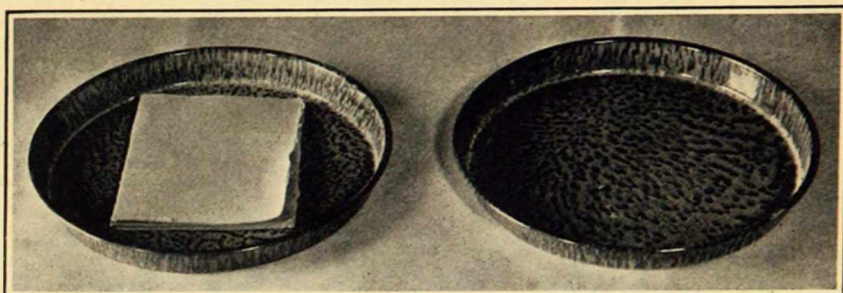


FIGURE 5. After seeds have been carefully placed upon blotter the seeds are covered with the other half of blotter and placed in pan.

5. The modified rag doll. Canton flannel about 12x54 inches. Heavy or glazed wrapping paper same width as cloth, about six inches longer than cloth.

Temperature:

For alfalfa and cereals a temperature of nearly 70° F. as can be maintained is best.

For corn an alternating temperature of approximately 85° F. during the daytime and 70° F. during the night gives quickest and most reliable results.

Moisture:

Seeds should be kept moist by occasional sprinkling but never so wet that cloth or blotter will drip. To avoid introducing moulds and bacteria all materials used should be clean. Dishes should be washed and scalded, cloths should be washed and boiled before using. Blotters should be used only once.

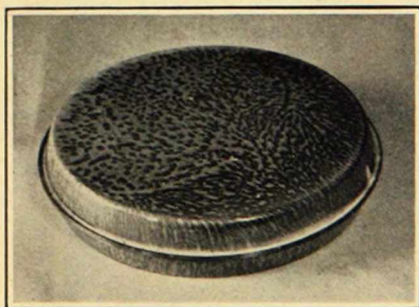


FIGURE 6. Cover with a second pan to keep blotter moist.

MAKING THE GERMINATION TEST

Make duplicate counts of one hundred seeds from the pure seed of the purity test. Fold cloth or blotter twice, moisten thoroughly, open so two thicknesses will be above the seed and two below. Scatter seed evenly over the blotter and cloth, (Figure 4), close blotter and place in a pan, (Figure 5), cover with a similar pan, (Figure 6). The duplicate counts may be placed one on top of the other in the pan.

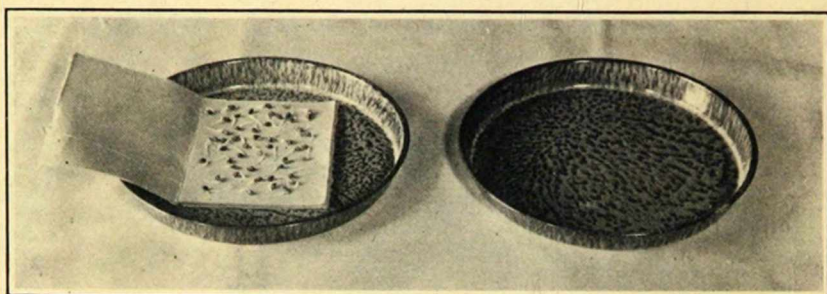


FIGURE 7. Seeds ready for preliminary count.

A third day count should be made of seeds showing good sprouts. (Figure 7). The rest are put back until fifth day or later when a final count is made. Percentage of germination is computed by averaging the total germination of the duplicates.

Large seeds may be planted in sand or soil in a shallow box. (Figure 8).

Seeds should be covered not more than a half inch deep, the surface should be kept moist by occasional sprinkling or a moist cloth. About twice as long a time for germination should be allowed for soil as for blotters or cloth. Corn may be tested by placing heavy cloth over two or three inches of sand in a shallow box. (Figure 9.)

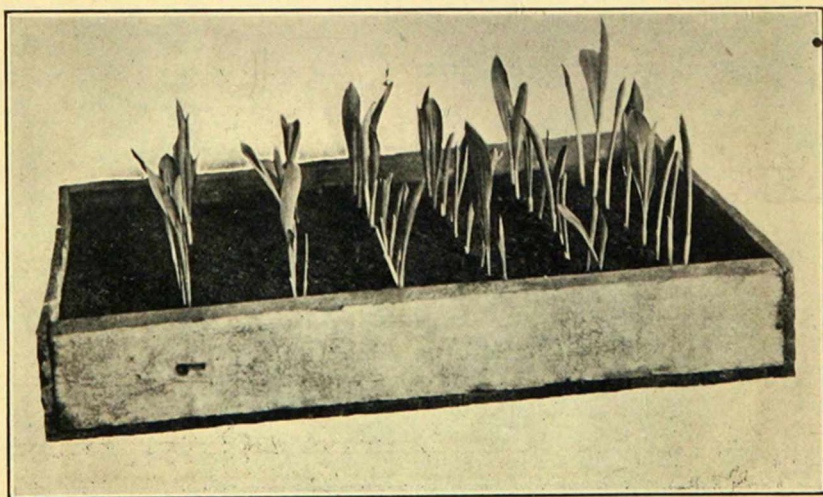


FIGURE 8. The soil flat, may be used for testing the germination of corn, beans, peas, and other large seeds. The flat may be laid off into squares by cross wires attached to the sides of the box, and thus made suitable for the individual ear test of corn.

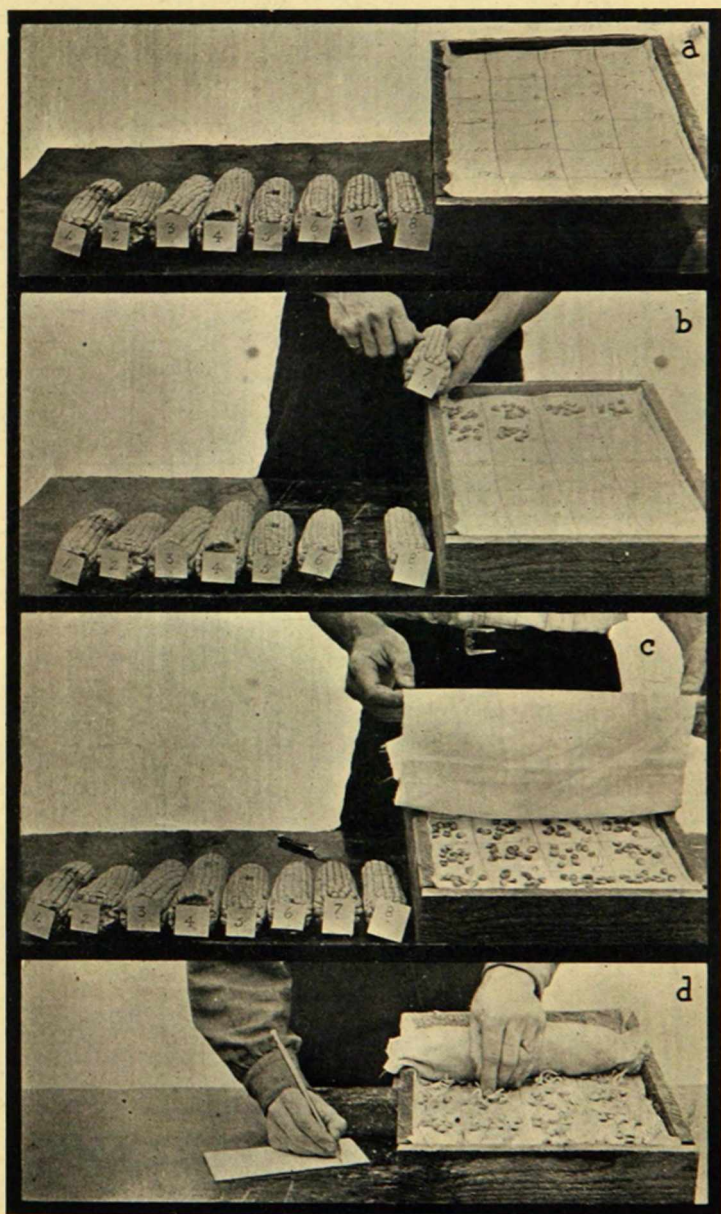


FIGURE 9. The soil flat or box tester, used by many in making individual ear tests of corn. (a) Number the squares on the cloth and ears to correspond; (b) Place the kernels from individual ears on the squares; (c) Cover the seeds with a second layer of canton flannel, moisten, and cover with moist soil or sand; (d) At the proper time, remove the top cloth carefully, count and record the sprouts.

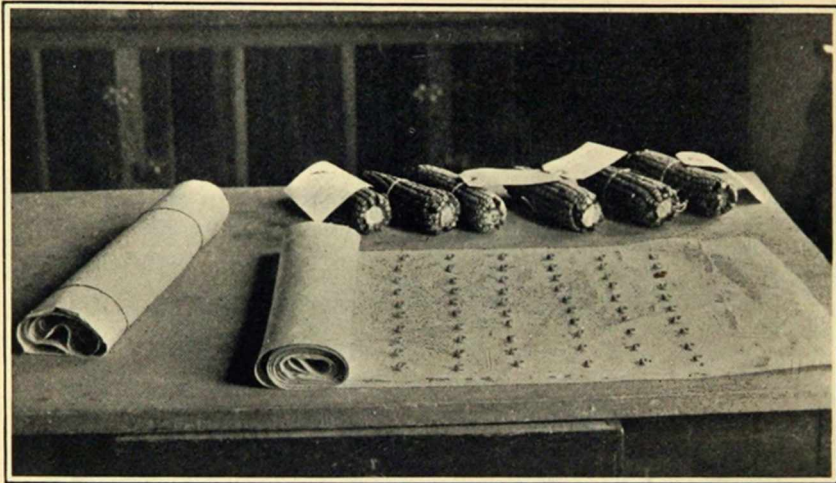


FIGURE 10. The modified rag doll ready for rolling and rolled.

The modified rag doll, devised by Purdue University, is an excellent method for testing corn in the home. It consists of a strip of cloth approximately 12x54 inches, preferably a cheap grade of canton flannel, and a strip of paper 12x60 inches. The paper should be a heavy glazed paper or the heavy fibre paper used by butchers. To make individual ear tests of corn proceed as follows:

Lay the strip of paper on a clean table. Moisten the strip of cloth thoroughly and lay over the paper, edges even, both ends of paper extending beyond the cloth. Lay ten or more grains from each

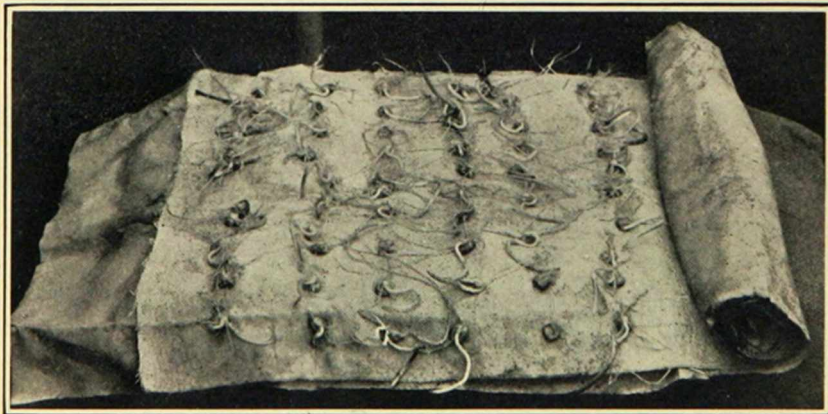


FIGURE 11. Modified rag doll unrolled showing seeds after six days germination

ear in rows crosswise, leaving two inches or more between the rows, each of which represents a single ear. When as many rows as desired have been placed on the cloth, roll carefully, rather loosely, placing a rubber band or string around each end to keep it from unrolling. (Figure 10). Stand the rag doll on end in a deep receptacle, cover with heavy damp cloth, sprinkle the doll from time to time, and keep as nearly as possible 85° F. during the day, 70° F. at night.

At the end of six days unroll and count germination. (Figure 11).

The paper prevents the spread of mould through the doll, and prevents roots from growing through, thus making unrolling and counting easier and more reliable.

Data collected from various well equipped laboratories over a long period of time show that the substrata and temperatures given in the following table give the best results.

SEED	Number of Seeds Used	Temperature	Substratum	COUNT	
				Preliminary	Final
Barley	2 x 100	70°F.	Between blotters	3rd day	5th day
Oats	2 x 100	70°F.	Between blotters	3rd day	5th day
Rye	2 x 100	70°F.	Between blotters	3rd day	5th day
Wheat	2 x 100	70°F.	Between blotters	3rd day	5th day
Alfalfa	2 x 100	70°F.	Between blotters	3rd day	5th day
Alsike Clover	2 x 200	70°F.	Between blotters	3rd day	5th day
Red Clover	2 x 100	70°F.	Between blotters	3rd day	5th day
Sweet Clover	2 x 100	70°F.	Between blotters	3rd day	5th day
Cabbage	2 x 100	70°F.	Between blotters	3rd day	5th day
Cauliflower	2 x 100	70°F.	Between blotters	3rd day	5th day
*Lettuce	2 x 100	70°F.	Between blotters	3rd day	5th day
Radish	2 x 100	70°F.	Between blotters	3rd day	5th day
†Spinach	2 x 100	70°F.	Between blotters	3rd day	5th day
Turnips	2 x 100	70°F.	Between blotters	3rd day	5th day
‡Peas	2 x 100	70°F.	Between cloth	3rd day	5th day
Vetch	2 x 100	70°F.	Between cloth	4th day	8th day
Beans	2 x 100	70°-85° F.	Between cloth	3rd day	6th day
Corn	2 x 100	70°-85° F.	Between cloth	3rd day	6th day
Pumpkin	2 x 100	70°-85° F.	Between cloth	3rd day	6th day
Squash	2 x 100	70°-85° F.	Between cloth	3rd day	6th day
Millet	2 x 100	70°-85° F.	Between blotters	3rd day	6th day
Sorghum	2 x 100	70°-85° F.	Between blotters	3rd day	6th day
Sudan Grass	2 x 100	70°-85° F.	Between blotters	3rd day	6th day
‡Beet	2 x 100	70°-85° F.	Between blotters	4th day	14th day
Carrot	2 x 100	70°-85° F.	Between blotters	6th day	14th day
°Cucumbers	2 x 100	70°-85° F.	Between blotters	3rd day	6th day
*Melons	2 x 100	70°-85° F.	Between blotters	3rd day	6th day
Onions	2 x 100	70°-85° F.	Between blotters	4th day	8th day
Tomatoes	2 x 100	70°-85° F.	Between blotters	4th day	10th day

*Lettuce should be soaked for six hours in water at room temperature before placing in blotter.

† Spinach should be given very little moisture.

‡ Peas and beets should be soaked in water at room temperature six hours before placing in substratum.

° Melons and cucumbers may also be germinated between folds of cloth.

SEED	Number of Seeds Used	Temperature	Substratum	COUNT	
				Preliminary	Final
Celery.....	2 x 100	70°-85° F.	Top of blotter	6th day	21st day
Timothy.....	2 x 200	70°-85° F.	Top of blotter	5th day	7th day

Note—Seeds requiring more than eight days should be counted between the preliminary and final date.

Temperature 70°-85° F. means 70° during the night and 85° during at least eight hours of each day. If it is impossible to keep them up to 85° F. a longer time should be allowed.

When testing legumes a note is made of hard seed per cent at the time of the final count. Hard seeds are those seeds that have taken up no water and have failed to show any change whatever during the period of germination.

Duplicate tests of 100 seeds of each are placed on top of each other. When seeds are placed on top of blotters, the blotters are laid side by side.

SUMMARY

1. Weed seeds are costly to the farmer in price paid for them and in loss of value in crop grown.
2. To prevent loss from weeds only clean seed should be planted.
3. Equipment for making purity and germination tests may be very simple and inexpensive.
4. The work of testing seeds is interesting and instructive.
5. Practical tests of seeds may be successfully made in the home and school.

In 1917, the Twenty-first General Assembly of Colorado passed an act known as the Colorado Pure Seed Law. The law was amended in 1921. This law regulates the sale and importation of seed; it also provides for a state seed-testing laboratory, and make appropriations of money for carrying on the work of the laboratory. The chief provision of the law is the one which requires that all field seeds sold, offered or exposed for sale, within Colorado, for seeding purposes in the State in lots of five pounds or more shall be labeled. This label shall give the following.

1. Kind of seed.
2. Percentage of purity.
3. Percentage of germination.
4. Date of germination test.
5. Place where seed was grown, and locality, if in Colorado.

6. Name and number per pound of each noxious weed seed in excess of 90 seeds per pound.

7. Name and address of salesman.

The act provides that any citizen of Colorado, or any person shipping seed into Colorado for seeding purposes in the State, may send samples of seeds to the seed laboratory of the Agricultural Experiment Station for test and analysis. The tests and analyses are made free of charge. Send a good two handfuls of seed, wrapping them well, and addressing them to Seed Laboratory, Colorado Agricultural College, Fort Collins, Colorado.

PUPIL'S RECORD OF GERMINATION

SCHOOL DISTRICT No. TEACHER

Kind of Seed Variety

Owner of Seed

Teacher's Number of Seed

Kind of Tester

Test Begun (Date)

Number of sprouts at the end of days (preliminary)

Number of sprouts at the end of days (final)

Number of hard seeds (in the case of legumes)

Individual Ear Test of Corn

Ear No. 1 Ear No. 6

Ear No. 2 Ear No. 7

Ear No. 3 Ear No. 8

Ear No. 4 Ear No. 9

Ear No. 5 Ear No. 10

Tested by

NOTE: If the teacher gives out the samples by number, the name of the owner of seed will not, of course, be entered on the Record.

PUPIL'S RECORD OF PURITY

SCHOOL DISTRICT No. TEACHER

Kind of Seed Variety

Owner of Seed

Teacher's Number of Seed

Per cent Pure Seed Per cent Other Seeds

Per cent Inert Matter (sticks, stones, chaff, etc.)

Foreign seeds in sample

.....

.....

.....

Analyzed by

NOTE: If the teacher gives out the samples by number, the name of the owner of the seed will not, of course, be entered on the Record.

