

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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CLOVER SEED IN THE CONNECTICUT MARKET.

BY E. H. JENKINS AND MARY H. JAGGER.

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CLOVER SEED IN THE CONNECTICUT MARKET.

By E. H. JENKINS AND MARY H. JAGGER.*

Early in the season we called attention, in the agricultural papers, to the poor quality of the clover seed now in our market, and advised purchasers to make sure of the quality of their seed before buying. A number of farmers have sent samples for examination here, and the Station sampling agent has bought clover seed where he has found it, so that in all fifty-one samples have been received, examined and reported.

The figures which are given below show that three of the samples were adulterated with seed of a comparatively worthless plant, only ten of the number were apparently free from dodder, which is the most dangerous weed found in clover and which may entirely ruin the crop, and of the samples free from dodder, two had a very low vitality. Only one-sixth of the whole number examined were fit to use. The detailed results of the tests are given in the table, pages 12 and 13.

Weight of the Seed.

For a considerable number of agricultural seeds it has been proved that, other conditions being alike, the heaviest seeds give the strongest plants during early growth, and, excepting perhaps under the most favorable conditions, the largest yield. Hellriegel¹ showed this with barley, other European experimenters with other cereals, and Hicks and Dabney² with peas, beans, soy beans and some other seeds.

Clover seed of average quality should weigh about one and one-half grams per 1,000 seeds, 302,000 seeds to the pound. With a given number of pounds of seed per acre, lighter seed than this yields, of course, a larger number of plants, assuming that they germinate equally well, but a larger proportion of the plants is likely to die out or do poorly.

* The entire work of the identification and testing of seeds has been done by Miss Jagger. The results have been prepared for publication by the Director. The methods followed have been those adopted by the Association of Agricultural Colleges and Stations, Circular 34, Office of Experiment Stations.

The seed of 26 of the samples examined weighed less than the above standard, that of two samples weighing 1.27 grams or less, equal to 363,000 seeds per pound. On the other hand two weighed 1.92 grams per 1,000 seeds, equal to 236,000 seeds per pound.

All else being equal, a good catch, a satisfactory stand and a heavy crop are more likely from a sowing of the heavy seed than from a sowing of the light, in spite of the smaller number of seeds in the former. It is equivalent to 43 plants per square foot, which is five to eight times as many good plants as will be found when the crop is cut.

Vitality.

The laboratory and greenhouse tests show the extreme limit of vitality, every seed being counted which has life enough to burst its coats and throw out a sprout.

Field tests, as a rule, show that fewer seeds will produce plants than will germinate, some seeds in almost any sample and many seeds in some having life enough to start, but not enough to push through the soil and assimilate food from outside the seed. The figures given in the table, therefore, show the vitality *under the very best conditions.*

The seed laboratory of the U. S. Department of Agriculture, as a provisional figure, recommends 85 per cent. as a minimum standard of vitality for commercial clover seed,³ that is, 85 out of every 100 clover seeds should sprout. The Pennsylvania Board of Agriculture⁴ found the average vitality of 33 samples of red clover seed 86.4 per cent. (94.3-20.3).

The Vermont Station⁵ found the average vitality of 134 samples collected by the Station and tested at the seed laboratory of the U. S. Department of Agriculture to be 87 per cent. (97.3-75*).

The Delaware Station⁶ found the average vitality of 43 samples to be 87 per cent. (95-51).

The average vitality of the 51 samples from our own market this spring is 86.6 per cent., which is satisfactory as an average.

But 20, or more than one-third of the samples, fell below the minimum named, 85 per cent., and four of them below 75 per cent., the lowest being 64.2.

* Next lowest figure, 41.5.

Viability.

The last column of the table gives the "Viability" of the seed, which means the percentage (by weight of the sample) of pure clover seed which is capable of germination. It is calculated by multiplying together the numbers which represent purity and vitality. For example, if the seed contains 85.5 per cent. of clover seed and of this 76.5 per cent. sprouts, the "viability" will be $85.5 \times .765$ or 65.4 per cent.

Purity of the Seed.

The purity of clover seed is perhaps of more importance than either its weight or its vitality.

The farmer loses less money by the partial failure of a crop of clover because of light or old seed, than he loses by stocking his field with long-leaved plantain, pig weed, foxtail, sorrel, dock, and other weeds which come in such clover seed as we are getting now. With most of the seed sold here this spring he also runs the chance of losing his crop, in part or wholly, by dodder, which may stay in the land as long as clover grows on it.

The average purity of the seed from our market this year is 90.5 per cent., which is 7.5 per cent. lower than the provisional standard of the U. S. Department of Agriculture,³ which is 98 per cent. The "purity," thus expressed, means that of 100 pounds of the seed as bought 98 pounds are clover, the rest being dirt or foreign seeds.

The kind and quantities of foreign seeds found in clover seed may be seen from the botanical analyses of five samples given on the next page. The figures give the number of seeds of each species in one pound of clover seed.

Leaving out of account the foreign clover, alfalfa and timothy seed present, a seeding of 8 pounds per acre of any of these samples would plant from two to eight weed seeds on every square foot of land.

Adulterated Clover Seed.

Three cases of adulteration are Nos. 4910, 4856 and 4834.

The first contains 21.2 per cent., the next 22.6 per cent., and the last 39.1 per cent. of black medic (*Medicago lupulina*), a legume growing in waste places and of no agricultural value.

It is not a thing which is accidentally or unavoidably harvested with clover, for no samples other than those named had more than a few seeds of this plant; nor is it grown as a crop in this country, but is imported from Germany in large quantity for the express purpose of use as an adulterant,⁷ and is not very readily

| Station No. | 4937 | 4933 | 4934 | 4935 | 4936 |
|--|--------|--------|--------|--------|--------|
| Clover, white | 565 | 15,820 | 455 | 1,208 | 8,475 |
| " alsike | 12,204 | 9,492 | ---- | 1,359 | 1,243 |
| " birdsfoot | 565 | ---- | ---- | ---- | ---- |
| Alfalfa | 565 | ---- | 1,456 | 2,869 | 1,695 |
| Sweet clover | ---- | ---- | ---- | ---- | 452 |
| Black medic | 2,486 | 791 | ---- | 151 | 2,260 |
| Timothy | 19,888 | 6,328 | 637 | 11,627 | 904 |
| Foxtail (<i>Chatochloa</i>) | 5,085 | 2,034 | 546 | 604 | 1,695 |
| Old witch grass | 339 | 3,390 | 91 | 302 | ---- |
| Bloody panic | 226 | 1,808 | 91 | ---- | ---- |
| Filiforme panic | ---- | 1,243 | ---- | ---- | ---- |
| Paspalum | ---- | 565 | 3,549 | ---- | ---- |
| Long-leaved plantain | 3,016 | 1,808 | 2,184 | 5,285 | 12,769 |
| Rugel's plantain | 1,243 | 1,469 | 455 | 1,510 | ---- |
| Bracted plantain | ---- | 226 | 455 | ---- | ---- |
| Broad-leaf plantain | ---- | ---- | ---- | 1,057 | ---- |
| Curled dock | 1,582 | 678 | 364 | 1,057 | 226 |
| Sorrel | 3,277 | 678 | 182 | 151 | 1,017 |
| Bindweed | 2,147 | 565 | 546 | ---- | 226 |
| Self-heal | 678 | ---- | ---- | 151 | 1,243 |
| Lamb's quarters | 2,034 | 226 | 182 | 302 | 2,147 |
| Tumble weed | ---- | 113 | ---- | 302 | 1,243 |
| Night-flowering catchfly | 16,498 | 1,808 | ---- | ---- | ---- |
| Chickweed | ---- | 226 | ---- | ---- | ---- |
| Wild carrot | 113 | 113 | ---- | ---- | 1,808 |
| Brassica sp. | 1,695 | ---- | ---- | ---- | ---- |
| Chicory | ---- | 452 | ---- | ---- | 678 |
| Rag weed | ---- | ---- | 91 | ---- | ---- |
| Spiny sida | ---- | 452 | 637 | ---- | ---- |
| Nightshade | ---- | 226 | 91 | 151 | ---- |
| Picris | ---- | ---- | ---- | 151 | ---- |
| Unknown | 2,260 | 2,047 | ---- | ---- | ---- |
| Field dodder | 339 | 226 | 364 | ---- | 1,469 |
| Clover dodder | 1,808 | 1,130 | 182 | ---- | 4,972 |
| Other dodders | ---- | 791 | ---- | ---- | ---- |
| Total number of foreign seeds per pound | 78,604 | 54,705 | 12,458 | 28,237 | 44,522 |

detected by the buyer. The adulteration was no doubt done by the wholesaler, who deceived thereby both the retail seedsman and his patrons.

The appearance of the seed of black medic and of red clover seed is shown in figure 3, where both seeds are equally enlarged to about four times their natural size. Essentially the two are alike in size, and do not differ radically in color. Medic never

has the purple or violet color of red clover, but the shape is very different and characteristic. Clover has a distorted heart shape, a roughly triangular outline with rounded corners. Medic is

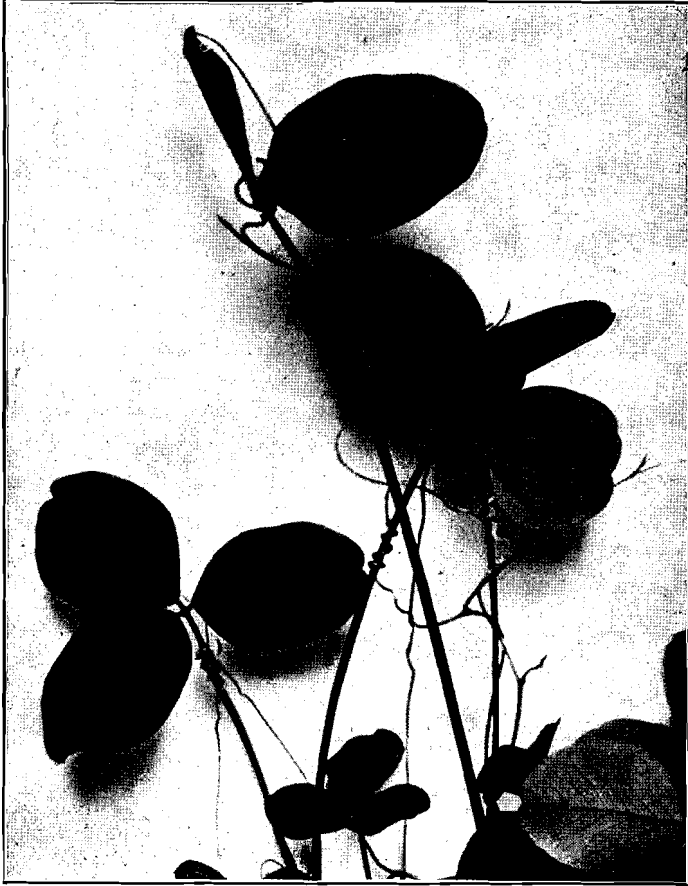


FIGURE 1. Clover attacked by Dodder.

more oval in shape and the rootlet of the embryo is within a sharp point near the middle of the longer axis of the seed.

Dodder.

Most of the clover seed sold in the state this spring contained dodder, the weed most dangerous and destructive to the clover crop. Figure 1 shows a clover plant attacked by this pest.

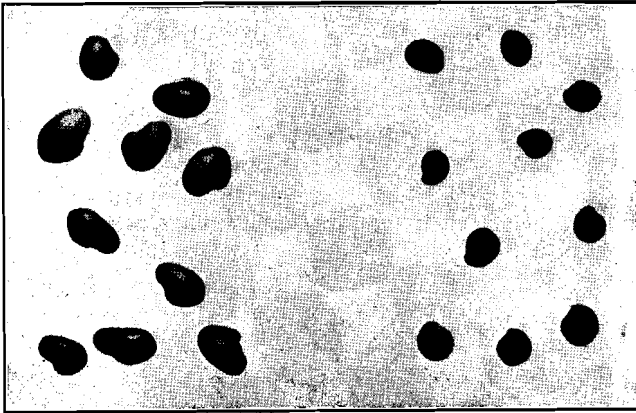


FIGURE 2. Seed of red clover (left) and of dodder (right.)

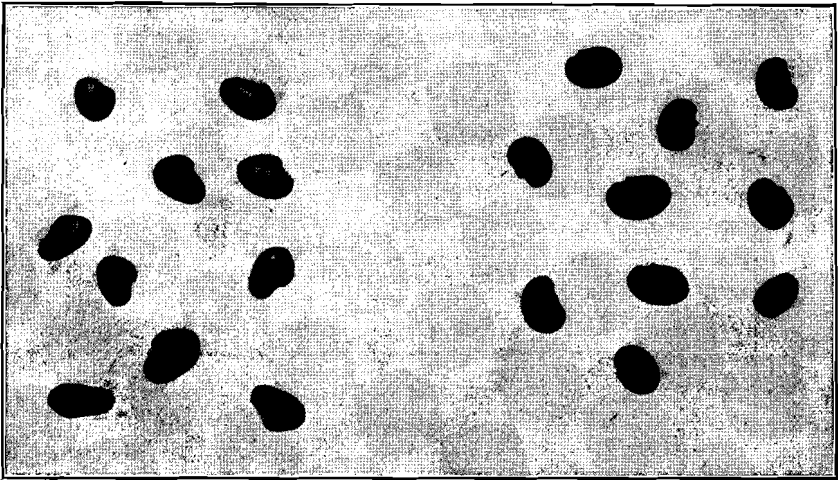


FIGURE 3. Seeds of red clover (left) and of black medic (right).

Figure 2 shows seeds of field dodder and clover equally enlarged to about four times their natural size. The dodder is about the size of small clover seed and difficult to separate perfectly from it. Its color is light gray, yellowish or light brown, dull, finely roughened, but not pitted. The seed may easily be mistaken for rounded bits of soil.

The seed of this weed germinates in the ground, sends up a thread-like stem, yellow or reddish in color, which immediately attaches itself to its host plant. If it finds no plant on which it can feed it dies, being entirely a parasite. Finding a suitable plant, it twines closely around the stem or leaf, sends its sucking organs into the tissue and lives on its juices, weakening or killing the host. Its connection with the ground soon ceases, and when actively growing the stem may be cut into any number of pieces, each of which, if attached to clover, will continue to flourish. It flowers and produces abundant seed, which stocks the ground for the next clover crop.

Clover infested with dodder lodges, mats together, cannot be properly cured, and either because of the dodder present or the moulding of the clover in consequence, has been known to scour cows when fed out as hay.

A study of dodders with a bibliography by Halsted is given in N. J. Agricultural Station Report, 1901, p. 451.

Only two species of dodder are common in our clover seed to-day: the clover dodder (*Cuscuta epithimum* or *trifolii*), and the field dodder (*C. arvensis*), which is much more common. Both plants are now widely distributed in the United States. The former has been introduced from Europe, and it is stated does not seed freely in this country. The other, field dodder, is a native, seeds very freely and is therefore the more dangerous.

Several other species of dodder occur on clover and alfalfa, but the two named are all that need be considered here.

The Delaware Station, in 1889,⁸ found dodder in 5 samples out of 49 examined.

The Maine Station,⁹ in 1908, found it in 5 samples out of 43.

The Vermont Station,¹⁰ in 1900, in 74 samples examined, makes no report of dodder found.

In 1893, the Iowa Station¹¹ examined 84 samples of clover, grown in 11 different states (the largest number in Iowa), and found no dodder in any of them. The statement is made that *Cuscuta epithimum* or clover dodder is seldom found in the West.

In 1902 the Montana Station¹² reports both the clover and alfalfa dodder as troublesome in two sections of the state in alfalfa fields and as much more troublesome further south.

Turning now to the clover seed sold in Connecticut this year, there are only ten samples in which we have not found

seed of one or more kinds of dodder, and four of these samples were so small that a thorough test for dodder was not possible. Where the size of the sample permitted, 40 grams, or about one and a half ounces, were carefully picked over and the dodder seeds counted, and calculation was made of the number in one pound of clover seed. This calculation shows fairly the amount of dodder present.

In the 28 samples tested in this way all the way from 18 to 11,615 dodder seeds were found per pound of clover; that is, on a seeding of 8 pounds per acre the smaller quantity of dodder would give one seed to every 300 square feet, the larger quantity more than 2 dodder seeds to every foot of land!

What amount of this dangerous parasite will germinate has not yet been determined, but that it is not dead seed has been abundantly shown by greenhouse seedings, in which the clover is being destroyed by both the field dodder and the clover dodder.

The Sources of Our Clover Seed.

In 1900 over twelve million bushels of clover seed were produced in the United States, of which one-third was grown in Indiana, and two-thirds in the three states of Indiana, Ohio and Illinois. The other great clover-growing states are Pennsylvania, Wisconsin, Michigan, Missouri, Kansas and Utah, each of which supplied over 35,000 bushels. The larger part of this is red clover. Certain weed seeds, like ox-eye daisy and the long-leaved plantain, cannot be entirely removed from clover by sieves or fans, and are almost unavoidably brought in to some extent even in good clover seed.

But the source of a large proportion of the weeds and very much of the dodder in clover seed is the cheap and dirty seed which is imported; part of it, in all probability, with the purpose of mixing it with good domestic seed, either to make a low-priced seed, or to increase the profits on seed sold at regular rates.

In 1907 more than 380,000 bushels of clover seed were imported from abroad, a part of it other kinds of clover, but too much of it low grade red clover and clover screenings, full of weed seed which could not be sold in any country which had an adequate seed control. The quality of this imported low grade stuff is well shown in Bureau of Plant Industry, Bulletin 111, part iii. "Argentina has a law prohibiting the importation of alfalfa and

clover seed containing the seed of dodder. Canada prohibits the sale within her borders of seed containing weed seeds, *but provides for its export*. Europe is effectually protected from the use of poor seeds through its seed-control stations, but its screenings are exported. It seems time that the United States had some restriction on the importation of seeds of such poor quality that they cannot be sold in other countries."

What are We Going to do About It?

Begin now by urging local seedsmen to buy and pay for only such clover and alfalfa seed as the wholesaler will guarantee to be free from dodder, and to have a sprouting power of 85 per cent. and purity of 95 per cent. Such seed will cost more than the mixed or low grade seed, and will be worth much more than the difference.

Do not buy clover seed until you have had its vitality and purity tested by the Station, and both are found satisfactory. There is some pure seed in the market, and there will be plenty of it when inferior seed finds no buyers.

Meantime those who have seeded land to clover this spring are urged to watch the crop closely and send word to this Station if dodder appears. If it is found, the clover on the infested spots should be cut at once, carefully gathered and burned or buried, every thread of the dodder being gathered up.

The Station will be glad to have a list of all those who seeded with clover last fall or this spring.

Instructions for Sampling Seeds.

In selecting a sample for examination the greatest care should be used to have it represent accurately the whole amount from which it was taken. Carelessness or inaccuracy in this particular impairs or destroys the value of the Station examination.

1. Mix well together with the hand and arm the contents of the package (bag or barrel) or packages of seed.
2. Take out five or six small handfuls or cupfuls* from various parts of the package, mix these carefully together and take a part of this mixture for the sample.

* A small cup may be closed with the palm of the hand, forced down to the desired place, then filled and withdrawn.

EXAMINATION OF CLOVER SEED BOUGHT IN CONNECTICUT, 1908.

| Station No. | Dealer. | Station agent | Sampled or Sent by | No. of dodder seed in pound of clover. | 1000 seeds weigh in grams | Pure seed per cent | Impurities per cent | Pure seed germination per cent | Viability per cent |
|-------------|---|--------------------------------------|--------------------|--|---------------------------|--------------------|---------------------|--------------------------------|--------------------|
| 4734 | F. S. Platt & Co., New Haven..... | Station agent..... | ..... | NONE | 1.74 | 97.6 | 2.4 | 90.0 | 87.8 |
| 4739 | E. E. Burwell, "..... | "..... | ..... | NONE | 1.41 | 83.1 | 16.9 | 64.2 | 53.3 |
| 4758 | Cadwell & Jones, Hartford..... | "..... | ..... | 238 | 1.65 | 92.6 | 7.4 | 77.0 | 71.3 |
| 4759 | Stanley Svea Grain & Coal Co., New Britain..... | "..... | ..... | 527 | 1.66 | 90.1 | 9.9 | 80.2 | 72.2 |
| 4771 | Olds & Whipple, Hartford..... | "..... | ..... | 463 | 1.25 | 83.5 | 16.5 | 83.7 | 69.8 |
| 4772 | D. B. Wilson & Co., Waterbury..... | "..... | ..... | 5206 | 1.47 | 84.4 | 15.6 | 76.2 | 64.3 |
| 4821 | Lockwood & Palmer, Stamford..... | "..... | ..... | NONE | 1.51 | 97.3 | 2.7 | 88.2 | 85.8 |
| 4832 | G. H. Alvord & Son, Willimantic..... | "..... | ..... | 1451 | 1.92 | 85.2 | 14.8 | 79.7 | 67.9 |
| 4834 | Smith & Bishel, Middletown..... | "..... | ..... | 653 | 1.62 | 48.1 | 51.9 | 84.0 | 40.4 |
| 4835 | Jordan Hardware Co., Willimantic..... | "..... | ..... | NONE | 1.55 | 99.0 | 1.0 | 93.5 | 92.5 |
| 4837 | J. P. Barstow & Co., Norwich..... | "..... | ..... | 178 | 1.30 | 90.8 | 9.2 | 90.7 | 82.3 |
| 4838 | Lyon & Ewald, New London..... | "..... | ..... | 710 | 1.72 | 86.2 | 13.8 | 89.0 | 76.7 |
| 4839 | Meriden Grain & Feed Co., Meriden..... | "..... | ..... | NONE | 1.38 | 93.9 | 6.1 | 84.0 | 78.8 |
| 4840 | Birdsey & Raven, Meriden..... | "..... | ..... | 18 | 1.45 | 96.0 | 4.0 | 90.2 | 86.5 |
| 4841 | O. H. Meeker, Danbury..... | "..... | ..... | 333 | 1.43 | 96.0 | 4.0 | 81.7 | 78.4 |
| 4846 | S. D. Woodruff & Sons, Orange..... | "..... | ..... | 52 | 1.40 | 96.5 | 3.5 | 95.0 | 91.6 |
| 4849 | Cadwell & Jones, Hartford..... | J. B. Lewis, Southington..... | ..... | present | 1.62 | 94.1 | 5.9 | 92.2 | 86.7 |
| 4850 | "..... | "..... | ..... | * | 1.72 | 98.2 | 1.8 | 88.5 | 86.9 |
| 4854 | Thos. Griswold & Co., Wethersfield..... | T. Griswold & Co., Wethersfield..... | ..... | * | 1.54 | 92.8 | 7.2 | 79.5 | 73.7 |
| 4855 | "..... | A. M. Lewis, Plantsville..... | ..... | present | 1.42 | 84.9 | 15.1 | 75.7 | 64.2 |
| 4856 | "..... | A. B. Pierpont, Waterbury..... | ..... | present | 1.63 | 71.5 | 28.5 | 95.0 | 67.9 |
| 4857 | "..... | "..... | ..... | present | 1.47 | 85.3 | 14.7 | 87.3 | 74.6 |
| 4858 | Wheeler & Co., Bridgeport..... | E. F. Ellwood, Green's Farms..... | ..... | NONE | 1.92 | 94.5 | 5.5 | 92.2 | 87.1 |
| 4860 | Rawson & Co., Boston..... | H. T. Child, Woodstock..... | ..... | present | 1.60 | 97.9 | 2.1 | 89.2 | 87.3 |
| 4861 | Ross Bros., Worcester, Mass..... | "..... | ..... | 108 | 1.88 | 96.3 | 3.7 | 93.7 | 90.2 |
| 4867 | Haskell Seed Co., Boston..... | T. A. Stanley, New Britain..... | ..... | 83 | 1.83 | 98.4 | 1.6 | 95.2 | 93.0 |

* None found. † Adulterated.

EXAMINATION OF CLOVER SEED BOUGHT IN CONNECTICUT, 1908 —Continued.

| Station No. | Dealer. | Sampled or sent by | No. of dodder seed in 1 pound of clover. | 1000 seed weigh. grams | Pure seed per cent | Impurities per cent | Pure seed germination per cent | Viability per cent |
|-------------|---|----------------------------------|--|------------------------|--------------------|---------------------|--------------------------------|--------------------|
| 4868 | Cadwell & Jones, Hartford..... | T. A. Stanley, New Britain..... | 336 | 1.47 | 93.3 | 6.7 | 91.2 | 85.0 |
| 4870 | J. P. Barstow & Co., Norwich..... | J. K. Hall, Norwich..... | present | 1.78 | 94.4 | 5.6 | 93.0 | 87.7 |
| 4871 | " | " | present | 1.27 | 91.2 | 9.8 | 95.2 | 86.8 |
| 4895 | F. C. Benjamin, Danbury..... | Station agent..... | 296 | 1.40 | 85.5 | 14.5 | 76.5 | 65.4 |
| 4896 | O. H. Meeker, | " | 266 | 1.12 | 96.5 | 3.5 | 81.7 | 78.8 |
| 4898 | " | " | * | 1.55 | 95.6 | 4.4 | 95.2 | 91.0 |
| 4901 | C. W. Willard Hardware Co., Westerly, R. I. | Luther Holton, No. Franklin..... | 11615 | 1.41 | 69.0 | 31.0 | 72.7 | 50.1 |
| 4902 | Campbell's Grist Mill | J. D. Avery, No. Stonington..... | present | 1.42 | 94.2 | 5.8 | 96.2 | 90.6 |
| 4910 | Perry & Brown, Putnam | Miss M. M. Bartholomew, Putnam | present | 1.41 | 69.9 | 30.1 | 81.7 | 57.1 |
| 4911 | Chandler & Morse, Putnam | " | present | 1.70 | 97.3 | 2.7 | 93.0 | 90.4 |
| 4912 | Ballard & Clark, | " | 73 | 1.37 | 92.6 | 7.4 | 90.7 | 83.9 |
| 4914 | Mammoth. S. D. Woodruff & Sons | Station agent..... | 87 | 1.31 | 96.6 | 3.4 | 92.2 | 89.0 |
| 4915 | Thos. Griswold & Co., Wethersfield | J. M. Gager, Willimantic..... | * | 1.53 | 96.4 | 3.6 | 81.0 | 78.0 |
| 4916 | " | A. J. Pierpont, Waterbury..... | present | 1.70 | 98.5 | 1.5 | 92.5 | 91.3 |
| 4926 | " | E. R. Dunn, Southington..... | present | 1.72 | 98.9 | 1.1 | 92.5 | 91.4 |
| 4929 | Spencer Bros., Suffield..... | Station Agent..... | 63 | 1.36 | 93.3 | 6.7 | 86.5 | 80.7 |
| 4930 | H. H. Bugbee, Willimantic..... | " | 165 | 1.35 | 91.5 | 8.5 | 89.2 | 81.6 |
| 4931 | I. G. Schwink, Meriden..... | " | 506 | 1.60 | 98.3 | 1.7 | 94.0 | 92.4 |
| 4932 | Edward White, Rockville..... | " | 229 | 1.48 | 92.0 | 8.0 | 85.0 | 77.7 |
| 4933 | F. S. Bidwell & Co., Windsor Locks | " | 1875 | 1.40 | 88.8 | 11.2 | 84.5 | 75.4 |
| 4934 | E. A. Buck & Co., Willimantic..... | " | 314 | 1.62 | 93.7 | 6.3 | 87.7 | 82.1 |
| 4935 | Coles & Co., Middletown..... | " | 53 | 1.33 | 93.4 | 6.6 | 84.7 | 79.1 |
| 4936 | Perry & Brown, Putnam..... | " | 1899 | 1.30 | 85.0 | 15.0 | 73.2 | 62.2 |
| 4937 | G. M. Williams Co., New London..... | " | 890 | 1.62 | 80.8 | 19.2 | 82.7 | 66.8 |
| 4938 | Thos. Griswold & Co., Wethersfield..... | J. D. Avery, No. Stonington..... | present | 1.42 | 93.3 | 6.7 | 88.5 | 82.5 |

None found. † Adulterated.

3. Send of the smaller seeds—red top, white clover, timothy, etc., *at least* two (2) ounces; of beets, turnips, red clover, etc., four (4) ounces; of wheat and cereals, and of peas and other legumes, eight (8) ounces.

4. Samples may be sent by mail, so securely packed as to prevent leakage or loss, prepaid, *plainly labeled* with name and address of the sender, and addressed to

CONN. AGRICULTURAL EXPERIMENT STATION,

New Haven, Conn.

As the test of germinating power requires some time for its completion, a report on samples sent in cannot be ordinarily expected in less than two weeks.

The examination of *grass-mixtures* can only be undertaken in special cases. It requires a large outlay of time and labor which is not often justified by the results.

Publications Cited in this Bulletin.

- 1 Grundlagen des Ackerbaus, p. 54.
- 2 Yearbook U. S. Dept. Ag., 1896, p. 310.
- 3 *Ibid*, p. 624.
- 4 Penn. Bd. Agr., Rep. 1901, p. 240.
- 5 Vt. Agl. Sta., Rep. 1904, p. 404.
- 6 Del. Agl. Sta., Bull. 5, 1889.
- 7 U. S. Dept. Ag., Farmers' Bull. 260, p. 7.
- 8 Del. Agl. Sta., Bull. 5, 1889.
- 9 Me. Agl. Sta., Bull. 152.
- 10 Vt. Agl. Sta., Rep. 1900, p. 287.
- 11 Iowa Agl. Sta., Bull. 21, p. 805.
- 12 Montana Agl. Sta., Rep. 1902, p. 70.