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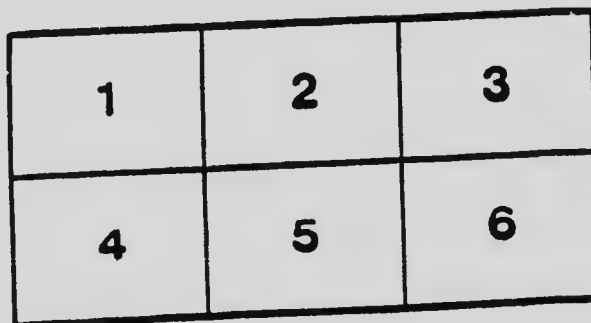
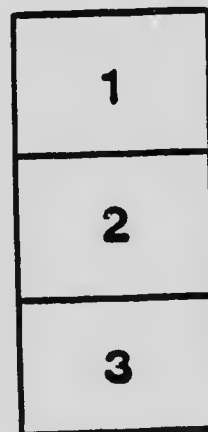
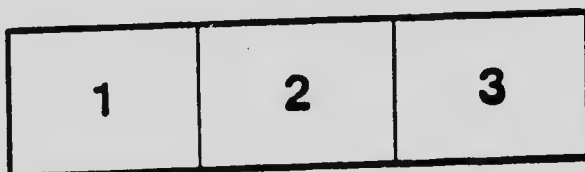
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DOMINION DEPARTMENT OF AGRICULTURE.

SEED BRANCH.

PAMPHLET No. S-2.

September, 1918.



RED CLOVER SEED

AND ITS IMPURITIES.

BY

JOHN R. DYMOND, B.A. *Seed Analyst.*

Considerable quantities of red clover seed are harvested in Canada, chiefly in Ontario and Quebec, each year. Much of this seed contains large numbers of weed seeds.

The SEED CONTROL ACT prohibits the sale of red clover seed (except for the purpose of being re-cleaned) if it contains more than 80 seeds of noxious weeds or 400 of all kinds of weed seeds per ounce, including noxious and other useless or harmful sorts.

There are only a few kinds of weed seeds which are commonly found in red clover seed in quantities sufficient to cause it to be prohibited from sale. Some kinds of weed seeds can easily be removed by cleaning if proper sieves are used, but others are so similar in size and weight to the clover seed that they are difficult or impossible to separate except by screening or blowing out a good deal of the clover seed with them.

The production of clean seed requires the adoption of a system of crop rotation and soil treatment that will keep weeds in check and produce conditions favourable to the growth of the clover plant.

Published by authority of Hon. T. A. CRERAR, Minister of Agriculture, Ottawa, Ont.

46006—1

APPLICATION OF THE SEED CONTROL ACT.

Section Seven of the Act requires that timothy, red clover, alfalfa and alsike seed, when sold for seeding be graded and the grade name, Extra No. 1, No. 1, No. 2, or No. 3, marked in a plain and indelible manner on each bag or on a label attached thereto. A farmer is not required to mark the grade on seed that is grown, sold and delivered on his own premises for seeding by the purchaser himself, but he cannot legally sell in this way any seed which is below the standard grade No. 3.

The Maximum Number of Weed Seeds per ounce permitted in the different grades of timothy, red clover, alfalfa and alsike is as follows:—

Kind of Seed.	Extra No. 1.		No. 1.		No. 2.		No. 3.	
	Weed Seeds per Ounce.		Weed Seeds per Ounce.		Weed Seeds per Ounce.		Weed Seeds per Ounce.	
	Noxious.	Total.	Noxious.	Total.	Noxious.	Total.	Noxious.	Total.
Timothy, Red Clover and Alfalfa.....	0	30	5	100	20	200	80	400
Alsike.....	0	30	10	100	40	200	160	400

Rejected Seed. Section 9 of the Act forbids the sale for seeding purposes of timothy, red clover, alsike, or alfalfa seed containing more weed seeds than are allowed in grade No. 3. Such seed is graded "Rejected" and may not be legally sold except to seed merchants for the purpose of being recleaned. This applies to farmers as well as to dealers. Any one selling rejected seed except for recleaning is guilty of a violation of the Act and is liable to prosecution.

Noxious Weeds. The species of farm weeds which are for the purpose of this Act included within the meaning of the term "noxious weeds" are as follows:—

Wild Oats (*Avena fatua* L.), Common Darnel (*Lolium temulentum* L.) Docks (*Rumex* species), Purple Cockle (*Agrostemma Githago* L.), Campions, including White Cockle (*Lychnis alba* Mill). Night-flowering Catchfly (*Silene noctiflora* L.) and Bladder Champion (*Silene latifolia* Mill) Britten & Rendle), Cow Cockle (*Saponaria Vaccaria* L.), Stinkweed (*Thlaspi* species) False Flax (*Camelina* species), Ball Mustard (*Neslie paniculata* (L.) Link.) Wild Radish (*Raphanus Raphanistrum* L.), Wild Mustard (*Brassica arvensis* (L.) Cz. & C. (Cz.) and other wild Brassica species, Hare's-ear Mustard (*Conringia* species) (L.) Dumort), Tumbling Mustard (*Sisymbrium altissimum* L.), Wild Carrot (*Daucus Carota* L.), Field Bindweed (*Convolvulus arvensis* L.) Dodder (*Cuscuta* species) in alfalfa seed, Blue Bur or Stickseed (*Lappula echinata* Gilibert), Blue-weed (*Echium vulgare* L.) Ribgrass (*Plantago lanceolata* L.), Ragweeds (*Ambrosia* species), Ox-eye Daisy (*Chrysanthemum Leucanthemum* L.), Canada Thistle (*Cirsium arvense* (L.) Scop.), Chicory (*Cichorium Intybus* L.), Sow Thistle (*Sonchus* species).

Germination Requirements. Section 10 requires that when seed will not germinate in the proportion of $\frac{1}{3}$ of the percentage standard for good seed of the kind, the bags containing it or labels securely attached to them must be marked with the percentage of seeds that are capable of germination. The percentage standard of vitality for good seed in the case of clovers is 95 per cent.

RED CLOVER SEED

AND ITS IMPURITIES.

IMPORTANCE OF THE CLOVER CROP.

From the standpoint of maintaining soil fertility, there is no more important crop than red clover in those parts of Canada where it may be successfully grown. It is unexcelled as a forage plant and has great value as a soil renovator. By the proper use of clover in rotations it is possible permanently to maintain the supply of nitrogen in the soil. The value of clovers and other leguminous plants as soil improvers is due to their ability to use the free nitrogen of the air through the agency of bacteria living in the little tubercles on their roots.

CANADIAN-GROWN RED CLOVER SEED.

Success in clover growing is much more certain if Canadian-grown seed is used. Imported seed, especially from a southern country, is likely to have been produced by varieties too tender for the Canadian winter. When Canadian-grown seed is used the risk of losing part of the crop from winter-killing is very much less than with imported seed.

One factor that discourages the production and use of Canadian-grown seed is that so much of it has a high weed seed content. This condition to a great extent, is due to the fact that the area of cultivated land per agricultural worker in Canada is very high.

It is quite possible, however, to improve the purity of our seed without materially increasing the labour applied to its production if correct principles are understood and applied.

Weed Seeds Lower the Value of Seed by making it necessary to waste so much of the clover seed to remove them. Some weed seeds are about the same size as the smaller clover seeds and to take them out, much small seed must be wasted. Other weeds have seeds that are the size of the larger clover seeds. To eliminate these, much of the plumpest and best clover seed must be sacrificed. If No. 1 seed is selling at \$12 a bushel, a rejected sample that must be reduced by one half to make it No. 1 will be worth much less than \$6, as the time, labour, power, etc., to clean it must be taken into consideration as well as the dockage. Indeed, few rejected samples could be cleaned to No. 1. If, after reducing a lot of seed by $\frac{1}{2}$ or $\frac{2}{3}$, it will grade only No. 3, its original value must be quite low since this grade is in small demand and consequently sells at a price considerably below that for No. 1. Some lots of rejected seed cannot be made saleable by any amount of cleaning. Clover that will yield such seed should never be left for seed.

The weeds that cause trouble in clover seed production are not, as a rule, those which are seriously injurious to ordinary crops, and for this reason farmers are not in the habit of giving them much attention.* Most of them are weeds that grow up from seeds during the summer, mature seeds in the fall about the time clover seed ripens, and then die. A few live two or three or more years. They make a start during the year the clover is seeded, live through the winter and are ready to produce seeds the next year, and in many cases every subsequent year until the field is broken up and the plants destroyed.

* Occasional lots of clover seed contain the seeds of such weeds as wild mustard, bladder campion or other serious pests. It is never safe to use seed whose weed seed content is not known.

Two classes of weeds are injurious in growing clover seed. The first are those whose seeds are in the soil ready to grow if the clover fails to make a good stand. In spots where the clover has been killed out or makes a thin stand, they will grow and produce seeds to pollute the clover seed crop. An even, vigorous stand of clover throughout, either smothers out this class of weeds or prevents their seeds from germinating.

There is another class of weeds, however, which are able to compete more or less successfully with the clover plants and therefore occur wherever they have been introduced and allowed to spread. A good stand of clover tends to hold them in check, but not to the same extent that it does those of the first class. Once introduced into a field, weeds of this second class grow in the clover seed crop until they have been destroyed by proper cultivation and crop rotation.

Weeds of the second class include ribgrass, high flowering catchfly, wild carrot, and black medick.

To prevent weeds from maturing seeds in clover seed crops the following precautions must be taken:—

1. *Eradicate ribgrass, catchfly, black medick and wild carrot* before the clover is seeded.

2. *An even, vigorous stand of the clover seed crop* will keep down green foxtail, plantain, lamb's quarters, ragweed, docks, etc. (See instructions for securing a good stand of clover on page 15.)

There are always plenty of seeds in the soil ready to produce weeds to occupy space where through any cause cultivated plants fail to make a good stand.

3. *If the first crop of clover is taken for hay, cut it as early as possible.* If this is done, the second crop is not only able to get a good start towards producing such a stand as will keep the weeds in check but it is ready to be cut for seed before some of the weeds are sufficiently matured to cause trouble.

4. *Weedy patches should be cut green* or if allowed to mature, should not be raked up and included with the crop drawn in and threshed for seed. Wherever the clover fails, weeds usually grow profusely and it is these spots in a field that often contribute largely towards the impurities found in the threshed seed.



Photo by F. C. Nunnick.

Fig. 1. The clover seed crop is cut in a variety of ways, but it is best to use some means of bunching it or leaving it in windrows so that it is not driven over as it is cut. The device here shown consists of a table of boards attached to the rear of the cutting bar by means of wires fastened through holes drilled in the bar. The table is allowed to drag and a man follows to keep the clover pulled back from the bar and to rake it off in windrows as shown in the figure.

When the clover is tall it may be cut by the binder. Two upright wind boards which help to hold the straw in, when the sheaf is made, and which fall down flat to permit the sheaf being kicked out, are taken off or securely fastened down and the sheaf trip is removed so that the clover as it is elevated, instead of being tied into bundles, simply passes on to the stubble in a continuous stream.



Photo by F. C. Nunnick.

Fig. 2. A clover huller is the best machine for threshing clover seed, but the ordinary grain thresher is often used. For threshing clover seed, the ordinary threshing machine is boarded up in front of the cylinder with the exception of about eight inches at the left. The back of the cylinder is boarded up in a like manner leaving about eight inches open on the right. The concave is placed close up to the cylinder which is run fairly fast. It is best to thresh in dry, frosty weather.

DESCRIPTION OF WEED SEEDS FOUND IN CLOVER SEED.*

WITH NOTES ON THEIR RELATIVE PREVALENCE.

Of every one hundred samples of Canadian-grown red clover seed examined at the Ottawa Seed Laboratory, about fifteen are rejected, thirty grade No. 3, forty No. 2, and fifteen No. 1. The following weed seeds are most commonly found and occur in the number of samples indicated: *Noxious weed seeds*: Ribgrass 60, ragweed 35, docks 30, catchfly 25, Canada thistle 10, stickseed 3, wild carrot 3; *other sorts*: green foxtail 65, pale plantain 40, lady's thumb 35, lamb's quarters 30, black medick 25, yellow foxtail 15, sheep sorrel 15, sweet clover 15, common plantain 10, mayweed 10.

Ragweed (*Ambrosia artemisiifolia* L.) seed occurs in three conditions in clover seed. (see illustration page 7). 1. Pear-shaped, $\frac{1}{2}$ to $\frac{1}{4}$ of an inch long, the apex long and tapering to a sharp point, often with a circle of sharp teeth pointing toward the apex. 2. Outer covering removed, showing a smooth brown, inner cover. 3. With the inner covering removed revealing the greenish white, nearly round inside. Only one quarter of the hulled seeds are counted in determining the number of impurities in seed.

In its natural condition ragweed seed is larger than clover seed, but in threshing, the hulls are removed and the greenish hulled seeds are almost identical in size with the clover.

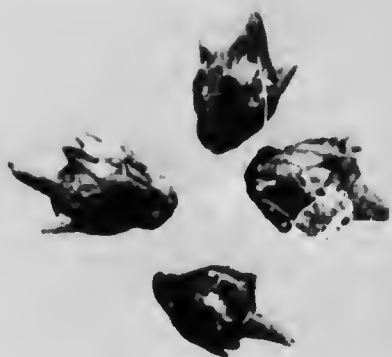
Stubble land where this weed is prevalent should be shallow-ploughed directly after harvest, or, if seeded to grass and clover, the autumn growth should be clipped with a mowing machine within two weeks after the grain crop is cut. As the plant is such a late seeder, hoed crops require special attention occasionally after general cultivation is discontinued. Lands badly infested should be put under a three-year rotation of crops, with prompt and thorough cultivation or mowing in early autumn after the crops have been removed.

RIBGRASS or buckhorn (*Plantago lanceolata* L.), $\frac{1}{10}$ inch long, chestnut brown and highly polished, boat-shaped with rounded ends. In cleaning, it turns on end and goes through the same size perforation as red clover. Many of the smaller seeds may be separated from clover by the 4 by 24 woven wire sieve. The larger seeds cannot be removed by sieves in ordinary cleaning machinery. The plant often lives for a number of years, and, as it seeds freely, spreads rapidly in fields not under cultivation; easily suppressed by hoed crops and short rotation.

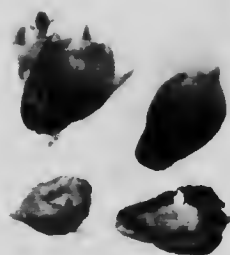
Docks (*Rumex species*), including Curled Dock (*Rumex crispus* L.) Bitter Dock (*Rumex obtusifolius* L.) and Clustered Dock (*Rumex conglomeratus* Murr). The seeds are very similar in appearance, $\frac{1}{2}$ inch long, shaped like miniature beech-nuts. The prevalence of docks in meadows is due to sowing contaminated grass and clover seeds. Land worked under a short rotation of crops is never badly infested with docks. When the soil is soft after continued rain they can be pulled from meadows and pastures.

Night-flowering Catchfly (*Silene noctiflora* L.), round kidney-shaped, $\frac{1}{20}$ inch in diameter, covered with cone-shaped tubercles; grayish-brown in colour; seeds difficult to separate from grass and clover seeds, especially from alsike. Even slightly infested fields should be ploughed up and worked under a short rotation of crops. Hand-pull to prevent seeding and consequent rapid spread of the weeds. Sow only pure seed.

* The descriptions of the weed seeds and much of the information on weeds contained in this pamphlet have been taken from "Farm Weeds of Canada" by Geo. H. Clark, B.S.A., and James Fletcher, LL.D., F.R.S.C., F.L.S.



Ragweed (*Ambrosia artemisiifolia* L.)



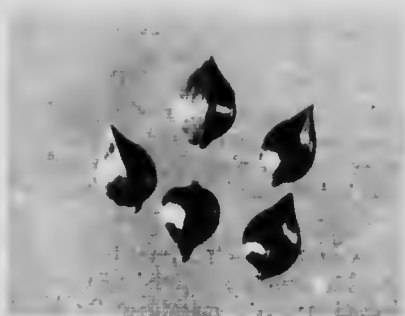
Successive stages in hulling of seed
of Ragweed.



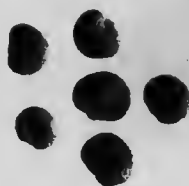
Red Clover (*Trifolium pratense* L.)



Ribwort (*Plantago lanceolata* L.)



Docks (*Rumex* species).



Night-flowering Catchfly (*Silene noctiflora* L.)

PLATE I.

Photos by H. B. Sifton

Green Foxtail (*Setaria viridis* (L.) Beauv), the most prevalent impurity in Canadian-grown clover seed. Seed colour very variable according to the degree of ripeness; yellow, grey, brown or purplish, the darker seeds mottled with dark spots. The kernel is greenish-white, convex on the outer face, which bears the germ, and flattened on the inner face. Some of the lighter seeds may be blown out in cleaning, but most of them are impossible of separation by the average fanning mill.

This plant seeds profusely from harvest to late autumn in cereal stubble lands, hoed crops, new meadows and clover seed crops. Thick seeding with clovers and grasses will help to suppress foxtail in the autumn stubble and subsequent clover crop. In clover seed crops the patches that have been winter-killed should be mown while the foxtail is still green. The cut thus taken may be of value as fodder. Bare stubble should be ploughed shallow or disced to prevent the further ripening of seed directly after the grain crop is removed. Any practice that will prevent this annual from seeding will reduce and ultimately eradicate it. **Yellow Foxtail** (*Setaria glauca* (L.) Beauv) seeds are similar to those of green foxtail only larger.

Sheep Sorrel (*Rumex Acetosella* L.). The seeds, as they occur in clover seed, are generally covered by the three larger, conspicuously-veined calyx divisions which fit closely over the seed. The naked seed, when the calyx divisions are removed, is $\frac{1}{20}$ of an inch long, resembling docks in shape; pale brown, shining.

Sheep sorrel is able to thrive on land where clover cannot grow. On this account it is found where, for some reason, the clover makes a thin stand or is killed out entirely. On acid or sour soil clover either fails to grow or grows thinly. The sorrel, however, is able to grow on such soil and takes the place of the clover. Prevalence of sheep sorrel, therefore, indicates an unfavourable soil condition. See page 15 for suggestions on correcting soil acidity.

Pale Plantain (*Plantago Rugelii* DCne). This impurity is easily removed by cleaning over the sieve recommended for ribgrass. The seed is black, angular in outline, not very thick through. Hoed crops every four years will keep plantains in check. Working with a broad-shared cultivator, followed by a harrow to drag the plants with their fibrous roots to the surface is recommended for spring cultivation.

Common Plantain (*Plantago major* L.) seeds are smaller than those of pale plantain and greenish-brown in colour.

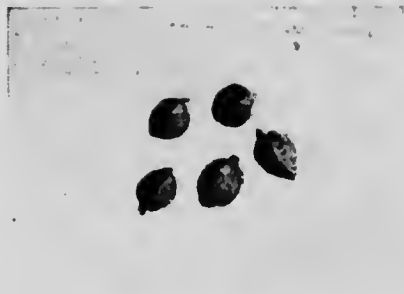
Black Medick (*Medicago lupulina* L.), a leguminous plant, often sown in Europe as a pasture crop. In red clover and alsike it should be considered as a weed as it matures earlier and the stems are hard and woody when the clover is ready to cut for hay. The seed is about $\frac{1}{8}$ of an inch long, hard, smooth and somewhat shining, egg-shaped rather than kidney-shaped, yellow to pale olive green. It has a sharp projection near the scar from which a light line runs towards the larger end of the seed.

The plant is an annual and may be eradicated by any means that will prevent its forming seeds. Thick seeding to more valuable leguminous plants will help crowd it out. The seed retains its vitality for some time and so the plant is apt to make its appearance for a number of years in fields where it has been allowed to mature its seeds.

Lamb's Quarters (*Chenopodium album* L.) about $\frac{1}{20}$ of an inch in diameter, circular in outline, more or less flattened on one side, strongly convex on the other, edges bluntly rounded, the lower convex face grooved from the margin to the central scar, minutely wrinkled; colour, shining black. The seeds, as found among crop seeds, have a thin envelope closely adhering to them, as a brown or grey mealy deposit, which gives them a granular-roughened appearance; they also often have the dried 5-angled calyx closed tightly over them. Small seeds are removed from red clover by 4 by 24 screen.



Green Foxtail (*Setaria viridis* (L.) Beauv.)



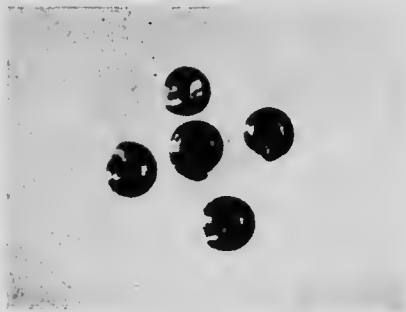
Sheep Sorrel (*Rumex Acetosella* L.)



Pale Plantain (*Plantago Rugelii* Dene.)



Black Medick (*Medicago lupulina* L.)



Lamb's Quarters (*Chenopodium album* L.)



Lady's Thumb (*Polygonum Persicaria* L.)

PLATE II.

Photos by H. B. Sifton.

Lady's Thumb (*Polygonum Persicaria* L.), about 1/12 inch in diameter, heart-shaped, hollowed out on one side or roundly triangular, jet black, shining. Many are removed from red clover seed by cleaning over 4 by 24 woven wire screen. This plant is not seriously noxious in most field and garden crops. By cutting the plants two or three times during the season for a few years this weed may be eliminated from waste places.

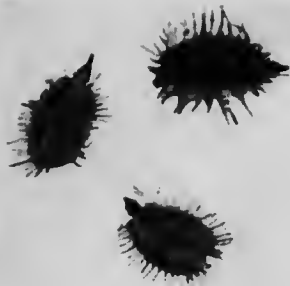
Stickseed (*Lappula echinata* Gilibert) and **Wild Carrot** (*Daucus Carota* L.) while not common, are very objectionable impurities, and seed containing either should be avoided.

Canada Thistle (*Cirsium arvense* (L) Scop.), the seed is 1/8 of an inch long, light brown, smooth, somewhat flattened and curved, marked with faint longitudinal lines; the top is nearly round, flat, and has a narrow rim with a small cone-shaped point in the centre.

Chicory (*Cichorium Intybus* L.), sometimes found in Quebec red clover. The seed is 1/4-inch long, dark brown or straw-coloured, mottled with brown; wedge-shaped obtusely 3- to 5-angled, sometimes much curved; the surface grooved and ridged from top to bottom and roughened crosswise with minute, close, raised and waved lines; at the top surrounding the apical scar, is a fringe of short, flat, white bristles. A short rotation of crops will soon suppress chicory.

Sweet Clovers (*Melilotus species*). **White Sweet Clover** (*Melilotus alba* Desr.) is much more prevalent than the yellow species. The seed is hard, small, 1/4 of an inch in length, smooth, dull yellow, evenly egg-shaped with a V-shaped, light mark running from the scar. Although it has some value as a forage crop when used alone, in red clover it is to be considered as a weed. A three-year rotation of crops including a well-cared-for hoed crop is recommended to suppress this plant.

Mayweed (*Anthemis Cotula* L.), occurs in large numbers in some samples. Seed is 1/4-inch long, oblong, cut off straight at the upper end, with a small knob in the centre; the smaller end abruptly pointed; the surface roughened with tubercles arranged more or less symmetrically in about 10 longitudinal rows; sometimes the surface is nearly smooth. The 4 by 24 screen will remove many of these seeds from clover seed.



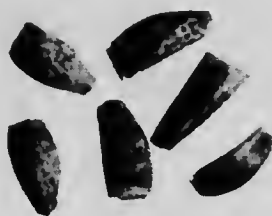
Wild Carrot (*Daucus Carota* L.)



Blue Bur or Stickseed (*Lappula echinata* Gilibert)



Canada Thistle (*Cirsium arvense* L.) Scop.)



Chicory (*Cichorium Intybus* L.)



Sweet Clover (*Melilotus* species)



Stinking Mayweed (*Anthemis Cotula* L.)

PLATE III.

Photos by H. B. Sifton.

CLEANING RED CLOVER SEED.*

The seeds of many of the weeds that grow in red clover and ripen at the same time are of such size that they are difficult or impossible to remove by sieves in an ordinary fanning mill. Few fanning mills are fully equipped with sieves for cleaning small seeds; indeed, most of them are not designed for this work. However, seed that contains a very large number of small weed seeds or that contains only a few more weed seeds than are permitted in seed that may be legally sold under the Seed Control Act may often be cleaned to grade without heavy dockage, provided the proper sieve is available.

If there is a properly equipped and operated power cleaner within a reasonable distance it will usually pay to have seed cleaned by it.

For cleaning small quantities, hand sieves may be found to be most satisfactory and economical.

A sample usually contains few weed seeds larger than the clover seed. Ragweed if none of the outer hulls has been removed in threshing, should be separated from the clover by a $\frac{1}{16}$ -inch perforated zinc riddle (fig. 4). Sticks, pieces of straw and anything larger than the clover run over this sieve.

A long mesh woven wire screen is better than one made of square mesh wire cloth for cleaning red clover seed. The 4 by 24 (fig. 3) is often employed for this purpose, but the exact mesh required will depend on the size of the clover seed and the kind of impurities to be removed. A long mesh sieve will hold all the good clover, allowing the smaller impurities to pass through. This sieve, assisted by the air blast, should take out practically all of the pale plantain, much of the mayweed and lamb's quarters, and many of the ribgrass as well as shrunken clover seeds. Besides the 4 by 24 sieve, the 4 by 25, 4 by 26, 4 by 28, 6 by 28, etc., are also recommended as lower sieves for cleaning red clover, their efficiency depending upon the size of the seeds composing the sample.

The 22 by 22 woven wire screen is very useful in the lower shoe for taking out sheep sorrel and seeds only slightly smaller than the clover. In some cases the 20 by 20 or 18 by 18 may be required, but this will allow considerable of the smaller clover to pass through.

Hulled ragweed, docks, catchfly, foxtail and black medick are very nearly the size of clover and are impossible to remove by means of an ordinary fanning mill. Fields must be cleaned of these weeds before clover seed can be grown with profit.

* Seed Branch Pamphlet No. 1 on "Cleaning Seed" deals with the cleaning of all kinds of seed and grain. It contains illustrations of nine different kinds of perforated zinc and woven wire sieves commonly used in cleaning seed. Copies may be had from the Publications Branch, Department of Agriculture, Ottawa.

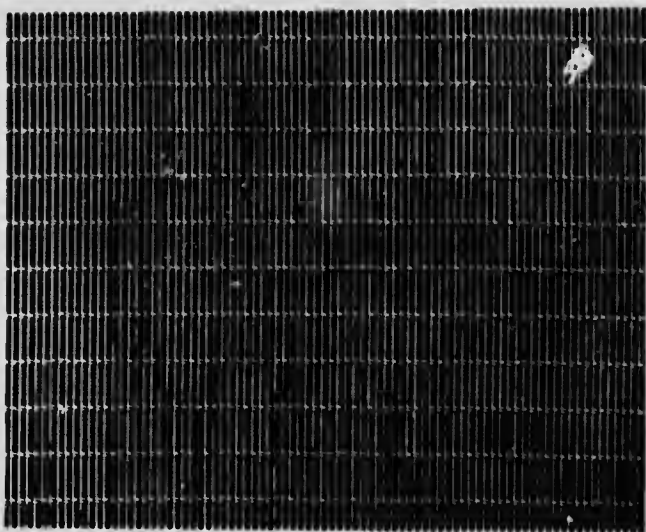


Fig. 3.—Four by twenty-four woven wire sieve, containing four wires to the inch one way and twenty-four the other, is the type of screen used in cleaning red clover seed. Shrunken clover seeds, ribgrass, and the smaller weed seeds pass through the oblong openings while the plump seed remains above.

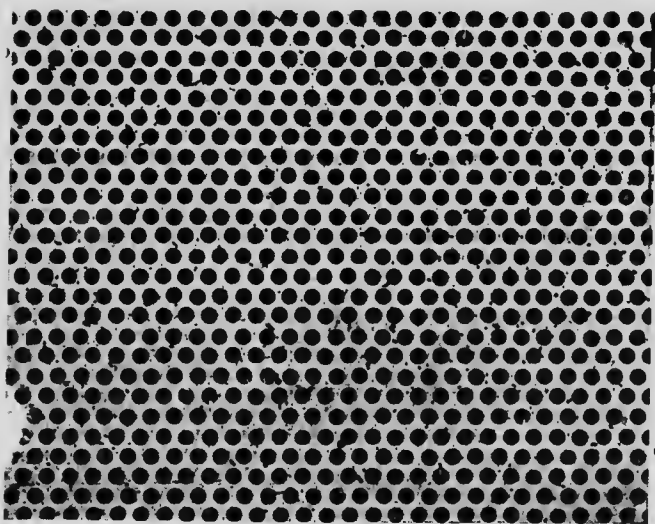


Fig. 4.—One-fifteenth-inch perforated zinc sieve—perforations $\frac{1}{16}$ -inch in diameter, used as a riddle or upper sieve for cleaning red clover.

WEED ERADICATION.*

To combat Weeds one should know their life histories, that is, how they are propagated, the nature of their root systems, when their seeds mature, how long they live, etc. Each weed has its own way of winning in its struggle with the farmer's crops, and its habits must be learned in order to know how to get the better of it.

In studying the life history of weeds they are usually considered in groups or classes according to the length of time they live: as annuals, biennials and perennials.

ANNUALS.

Examples, green foxtail, ragweed.

Annual weeds complete their entire life history in one year. The seeds produced during the late summer or autumn lie dormant in the soil over winter and germinate in spring, blossom, mature their seeds and then die, root and all. Some plants that complete their life-cycle in a year are known as *winter annuals*; the seeds that have matured during the summer germinate in the fall, make a certain growth before winter sets in, complete their development and mature their seeds the next summer.

Annuals may be eradicated from land, however badly infested it may be, through any method by which germination is hastened and the young plants destroyed before they produce seed. The weeds of this class that give trouble in clover seed crops are those whose seeds ripen in the fall, at the time red clover seed matures. They make little growth in the early summer, shooting up unmolested after harvest when other farm work is so pressing, and producing seeds that are returned to the soil to lie dormant until conditions are favourable for their growth a year or more in the future.

To reduce the number of these weed seeds in the soil bare stubbles should have surface cultivation directly after harvest to prevent the further ripening of seed as soon as the grain crop is removed, and to encourage the germination of seeds already in the soil. The young plants that start from the seeds brought to the surface by cultivation may be killed by the harrow or ploughed under. In hoed crops, tillage should be continued late, as it is the plants that bloom and fruit after cultivation has ceased which are most likely to pollute the land. The hoe should be used to destroy late plants after cultivation of the crops becomes impracticable. Any practice that will prevent an annual weed from seeding will reduce and ultimately eradicate it. Fields seeded to clover should be clipped with a mowing machine a few weeks after the nurse crop is harvested to prevent the seeding of autumn weeds.

BIENNIALS.

Example, wild carrot.

Biennials require two seasons to complete their growth, the first being spent in collecting and storing up a supply of nourishment, which is used the second season in producing flowers and seeds. Biennials must be either cut or ploughed down before they flower. Mowing at short intervals in the second year, so as to prevent the development of new seeds, will clear the land of this class of plants; but a single mowing will only induce them to send out lateral branches, which, if not cut, will mature many seeds. Where ploughing is impracticable, such plants should be cut off below the crown of the root.

* Pamphlets containing illustrations and descriptions of the following weeds with suggestions for their eradication may be had on application to the Publications Branch, Department of Agriculture, Ottawa: Ribgrass, ragweed, night-flowering catchfly, green foxtail, black medick, sheep sorrel, plantain, upright cinquefoil.

PERENNIALS.

Exa. . . , Canada thistle, ribgrass, docks, sheep sorrel, plantain.

Perennials are plants that live for many years. They are propagated in several ways, but all produce seeds. Annuals and biennials, which live only one or two years and are reproduced only by seeds, may be eradicated by preventing them from maturing their seeds, but in combating perennials it is necessary to destroy the plant. On account of the variety of life-habits of the plants belonging to this class, no general treatment for their eradication can be given except that fields in which they are prevalent must be broken up and worked under a crop rotation that provides opportunities of attacking the weeds when they are most easily injured. Methods of eradicating the different weeds belonging to this class are outlined in circulars describing individual weeds. See footnote page 14.

GETTING A STAND OF CLOVER.

One of the best means of producing clean seed is to secure a good stand of the clover crop. On many farms clover once grew luxuriantly where it is now very difficult if not impossible to get a stand. The longer land is allowed to run without securing a good catch of clover, the more difficult it is to get a stand. This condition should be given serious attention and every possible means used to get red clover back into the rotation.

The chief causes of clover failures are soil acidity and depletion of the humus content of the soil. Another common cause of clover failure is the heaving of fields in spring through alternate thawing and freezing of water-soaked soil. This may be minimized by proper drainage. Other causes of winter-killing are:—

- (1) Plants going into the winter in a weak condition or with too much growth.
- (2) Exposed position of fields.
- (3) Water lying in pockets.
- (4) Wet weather on bared soil, followed by cold winds or formation of ice.

To ensure a stand of clover the following precautions should be taken:—

- (1) See that the land is well drained; fill up pockets by levelling.
- (2) Correct acidity by application of lime. For further information in this connection apply to Publications Branch, Department of Agriculture, Ottawa, for copies of Ex. Circular No. 86 and Bulletin No. 80 on "Lime in Agriculture."
- (3) Get some humus into soil by manuring.
- (4) Inoculate the seed with nitroculture.*
- (5) Sow nurse crop thin and if season is dry, cut it green.
- (6) Avoid pasturing new seeding. The young plants are easily killed by tramping in wet weather. Pasturing with sheep or horses, which graze closely, should never be practised.
- (7) Clipping with a mowing machine soon after the nurse crop is harvested stimulates the branching and stooling of the clover and encourages root development, thus ensuring a better stand and a more uniform growth the following spring. It is important, however, that this be done in plenty of time to ensure a good top growth for winter protection. After such autumn clipping the meadow should never be pastured.
- (8) A light dressing of manure applied to a weak stand will often bring it through the winter in good condition.
- (9) Early the following spring, if the land is sufficiently well drained, the use of a heavy roller is often beneficial. It packs the earth around the roots of plants that may have been partially lifted out of the soil by alternate thawing and freezing.

* For further information consult the Division of Botany, Central Experimental Farm, Ottawa. Various agricultural colleges sell nitroculture at practically the cost of preparation.

(11) Use only Canadian-grown seed. The experience of thousands of farmers, that southern-grown seed produces a crop less able to withstand the rigours of our severe winters, has been corroborated by scientifically conducted experiments in which the best crops of red clover were realized when Canadian-grown seed was used.

Advantages of Canadian-grown Seed. Seed grown in a mild climate, although an excellent looking sample, is less desirable for regions where the winters are severe than inferior looking, acclimated seed. Northern-grown seed of a hardy strain containing considerable numbers of weed seeds may give a cleaner stand than less hardy seed free from weed seeds, for the reason that the hardy seed may survive the winter and give a heavy stand of strong plants that will choke out the weeds. Where the crop winter-kills, it is the common experience that weeds are always ready to come up. Imported seed often contains seeds of weeds new to the district, whereas the impurities of home-grown seed are usually those already common.

The preparation of the soil* prior to seeding with grasses and clovers is usually intended primarily for the benefit of the nurse crop. To get a good catch, it is important that the surface soil be of fine tith, friable, well-drained and contain a liberal supply of decaying vegetable matter. If the soil lacks humus and a hard crust is formed over its surface, growth will be stunted and the young plants will suffer from even a few hot, dry days.

Seeding to clover should follow a cleaning crop that has had deep and thorough cultivation. The suppression of perennial weeds should precede the making of a meadow. Such a location as a clayey hillside, where the soil is apt to become hard after heavy rains, may be greatly improved by a light top-dressing of rotted stable manure, which should be incorporated with the surface soil by harrowing.

Nurse crops* are designed, in part at least, for the protection of seedling plants of grasses and clovers. When all the soil moisture does not have to be saved for the meadow, a light nurse crop screens the seedlings from the burning heat of the sun; it helps to suppress weeds until the clover has sufficient vigour to compete with them; and it may give a return from the land while the meadow is developing. Wheat or barley is generally considered most satisfactory as a nurse crop. Oats, even with thin seeding, are later to mature and apt to make too much shade. Standing in a nurse crop, one should be able at any time during the growing season to see the young plants ten or twelve feet away. The nurse crop should be ready to harvest as soon as the clover commences to develop new shoots or branches from the crown.

In districts where the rainfall is less than thirty inches, or not well distributed throughout the growing season, the nurse crop may rob the young fodder plants of necessary moisture. In some seasons a good stand of Red Clover is difficult to obtain, partly because of the lack of humus in the soil, but also because the nurse crop, frequently oats, robs the young plants of the available moisture. If the meadow is of more importance than the nurse crop, it is advisable in a dry season to dispense with the latter, or, if planted, to cut it for fodder before the seedlings perish from thirst.

The suppression of noxious weeds in meadows* is most effectively and economically accomplished by clean cultivation before fodder crop seeds are sown. After seeding to clover on reasonably clean land, an early maturing nurse crop can usually be counted upon to check weed growth and prevent the seeds from maturing before the crop is harvested. The nurse crop should be ready to harvest or be cut for fodder within three or at most three and a half months after seeding. If weeds are not too prevalent when the nurse crop is harvested, it is better for the seedling clover, to leave a stubble four or five inches high. That will remove the seed stalks of the taller and more vigorous weeds and will enable the still tender clover plants to gradually adapt themselves to altered conditions. Autumn weeds may be largely prevented from seeding by clipping with a mowing machine about a month after the nurse crop is harvested, and when ragweed is prevalent this is especially important.

* These paragraphs and that at the top of the next page are taken from the introduction to "Fodder and Pasture Plants." See footnote page 17.

How to deal with killed-out patches. It frequently happens, as a result of unfavourable weather, irregular seeding, patches of too wet or too hard and dry soil, or a heavy nurse crop perhaps lodging in places, that the seedling plants suffer severely or are killed out in small areas. As soon as the autumn rains commence, or, if the soil is sufficiently moist, at any time after the summer heat is past, it is well to re-seed such patches quite thickly. If necessary, apply a thin dressing of rotted barnyard manure to cover the seed, to retain moisture and to ensure vigorous autumn growth. If the killed out areas are large, it is sometimes advisable to use a sharp harrow to make a good seed bed. If the late fall is favourable and the re-seeded patches are well protected during the winter, they should make a fair growth, even for the first cutting, and succeeding crops will well repay the trouble and expense.

THE RED CLOVER PLANT AND ITS CULTURE.*

Botanical description. Red Clover is mainly biennial. The year the seed germinates, only short leaves and stems are produced and no flowers. The second year the flowers are developed and the seed formed, and after ripening the seed the plant dies. As with most biennial plants, the root is a taproot; that is, the single main root gradually tapers downward and produces numerous side branches. On these are developed the small, rounded or egg-shaped nodules which contain the bacteria necessary for the proper development of the plant. From the upper end of the taproot, which is somewhat enlarged and generally known as the crown, are formed more or less numerous buds which develop into leafy stems. These as a rule are from one-half to two feet high, strictly upright or ascending from a decumbent base, the latter being the normal growth of stems developed from the outer margin of the crown. The stems are generally branched above the middle and the leaves are single at each joint. The three leaflets of which each leaf consists are oblong or egg-shaped and usually marked with a white spot of varying size and shape.

Biology of flower. If Red Clover is isolated during flowering time, so that no insects can visit the blooms, no seeds will be formed, as it depends upon insects to transport the pollen from one flower to another. Bumble bees, which visit the flowers in order to secure the nectar, are especially active in this transportation. As the insect travels from one plant to another, carrying pollen from different individuals, the pistils of one are apt to be fertilized by pollen from another. Such cross-fertilization must, in fact, take place before seed can be developed.

Cultural conditions.—Being a resident of the temperate zone, Red Clover succeeds best where the summers are not too hot nor the winters too severe. Although the roots go rather deep, the plant is injured by long and continuous drought. It needs sufficient rain during the growing period to enable it to flourish during the whole season. As Red Clover is rather cosmopolitan, a great number of varieties, adapted to different climates, have been developed. The suitability of a variety for a northern climate like that of Canada depends to a great extent upon its hardiness. Chilean Red Clover or other varieties originating in countries with a mild climate are invariably killed by the Canadian winter, except in the southern parts of the country. It is, therefore, important to secure seed of northern origin. If possible, Canadian-grown seed should be obtained because as a rule home-grown seed gives the best results.

Soil.—Red Clover can be successfully grown on many kinds of soil, the most suitable being clay loams with a certain amount of lime and plenty of organic matter.

*What appears under this heading (pages 17 to 19) is taken from "Fodder and Pasture Plants" by Geo. H. Clark, B.S.A., Seed Commissioner and M. Oscar Malte, Ph. D., Dominion Agrostologist. This book contains descriptions and coloured illustrations by Norman Criddle of more than 50 grasses, clovers and other forage plants cultivated in Canada. Copies may be had for fifty cents from the Superintendent of Stationery, Government Printing Bureau, Ottawa.

Sandy loams also give good returns, especially on limestone foundation; but generally speaking, Red Clover prefers the heavier soils. It can be grown even on stiff clay, provided the subsoil is open. For its proper development Red Clover, like Alfalfa, depends a good deal upon the subsoil. This must be open and well-drained. Stagnant water near or on the surface is decidedly injurious. Water-soaked soil excludes the air necessary for the respiration of the roots and is in a bad physical condition to meet the alternate thawing and freezing of early spring. As is well known, water expands when changing into ice, and if the surface soil contains an abundance of water it will consequently expand when freezing. The overground parts of the plants will be lifted up with the freezing soil. As the lower roots are anchored in the subsoil and therefore unable to follow the upward movement, they will be stretched and sometimes broken. The disastrous effects of alternate thawing and freezing make it evident that one of the first conditions of successful clover growing is well-drained soil.

Habits of growth.—Being a biennial, Red Clover devotes the first season's growth to the development of its root system and the accumulation of strength to meet the winter's hardships. It therefore produces a strong tap root, which, if soil and weather are favourable, penetrates to a considerable depth. The overground parts of the plants consist at first of only a few short, upright stems which carry leaves but no flowers. Later in the season, short leafy shoots are developed which generally lie flat on the ground and are known as the winter tuft. At the same time the tap root begins to contract until its original length is reduced by more than ten per cent. As the end of the root is firmly anchored in the ground, the result is that the overground parts of the plant are pulled down. This process, which has been observed in other plants such as carrots and parsnips, is evidently meant to bring the stems and leaves into close contact with the ground where they are best protected against frost and wind. Early in the spring of the second year, the branches of the winter tuft develop into flower-bearing stems, which, if not cut or pastured, produce seed and late in the fall die. The great mass of clover plants are thus biennial. Red Clover types exist, however, which show a decided tendency to live longer, especially if the plants are kept from seeding by continual cutting or pasturing.

Seed.—Except in southwestern Ontario, Red Clover seed is only grown to a very limited extent in Canada. Whether or not a field should be used for seed production depends on conditions. If these are favourable, all or certain parts of the field are commonly left for seed. Success depends on many factors. If the latter part of the summer, when the seed is ripening, is rainy, there is far less chance of producing good seed than if the weather is warm and dry. Cold, stiff soils, which may produce luxuriant growth, are not as a rule satisfactory for seed production. The best soils are sandy loams with an abundance of lime and a fair supply of potash and phosphates. A thick stand of clover improves the quality of the hay but produces only a scant amount of seed. A relatively thin crop will give a heavier yield and the seed produced is of a better quality. A smaller amount should therefore be sown for seed production than for hay or pasture.

The first cut of Red Clover gives a small return of seed because the bumble bees, which fertilize the blossoms, are less numerous during the early part of the summer than later. For this reason the first growth is cut for hay or pastured and the second growth left for seed. By cutting or pasturing the first crop, the weeds are checked and the second growth is cleaner.

Red clover should be cut for seed when most of the heads have turned brown and the stems begin to dry up. The seeds in most of the heads are then ripe and of a pronounced colour. By cutting earlier, a large proportion of the seeds will be immature and shrunken, the vitality will be low and the general colour and appearance inferior. It can be cut with an ordinary mowing machine. The heads and flowers can be easily

broken by careless handling, especially in dry, hot weather. Threshing should be done in cold, dry weather as it is difficult to separate the seeds from the pod when it is damp.

Quality of seed.—The colour of ordinary commercial Red Clover seed is mixed, some seeds being yellow, others purple, and others bright in one end and dark in the other. In some samples the bright colours prevail while in others the dark seeds are most common. It is a popular belief that bright coloured seeds are not fully mature and that samples which contain a large proportion of them are inferior. This, however, is an error. All seeds gathered from any individual plant are of the same general colour. In some plants all the seeds are yellow, in others deep violet, and in others uniformly two-coloured. Bright yellow seeds are just as ripe as dark purple ones. The mixed colour of the ordinary commercial sample therefore does not mean that the seeds are not uniformly ripe. It simply means that it is composed of seeds of different types, each type having its own colour. Although the darker seeds are more popular, the colour should not be taken as an index of value as the most desirable plant types may have pale yellow seeds. Good red clover seed should have a shiny lustre and contain only a small proportion of undeveloped, shrunk seed. The legal weight is sixty pounds per bushel.

VARIETIES OF RED CLOVER.

Red clover consists of thousands of types, differing in general characteristics, biological behaviour and practical value. From a botanical point of view, two main types can be distinguished which might be termed the American and the European. The latter has smooth stems whereas the stems of the former have many outstanding hairs. This hairiness makes the American type somewhat inferior for hay, as it is apt to be dusty. Within either type numerous varieties can be recognized, differing in such practical qualities as yielding power, hardness, maturity, stooking after cutting and duration. Most varieties are merely geographical ones. Such names as Chinese, English, Swedish, French, South or North Russian Clover do not mean that the varieties are botanically distinct, but simply that the seed is of certain origin and that the plants are adapted to the countries for which they are named.

Mammoth Clover, called **Cow Grass** in England, is one of the best known varieties. It has sometimes been called *Trifolium medium* L., but this is not correct, *Trifolium medium* L. being a distinct species, clearly distinguished from Red Clover in many essentials. As indicated by its name, Mammoth clover is a large variety of red. It is more decidedly perennial and has therefore been called *Trifolium pratense* var. *perenne*, or Perennial Red Clover. The stems are long, coarse and generally spreading. The leaves usually lack the white blotch characteristic of common red clover. This cannot, however, be used as a distinguishing mark as common red is often without the spot. Mammoth clover is decidedly later; it blooms ten days to three weeks after common red clover. It grows slowly after mowing and can generally be cut only once in a season. It requires the same soil and climate as common red, but on account of its stronger root system and perennial tendency it is more apt to thrive under adverse conditions. Its coarser growth makes the hay less relished by stock; on the other hand, its greater luxuriance makes it a better soil improver.

It is not possible to separate seed of Mammoth red clover from that of common red.

SEED TESTING—INSTRUCTIONS FOR TAKING AND SENDING SAMPLES.

Address Samples.—(a) To the Seed Commissioner, Department of Agriculture, Ottawa, when samples are sent from Eastern Canada. (b) Samples from Manitoba and Saskatchewan must be addressed to Dominion Seed Laboratory, Winnipeg, Manitoba. (c) Samples from Alberta and British Columbia must be sent to Dominion Seed Laboratory, Calgary, Alberta.

Postage.—Letters and samples not exceeding 12 ounces in weight go *free* when addressed to the Seed Commissioner, Ottawa. Samples weighing more than 12 ounces and those addressed to Winnipeg and Calgary must have postage prepaid.

Size of Samples for Test.—For purity test and grading—Timothy, alsike and seeds of like size, 1 ounce (about 7 teaspoonfuls). Red clover and seeds of like size, 2 ounces (about 12 teaspoonfuls). Wheat, oats, barley or buckwheat, 1 pound. When a germination test only is wanted, about 1,000 seeds.

Strong manilla paper or cotton bags should be used for sending samples of seeds. Glass bottles, cardboard boxes, ordinary envelopes, or thin paper bags are apt to be broken in the mails. Those not having strong seed envelopes are recommended to use small cotton bags, enclosing name and address of sender and designation of seed on a card or piece of paper *inside* the bag.

When several samples are enclosed in thin paper bags and sent under one cover, two or more of them are often broken open in the mails and the contents mixed or lost.

Mark Samples with.—(1) Name and address of sender. (2) Some letter, number or other designation by which samples of the same kind of seed may be distinguished. (3) The grade and test number if the seed has been tested before. *This is important.*

Charge for Seed Testing.—Twenty-five samples will be tested free of charge for any one individual or firm in one year. Twenty-five cents per test is charged on all samples in excess of this number.

Variation in Tests.—The grade given by the laboratory on a lot of seed is for the sample received and kept on file, and may safely be used for seed from which the sample was taken only when the sample accurately represents the average quality of the whole lot. The Seed Branch stands behind the grade which it issues on samples, and is prepared to confirm the grade on subsequent samples provided there is not an unreasonable difference between samples said to be from the same lot of seed. Two or more samples taken from widely different parts of a quantity of seed may show a great range in number of weed seeds, and even in the quality of the seed. This is a frequent source of misunderstanding on the part of senders of samples, and the cause of it lies in the fact that the portion sent us does not represent the average of all the seed to be graded. The extent of the difference between samples from the same lot will be greater in seed that has not been thoroughly mixed and bulked, and in seed containing a large number of weed seeds.

To secure a proper sample of seed for test it is first essential that the lot to be sampled be fairly uniform in composition. If the seed is in bags just as it came from the thresher there will be some bags from certain parts of the field of much higher quality and containing fewer weed seeds than seed from other parts. In such a case it is better to sample the bags separately. When the seed is known to be fairly uniform one sample may be taken to represent the lot. This sample should be made up of small portions from several different parts as from the top, middle and bottom of each bag. (A sampler for taking seed from any part of a closed bag may be bought from any wholesale seed dealer.) The smaller quantities so drawn should be thoroughly mixed together and the proper quantity taken from the mixture to send for testing. It is recommended that the sender keep a duplicate of this sample in case the correctness of his sample or grade is ever called in question.

