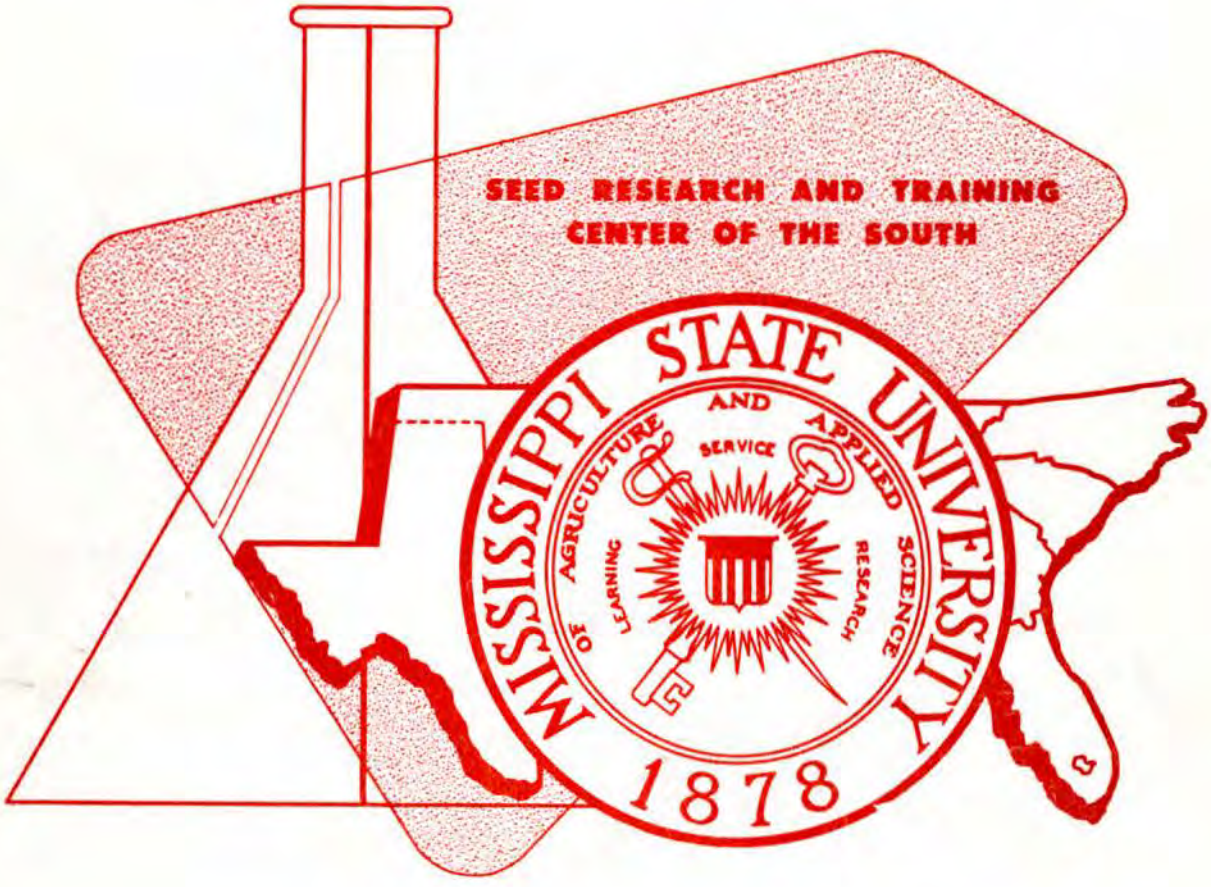
5-1-1961

Proceedings: 1961 Short Course for Seedsmen (Full Document)

Proceedings
1961 SHORT COURSE
for
SEEDSMEN



MAY 8-11

SEED TECHNOLOGY LABORATORY

STATE COLLEGE MISSISSIPPI

Sponsored By The Mississippi Seedmen's Association

PROCEEDINGS

1961 SHORT COURSE FOR SEEDSMEN

May 8 - 11, 1961

Seed Technology Laboratory
Mississippi Agricultural Experiment Station
Mississippi State University
State College, Mississippi

THE 1961 SHORT COURSE

Provided a Variety of Subjects
To Accommodate the Diverse Interests of Seedsmen

Seed Processing

Seed Treating

Tetrazolium Testing

Coffee Break

STAFF

SEED TECHNOLOGY LABORATORY

Dr. H. Dean Bunch . . . . . Agronomist and Director

Dr. James C. Delouche. . . . . Associate Agronomist and Seed Technologist

G. Burns Welch . . . . . Associate Agricultural Engineer

William P. Caldwell . . . . . .Assistant Agronomist and Seed Technologist

C. Hunter Andrews. . . . . Assistant Agronomist

Charles E. Vaughan . . . . . Assistant Agronomist

W. W. Guerry . . . . . Assistant Agronomist and Manager, Foundation Seed

T. Wayne Still . . . . . .Assistant Agronomist

James M. Beck . . . . . .Research Assistant

Myrta E. Lienhard . . . . . Research Assistant

Mabel W. Raspet . . . . . Research Assistant

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A REVIEW OF VIOLATIONS OF THE FEDERAL SEED ACT

C. R. Edwards[1/]

It is a pleasure being with you at this session of the 1961 Short Course for Seedsmen. I have wanted to attend one of these sessions since their beginning 10 years or so ago here at Mississippi State University.

It is not surprising that the organizers of your program have included this part on seed laws, labeling, maintenance of records, etc. This subject is an integral part of the operation of a seed business. Even though you may have heard several talks on the subject before, there is always more to learn.

To make this subject more interesting to you, and to emphasize the practical importance of keeping records, blending to uniformity, assigning lot numbers, sampling and testing, labeling, and similar matters, we have reviewed a number of actual cases in which judgments have been rendered under the Federal Seed Act. We believe lessons can be learned from these cases. Identity of the persons or firms involved in these cases will not be disclosed.

As I review these cases for you, there may be questions occur to you. Please feel free to ask these questions as we go along.

When I use the word "seedsman" in this discussion, I mean the person or firm deemed liable under the Federal Seed Act.

Germination

FS 875 - A shipment of peanut seed was labeled to have a germination of 70 percent and to consist of 99.00 percent pure seed and 1.00 percent inert matter. The seed was found to have a germination of 31 percent and to consist of 93.58 percent pure seed and 6.42 percent inert matter. The seedsman purchased this seed from a supplier in another town within the same State. The seedsman sent a truck to transport the seed from the supplier's place to a customer in another State. The supplier did not know that the seed was being taken to a different State. It was construed that the transaction by the supplier was not knowingly in interstate commerce and therefore the supplier was not deemed liable under the Federal Seed Act for the labeling as to germination and purity. The seedsman actually left the labels of his supplier on the bags when the seed was shipped. He relied upon his supplier's labeling, but made no effort to determine whether the seed was correctly labeled. Although the seedsman did not test the seed nor attach the labels, he was deemed liable for the false labeling in interstate commerce.

FS 879 - A shipment of barley seed was labeled to have a germination of 92 percent and to consist of 99.44 percent pure seed and 0.56 percent inert

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1/ Mr. Edwards is Marketing Specialist, Seed Branch, Grain Division, Agricultural Marketing Service, U. S. Department of Agriculture, Beltsville, Maryland.

matter. The seed was found to have a germination of 65 percent and to consist of 97.31 percent pure seed and 2.69 percent inert matter. Our investigation revealed that 340,000 pounds of seed were assigned one lot number. This quantity was not all processed at one time. A sample of the first portion cleaned was tested, and the report was used in labeling the portions processed at later dates. Also, the sample tested by the seedsman was not treated, but the seed shipped in this instance was treated. It appeared that the seed was overtreated, thus reducing the percentage of germination. Note that the purity of the seed shipped also varied from the labeling. What mistakes did the seedsman make? (1) The entire "lot of seed" was not of uniform quality. We doubt that anyone has facilities to blend 340,000 pounds of seed to uniformity. (2) The sample tested did not represent all the seed in this shipment. (3) The sample tested was untreated; whereas, this seed was treated.

FS 880 - A shipment of oat seed was labeled to have a germination of 90 percent. The seed was found to have a germination of 56 percent. The seedsman's file sample had a good germination, but was dissimilar in appearance to the seed shipped. When his records were inspected, he indicated this lot was purchased from one farmer. In reply to the charges, he indicated it was purchased from another farmer. It appears that he did not clearly identify the seed at all times, and ultimately attached labels to the wrong lot of seed.

FS 890 - A shipment of sorghum seed was labeled to have a germination of 80 percent; whereas, the seed was found to have a germination of 62 percent. At the time of shipment, the seed firm had in its files a report from a commercial seed laboratory indicating 64 percent germination. It alleged to have made a test itself which resulted in 82 percent germination. No record of that test was kept, however. Apparently the seedsman chose to ignore the report showing 64 percent germination made by the commercial laboratory.

FS 891 - A shipment of sorghum seed was labeled to have a germination of 85 percent. The seed was found to have a germination of 40 percent. The seedsman claimed that when he purchased the seed from the grower, the grower alleged to have submitted a sample to the State Seed Laboratory, which reported a germination of 85 percent. The seedsman did not obtain or keep a copy of the test record. Actually, the farmer had certified seed and non-certified seed. The farmer's test record pertained to the certified seed. No test of the non-certified seed was made. This may sound as if the farmer "pulled a fast one" on the seedsman, but that is not necessarily true. The seedsman may not have clearly remembered to which lot the test report pertained.

Let us digress just a moment from the facts in this case and consider something that does not occur in any of the cases being reviewed. I have in mind samples submitted by farmers, and the test reports thereof. We must recognize that the average farmer is not trained or equipped to sample seed in such a manner as to obtain a representative sample. The tendency may be for the farmer to merely grab a handful from the top of the bin, or he may even tend

to select what looks to him like the cleanest seed. High moisture content may cause heating down in the bin that does not damage the seed on the surface. Noxious-weed seeds may be unevenly distributed in the bin of seed. The bin may hold seed from two different fields and thus be of distinctly different quality. Reliance on farmers' samples for labeling seed delivered at a later date is a risky practice.

FS 901 - A shipment of tall fescue seed was labeled to have a germination of 85 percent. The seed was found to have a germination of 50 percent. The seedsman had purchased the seed on a contract specifying 85 percent germination. He did not receive a laboratory report of other labeling. This shipment was made before his test was completed. Question!! How did he know what calendar month and year to show on the label as the date of test? Did he have a complete record of the germination of this seed? Seven days after shipment, his test was completed, which indicated a germination of 60 percent. No effort was made to inform his customer of the false labeling after it became known. Had he corrected the labels or recovered the seed as soon as the mislabeling became known to him, the State seed inspector would never have discovered the error and no court action under the Federal Seed Act would have been filed.

FS 859 - A shipment of smooth brome seed was labeled to have a germination of 82 percent. The seed was found to have a germination of 55 percent. This was a blended lot. A sample of the seed was not tested by the seedsman after blending and before shipment. He relied on the computed germination of the individual lots blended together. Some of the lots blended had been tested more than six months prior to this shipment. This brings up two points for consideration (1) The Federal Seed Act provides that it shall be unlawful to ship seeds in interstate commerce unless the test to determine the percentage of germination shall have been completed within a 5-month period, exclusive of the calendar month in which the test has been completed. (2) The interstate shipper is liable for the labeling as to germination at the time the seed is shipped in interstate commerce. If the tests are made several months prior to shipment, they are not a reliable basis for labeling the seed.

FS 873 - A shipment of cotton seed was labeled to have a germination of 80 percent. The seed was found to have a germination of 45 percent with one percent hard seed remaining. The seedsman had purchased over 100 tons of cotton seed from a gin. Three tests in November, before processing, indicated 62 percent germination with 19 percent hard seeds, 51 percent germination with 34 percent hard seeds, and 59 percent germination with 19 percent hard seeds. No tests were made after processing. Shipment was made the following February. To assume that three samples from 100 tons of seed represents the quality of all the seed is assuming a considerable risk. Processing may or may not change the germination of the seed. Another mistake was to add the percentage of hard seed to the percentage of germination when labeling the seed.

The Federal Seed Act provides that the percentage of germination and the percentage of hard seeds, if any, shall be stated on the label. The sum of the germination percentage plus the hard seed percentage may be shown as "Total ---%" or "Total germination and hard seeds ---%".

Noxious-Weed Seeds

FS 876 - Two shipments of the same lot of timothy seed were not labeled to indicate the presence of the noxious-weed seed black-seeded plantain. Four samples of this seed were found to contain black-seeded plantain seeds at the rates of 34, 42, 40, and 30 per ounce. The seedsman's test record indicated black-seeded plantain at the rate of 31 per ounce. Apparently the seedsman's employee overlooked this indication of noxious-weed seeds when preparing the labels. The employee who prepared the labels should have checked the noxious-weed seed requirements of the State into which the shipments were being made.

FS 876 - A shipment of alsike clover seed was not labeled to indicate the presence of the noxious-weed seed buckhorn plantain. The seed was found to contain buckhorn plantain seeds at the rate of 31 per ounce. This seedsman had purchased the seed from another dealer in another State. The labels on the bags when received did not indicate the presence of buckhorn plantain seeds. Buckhorn plantain seeds are not considered noxious-weed seeds in this seedsman's State, and did not have to be shown. This seedsman relied upon his supplier's labeling when he reshipped the seed into another State where buckhorn plantain seeds are considered noxious-weed seeds. Question! What did the seedsman fail to do? The seedsman failed to determine whether this seed was labeled with respect to noxious-weed seeds in accordance with the seed law of the State into which the seed was eventually shipped.

FS 886 - A shipment of bentgrass seed was labeled to contain no noxious-weed seeds. The seed was found to contain the noxious-weed seed Klamath weed at the rate of 90 per pound. The firm's test record indicated "St. Johnswort" seeds at the rate of 360 per pound. The seedsman's employee that prepared the labels did not realize that "St. Johnswort" and "Klamath weed" are synonyms.

FS 892 - A shipment of striate lespedeza seed was labeled to contain the noxious-weed seed bracted plantain at the rate of 18 per pound. The seed was found to contain bracted plantain seeds at the rate of 387 per pound. The seedsman purchased the seed from another dealer within the same State and relied upon the supplier's labeling. After this shipment was made, the seedsman submitted a sample to a laboratory for testing. The report showed bracted plantain seeds at the rate of 342 per pound. The moral of this story is your supplier's labeling may not be reliable. The supplier in this case did not ship the seed in interstate commerce and was not liable under the Federal Seed Act.

FS 916 - A shipment of sudangrass seed was labeled to contain the

noxious-weed seed purple nightshade at the rate of 10 per pound. The seed was found to contain purple nightshade seeds at the rate of 117 per pound. The seedsman's test record indicated purple nightshade seeds at the rate of 10 per pound. It appears that his sample was not representative of the seed shipped. Maybe the lot of seed was not uniform, and the shipment in this instance happened to be a portion with more purple nightshade than the average of the lot.

FS 862 - A shipment of crested wheatgrass seed was labeled to contain no noxious-weed seeds. The seed was found to contain noxious-weed seeds at the rate of 40 per ounce. The sale was made by a firm that did not have the kind of seed in stock. The seller purchased the needed seed from another seedsman and instructed the seedsman to deliver the seed to a common carrier for shipment into another State. The firm that sold and ordered the seed shipped in interstate commerce could have been held liable in this instance. However, the seed firm that labeled and shipped the seed seemed to be the most culpable. It was in the best position to determine the quality of the seed. The seedsman did deliver the seed for transportation in interstate commerce and was subject to the act. The seed firm made a very common error. It submitted a sample to a State seed laboratory for testing. The State seed laboratory examined the seed for noxious-weed seed according to its own State law. The supplier failed to ask for a noxious-weed seed examination for the State into which the seed was to be shipped. The noxious-weed seed found was not noxious in the seedsman's own State, but it is considered noxious in the State into which this shipment was made.

Variety

FS 898 - Oat seed was labeled to be the Andrew variety. Trueness-to-variety tests indicated this seed was not the Andrew variety. The seedsman did not obtain and keep growers' declarations of variety, receiving records, and blending and processing records. It appeared that no precautions were taken to determine that the seed was of the variety stated.

FS 910 - A shipment of rye seed was labeled to be the Balbo variety. Trueness-to-variety tests indicated it was not the Balbo variety. The seedsman did not obtain and keep a grower's declaration of variety. He indicated that the seed was bought in good faith on the farmer's word and also that no other variety of rye had been grown in his community for 15 years.

FS 895 - A shipment of rye seed was represented to be the Abruzzi variety, to consist of 95.24 percent pure seed, 3.75 percent other crop seeds, and 0.92 percent inert matter; to contain the noxious-weed seed darnel at the rate of 42 per pound; and to be one lot of seed. A number of individual bag samples of this seed were tested. Some were the Abruzzi variety, some were mixtures of varieties, and some were not Abruzzi at all. The pure seed percentages ranged from 88.11 to 97.81. Other crop seed percentages ranged

from 1.84 to 9.77. Inert matter percentages ranged from 0.02 to 3.07. The rate of occurrence of darnel seeds ranged from none to 240 per pound. The seedsman did not obtain and keep growers' declarations of variety, or invoices or other documents indicating the seed to be the variety stated. Our investigation revealed that this shipment was made up of seed from various sources. No attempt was made to blend the seed to uniformity or determine by tests that it was all of equal quality and was therefore a "lot of seed" as that term is defined under the Federal Seed Act. An "average sample" of the entire amount was tested. Obviously, an average sample of this heterogenous mass of seed was not a reliable basis for labeling each bag.

FS 858 - A shipment of rye seed was labeled to be the Balbo variety. A trueness-to-variety test indicated it was not the Balbo variety. A grower's declaration of variety allegedly pertaining to this seed was furnished by the seedsman for our inspection. Our investigation revealed that the seed in this instance had been purchased from a grain elevator as feed rye, and was not the seed identified by the grower's declaration.

FS 854 - A shipment of sorghum seed was labeled to be the "Honey Drip" variety. The seed was a mixture of varieties and inter-crosses of sorghum. The seedsman obtained a grower's declaration of variety. However, the seed could be distinguished from Honey sorghum by characteristics of the seed. Therefore, the grower's declaration of variety did not constitute an exemption under section 203 of the act from being deemed liable.

Miscellaneous

FS 863 - Three shipments of mixed lawn seeds were found to be mislabeled as to the percentages of the various kinds included in the mixture. Some kinds claimed on the labels were not even present in the mixtures. Other kinds not claimed were present in excess of five percent and should have been shown. Some of the percentages for kinds present were false. No tests were made of the lots after blending. No records of blending were kept; therefore, any records of tests of the component lots the seedsman may have kept could not be identified with the seed shipped. The seedsman was deemed in violation of the Federal Seed Act not only for the false labeling but also for failure to keep a complete record.

Proposed Amendments to the Regulations Under the Federal Seed Act

Notice has been published in the Federal Register of a proposal to amend certain sections of the rules and regulations under the act. One hearing will be held June 19, 1961, in Washington, D. C. Another hearing will be held June 29, 1961, in Chicago, Illinois. The second hearing mentioned is scheduled to follow the convention of the American Seed Trade Association. Anyone interested in these proposed amendments may appear at the hearings and present his views orally, or comments may be submitted to the United States Department of

Agriculture, Washington, D. C., in writing prior to July 31, 1961.

Proposals which may be of particular interest are as follows: The name "Ryegrass" would be removed from the list of names of kinds of agricultural seed, and the term "annual" would be recognized as a synonym of "Italian". This would require that ryegrass seed be labeled to show the name "perennial ryegrass" or "Italian (or annual) ryegrass," and the percentage thereof. Some freshly harvested ryegrass seed may be dormant, and the time interval between harvest in the Northwestern States and sowing in the Southeastern States will not always permit a florescence test to be made prior to shipment. It is intended that freshly harvested ryegrass seed will be recognized as indistinguishable seed during the months of July, August, and September. Grower's declarations or other documents establishing the name of the kind will be recognized as a proper precaution taken to assure the identity to be that stated. The exemption would not apply to blended lots of seed.

Section 201.34, which pertains to labeling as to kind, variety, or type, would be amended to provide that grower's declarations, invoices, and other documents would not be recognized as an exemption from liability for labeling indistinguishable seed as to kind, variety, or type if the person responsible for the labeling blended together or combined different lots of seed for which separate grower's declarations are required.

Glaucantha bluegrass, Kenya clover, hard fescue, green panicgrass, Wimmera ryegrass, beardless wheatgrass, and Siberian wheatgrass would be added to the kinds of agricultural seed subject to the act. Great burdock, tronchuda cabbage, and chives would be added to the kinds of vegetable seed subject to the act.

Rules for testing would be brought up to date and rules for sampling and tolerances would be amended to agree with rules for sampling and tolerances approved by the Association of Official Seed Analysts.

A declaration of labeling would be required to accompany the entry documents pertaining to imported seed.

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Grain Division
Washington 25, D. C.

February 1, 1961

SEEDSMEN'S RECORDS AND THE FEDERAL SEED ACT

I. Introduction

Maintaining proper records as required under the Federal Seed Act is a problem to some seedsmen. The failure to keep proper records may make it difficult to defend oneself against charges of false labeling or claims filed for failure to fulfill a contract. Records necessary for normal good business management will ordinarily meet the requirements of the Federal Seed Act and the rules and regulations thereunder. Records which disclose receiving, processing, quality, testing, labeling, sales, and shipping information are essential to everyday management of a seed business.

The term "complete record" is defined in the rules and regulations under the Federal Seed Act to mean "information which relates to the origin, germination, and purity (including variety) of each lot of agricultural seed transported or delivered for transportation in interstate commerce, or which relates to the germination and variety of each lot of vegetable seed transported or delivered for transportation in interstate commerce. Such information includes seed samples and records of declarations, labels, purchases, sales, cleaning, bulking, handling, storage, analyses, tests, and examinations. The complete record kept by each person for each lot of seed consists of the information pertaining to his own transactions and the information received from others pertaining to their transactions with respect to each lot of seed."

Section 202 of the Federal Seed Act and sections 201.4, 201.5, 201.6, and 201.7 of the rules and regulations under the act set forth the requirements of record keeping. A complete record of each lot is required to be kept for 3 years, except that the file sample may be discarded one year after disposal of the entire lot of seed. Growers' declarations of origin or of kind, variety, or type for seeds indistinguishable by seed characteristics should be kept by the person procuring the seed from the grower if exemption from responsibility for false labeling as to variety is to be claimed as provided under section 203(d) of the act. Shippers' declarations, invoices, or other labeling should be kept by subsequent handlers to indicate how the seed was represented when received. The records should be kept in such a manner as to permit comparison with the records kept by others pertaining to the same lot of seed so that the seed may be traced from the place where it is sampled back to the grower, if necessary.

The following suggested records provide the information pertaining to seed subject to the Federal Seed Act. They are designed for simplicity, yet

relate a continuous history of the seed. No record is of value unless it is kept up to date and filed where it is readily available. The receiving record, grower's declaration, processing record, test record, and labeling and disposition record may be kept together in one file folder for each lot, or they may be kept separately.

II. Lot Numbers

Lot numbers are the principal means of identifying seed and should be shown on all records. Choose a simple set of numbers. Do not repeat the series of lot designations more often than every 3 years.

III. Receiving Records

Receiving records may be conveniently kept in a ledger or notebook, or on a special form. Country dealers purchasing seed primarily from growers may prefer a simple style. Prenumber the lines with lot numbers. Each time a purchase of seed is made, it receives the next lot number and information is entered as indicated below. Invoices received, scale tickets, labels or test records received, and declarations of origin or variety supplement this simple record.

RECEIVING RECORD
(Sample)

Our Lot No.	Date	From	Kind and Variety	Amount	Incoming Lot No. or Remarks
1	10-1-60	Farmer Brown Brookhaven	Minhafer oat	18,460	bulk, load 1
2	10-2-60	John Doe Farmdale	Red clover	1,610	18 bags uncl.
3	10-2-60	Valley Seed Co. St. Louis	Ky. bluegrass	25 bags	lot B1014
4	10-6-60	Pacific Shippers Inc., Portland	Per. ryegrass	50 bags	lot 6K16R
5	10-8-60	Blend of lots 988, 992 and 1004	Ky. 31 tall	60 bags	cleaned

Receiving records showing more information may be on 3 x 5 or 5 x 7 file cards and kept in numerical order by lot numbers.

RECEIVING RECORD
(Sample)

Our lot No. _____ Kind and Variety _____
Date received _____ Amount _____
From _____ Address _____
Their lot No. _____ Brand _____
Their invoice No. or date _____ Price _____
Transported to us by _____
_____
Remarks: _____
_____
_____

IV. Growers' Declarations

Growers' declarations of origin, or information traceable to a declaration of origin, are required for alfalfa, red clover, white clover, and open-pollinated corn. A declaration of kind, variety, or type for any seed indistinguishable by seed characteristics should be obtained by the person procuring the seed from the grower if exemption from responsibility for false labeling as to variety is to be claimed as provided under section 203(d) of the act. When in doubt, obtain a declaration. A copy of the declaration and a sample of the seed should be kept by the grower.

Forms may be obtained in booklets from the State Printing Co., 136 No. 12th Street, Lincoln, Nebraska, or The Ellis Press, 723 West Indiana Street, Enid, Oklahoma. The books include yellow alternate sheets for carbon copies. By furnishing the names of these printers, no discrimination is intended nor guarantee of reliability implied. Similar forms may be available from other sources or may be printed by local printers on order.

Form GSFSA - 250

GROWER'S DECLARATION
(Sample)

United States Department of Agriculture
GROWER'S DECLARATION OF ORIGIN, KIND, VARIETY, OR TYPE

(Declarations of ORIGIN are required for alfalfa, red clover, white clover, and corn, other than hybrid corn. Declarations of KIND, VARIETY, or TYPE are required only when the seed is being sold under the name of a KIND, VARIETY, or TYPE that cannot be determined by the appearance of the seed.) In accordance with the regulations under the Federal Seed Act, I, the grower of the seed described below, do hereby declare that the facts stated are correct

to the best of my knowledge and belief.

KIND OF SEED_____ VARIETY*_____ TYPE*_____

Grower's lot number or mark, if any_____ Bags_____ Pounds_____

Where grown: County_____ State_____

Seed sold to_____ P. O. Address_____

Delivered to_____ Place_____

Date shipped or delivered by grower_____ 19____

*The grower should have adequate information to support his naming of the variety or type. Not having such information the variety or type should not be stated.

(To be filled in by purchaser) Signature of grower and post office

Auto Tag: State_____ No._____ _____

Purchaser's receiving lot No._____ P. O. _____

Note: A copy of this declaration should be retained by the grower.

V. Processing Records

Records of blending, cleaning or processing, and treating may be combined into one form.

PROCESSING and/or BLENDING RECORD
(Sample)

New lot No. 21

Kind Red Clover

Variety Unknown

Origin Ill.

Date Processed 12-10-60

Instructions:

Clean X clipper, gravity and dodder

Blend X _____

Rebag X plain white 60 lbs.

Treat X Thiram 1 oz. per bu.

Seed cleaned or blended:

Kind and Variety

	Origin	Lot No.	No. bags	Weight
Red Clover	Ill.	3	7	710
" "	Ill.	11	4	450
" "	Ill.	17	10	1120
" "	Ill.	18	10	980
				3260

After processing: Disposition:

New lot No.	No. bags	Weight	Show lot into which bulked or to whom shipped	Date
21	43+10#	2590	to stock record lot 21	12-10-60
21#1 SCR	2	215	to lot 37	12-28-60
21#2 SCR	1 1/2	132	to lot 37	12-28-60
21#3 SCR	1	114	to lot 37	12-28-60
no value	2	167	to feed bin	12-10-60
mill loss		42		
total		3260		

VI. Disposition Records

A record of disposition of each lot of seed may be added to the bottom of the processing record if printed on an 8" x 11 1/2" sheet or it may be added to the reverse side of a 5 x 7 file card. The disposition record may also be kept as a separate record. Such a record should identify the seed by lot number and kind or kind and variety and should show the original amount of the lot. Space should be provided to enter the date, amount, and invoice number of each sale of the lot. The disposition record may also serve as an inventory record. Disposition records of retail sales are not usually kept. Firms doing both retail and wholesale business should assign certain lots for retail purposes.

DISPOSITION RECORD OR STOCK RECORD
(Sample)

Lot No. 21 Kind and Variety _____

Original amount 43 bu. + 10 # 2,590 43 + 10#

Inv. No.	Date	Bags	Weight	Balance	Sold to
101	12-10-60	10	600	33 + 10#	XYZ Seed Co.
114	12-19-60	20	1200	13 + 10#	Farmers Supply Co.
126	12-22-60	10	600	3 + 10#	Lucky Seed Co.
	12-22-60	3 + 10#	190	-----	into lot No. 36

VII. Test Records

Some firms send samples to a commercial or State seed laboratory for testing. The reports received are the seedsman's test records. A seed firm employing its own seed analyst usually relies upon the analyst to maintain a record of each test made. A 5 x 7 file card is suitable for this record. The germination record may be shown on the reverse side of the purity record.

All tests should be made in accordance with the procedures set forth in the rules and regulations under the Federal Seed Act. Be sure that the sample is drawn in such a manner as to represent the entire lot of seed. Also, be sure that tests are made to determine the name and rate of occurrence

of noxious-weed seeds for each State into which the seed may be shipped.

PURITY TEST RECORD
(Sample)

Lab No. _____ Kind and Variety submitted as _____
Lot No. _____ Submitted by _____
Date received _____ Size of sample _____ Test for _____
Date test begun, purity _____ germination _____ nox. _____
Date test reported, purity _____ germination _____
Test made by _____

PURITY ANALYSIS
(Sample)

	Wt.	%	*Varietal determination and method used
Pure seed*			
Other crop			
Inert			
Weed seeds			
Totals			Character of inert matter

Names of other crop seeds	Names of weed seeds	Noxious-weed seeds in _____ grams. Name No.

GERMINATION TEST RECORD
(Sample)

Lab No. _____
Lot No. _____ Kind _____

Date test begun								
Special treatment								
Temperature								
Substratum								
No. seeds tested								
Dates and normal seedlings counted								
Totals								

Germination Test Record (Continued)

Average								
Hard Seeds								
Average								
Abnormal seedlings								
Dead seeds								
Test made by								

VIII. Labeling Record

Labeling records should be kept even if the same information is shown on the label as is shown on the test report. The simplest record consists of keeping one of the printed labels or the stencil used to print the labels. These may be filed by lot numbers or filed with the test record.

IX. File Samples

A file sample of each lot of seed is considered a part of the purity and germination record. The containers should be marked, or other records kept, to show when, where, and how the sample was obtained and the amount and identification of the lot of seed it represents. If weevils or other pests tend to damage these samples, add a pinch of para-dichlorobenzene crystals (obtainable at most drug stores). A file sample of agricultural seed should be at least the minimum size for a noxious-weed seed examination as set forth in section 201.52 of the rules and regulations, and a file sample of vegetable seed should consist of at least 400 seeds. A sample kept by a seed laboratory may be considered as a seedsman's file sample provided the sample is available for inspection upon request. A seedsman who arranges for a seed laboratory to keep his file samples should always submit for testing a sample at least twice the size required for the tests requested so that ample seed will remain on file after the test.

X. Record Check List

If your records show the following information, you can rest assured that your records comply with the Federal Seed Act and the rules and regulations thereunder and they will supply you with sufficient information to trace the history of any lot of seed handled.

A. Receiving Records

1. Lot No. assigned
2. Purchased from
3. Name and address of carrier
4. Invoice No.
5. Invoice date
6. Transportation record No.

7. Date shipped
8. Date received
9. Amount received
10. How represented by supplier
    a. Kind and variety
    b. Lot No.
    c. Origin
    d. Pure seed percentage
    e. Inert matter percentage
    f. Other crop seed percentage
    g. Weed seed percentage
    h. Germination percentage
    i. Hard seed percentage
    j. Date of test
    k. Name and rate of noxious weed seeds
    l. If represented by laboratory report
        (1) Name of laboratory
        (2) Laboratory No.
    m. If by label, retain one of the labels

B. Processing records
1. New lot number assigned
2. Date processed
3. Lot number and weight of each lot blended
4. Rough weight
5. Cleaned weight
6. No. bags cleaned seed
7. Kind of bags and how marked
8. How processed
9. Description and name of substance with which treated

C. Sales and Shipping Records
1. Invoice No.
2. Invoice date
3. Kind and variety
4. Lot number
5. No. bags
6. Weight shipped
7. Quality represented on invoice
8. Date shipped
9. Shipped from
10. Date delivered
11. Shipped to

12. Transportation record No. and date
13. Name and address of carrier

D. Laboratory Test Record
1. Laboratory name
2. Test No.
3. Kind and variety
4. Lot No.
5. Submitted by
6. Date test begun
7. Date test completed
8. Size of sample tested for noxious-weed seeds
9. No. of seeds tested for germination and method used
10. Pure seed percentage, including varietal determinations made
11. Inert matter percentage
12. Other crop seed percentage
13. Weed seed percentage
14. Germination percentage
15. Hard seed percentage
16. Names and rates of noxious-weed seeds
17. If labeling is based on analysis of component lots, each lot should have complete records as indicated above.

E. Stencil or copy of label used

F. File sample
1. For minimum size see section 201.52 of the regulations under the Federal Seed Act
2. Lot No.
3. Sample No.
4. How and where sample was obtained

G. Copy of Grower's Declaration of Origin or Variety

H. Correspondence or reports relating to official tests made by State enforcement agencies

Note: If you did not process the seed, you do not need a processing record. If you did not represent agricultural seed as to origin or to be a particular variety which is indistinguishable by seed characteristics, you do not need declarations of origin or variety. Records of the purity and origin of vegetable seed need not be kept as that information is not required to be shown on labels. However, records of the variety of vegetable seeds are necessary as all vegetable seed must be labeled to show the name of the variety.

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Grain Division
Washington 25, D. C.

January 1961

NAMES AND TERMS USED IN ADVERTISEMENTS NOT IN COMPLIANCE WITH THE FEDERAL SEED ACT

Names of kinds and varieties of seed and descriptive terms have been noted in advertisements which do not comply with section 205 of the Federal Seed Act and sections 201.2(h) and (i), 201.34, and 201.36b of the rules and regulations under the act.

Section 205 of the act prohibits the dissemination by the United States mails or in interstate or foreign commerce of any false advertisement pertaining to agricultural or vegetable seeds. Sections 201.2(h) and (i) of the regulations set forth the names of the kinds of agricultural and vegetable seed subject to the act. Certain synonyms are recognized, such as suckling clover (small hop clover), cattail millet (pearl millet), Singletary-pea or Caley-pea (roughpea), sorgo (sweet type sorghum), and horse or fava bean (broadbean). Section 201.34 of the regulations sets forth the method of determining the correct name of the kind and variety. Section 201.36b sets forth the manner in which descriptive terms, origin designations, and terms taken from trademarks (including firm names) may be associated with names of kinds and varieties.

The name of the kind or variety may be shown separately in an advertisement provided it is confined to the recognized name and is shown in a manner that is not misleading.

In advertisements subject to the act, plural terms, such as "clovers," "hop clovers," "vetches," lespedezas," "millets," or "fescues," may be shown to indicate collectively several related species without showing the complete name of each kind. If variety names and kind names are both shown, however, the complete name of the kind must be clearly associated with the variety name.

Abbreviations of names of kinds and varieties are construed to be misleading as the average consumer may not be able to translate the abbreviations.

The following is a list of terms frequently noted as being not in compliance. The incorrect term is shown in the left column and the correct form in the right column.

Names of kinds and varieties (variety names underlined for distinction)

Common Errors	Correct Form
Clover, Alyce	Alyceclover
Bean	Field bean (if field bean)

Common Errors	Correct Form
Astoria bentgrass	Astoria colonial bentgrass
Highland bentgrass	Highland colonial bentgrass
Merion bluegrass	Merion Kentucky bluegrass
Delta bluegrass	Delta Kentucky bluegrass
Newport bluegrass	Newport Kentucky bluegrass
King Ranch bluestem	King Ranch yellow bluestem
Bromegrass	Smooth brome, field brome or mountain brome
Burclover or Clover, Bur	California burclover or spotted burclover
Clover, Button	Buttonclover
Alsike	Alsike clover
Hop clover	Large hop clover or small hop clover
Peas	Cowpea (if species Vigna sinensis)
Peas, Southern	Cowpea (if species Vigna sinensis)
Pea	Field pea (if field pea)
Illahee fescue	Illahee red fescue
Pennlawn fescue	Pennlawn red fescue
Alta fescue	Alta tall fescue
Ky. 31 fescue	Ky. 31 tall fescue
Kobe lespedeza	Kobe striate lespedeza
Black medic clover	Black medic
German millet	German foxtail millet
Hungarian millet	Hungarian foxtail millet
Starr millet	Starr pearl millet
Gahi-1 millet	Gahi-1 pearl millet
Austrian Winter pea	Austrian Winter field pea
Cane	Sorghum
Kafir	Sorghum
Milo	Sorghum
Maize	Sorghum (if sorghum)
African Millet Cane	African Millet sorghum or Sourless sorghum
Black Amber Cane	Black Amber Sorghum
Honey Drip Cane	Honey sorghum
Red Top Cane	Red Top sorghum or Sumac sorghum
Martin Milo	Martin sorghum or Martin Combine Milo sorghum
7078 or 7078 Milo	Combine 7078 sorghum
Hybrid milo	Hybrid sorghum
Clover, Sweet	Sweetclover

Common Errors	Correct Form
Hubam clover	Hubam white sweetclover
Madrid clover	Madrid yellow sweetclover
Melilotus indica	Sourclover
Sudan	Sudangrass
Viking trefoil	Viking birdsfoot trefoil
Empire trefoil	Empire birdsfoot trefoil
Lana vetch	Lana woollypod vetch
Willamette vetch	Willamette common vetch

Descriptive terms, origin designations and terms from trademarks

Common Errors	Correct Form
Winter barley	Barley, winter type
Select Sweet sudangrass	Sweet sudangrass, select quality
Fancy bermudagrass	Bermudagrass, fancy quality
Bromegrass, Southern	Smooth brome, southern type
Reseeding crimson clover	Crimson clover, reseeding type
Creeping red fescue	Red fescue, creeping type
Kansas alfalfa	Alfalfa, Kansas origin
Oklahoma approved alfalfa	Alfalfa, Oklahoma approved origin
Utah Grimm alfalfa	Grimm alfalfa, Utah origin
Northwestern alfalfa	Alfalfa, Northwestern origin
Domestic ryegrass	Ryegrass, domestic origin
Danish orchardgrass	Orchardgrass, Danish origin
John Doe alfalfa	John Doe brand alfalfa
John Doe's Lee soybean	John Doe's brand Lee soybean

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Grain Division
Washington 25, D. C.

October 1960

REQUIREMENTS UNDER THE FEDERAL SEED ACT FOR LABELING TREATED SEED

Definition of Treated Seed

The term "treated" means given an application of a substance or subjected to a process designed to reduce, control, or repel disease organisms, insects, or other pests which attack seeds or seedlings growing therefrom.

Information Required to be Shown on the Label

A word or statement in type no smaller than 8 points indicating that the seed has been treated.

The commonly accepted coined, chemical (generic), or abbreviated chemical name or a description of any process (other than application of a substance) used in such treatment in type no smaller than 8 points.

A caution statement if the substance used in such treatment in the amount remaining with the seed is harmful to humans or other vertebrate animals.

1. Seed treated with a mercurial or similarly toxic substance, if any amount remains with the seed, shall be labeled to show a statement such as "Poison", "Poison treated," or "Treated with Poison." The word "Poison" shall be in type no smaller than 8 points and shall be in red letters on a distinctly contrasting background. In addition, the label shall show a representation of a skull and crossbones at least twice the size of the type used for the name of the substance and the statement indicating that the seed has been treated.

2. Seed treated with other harmful substances (other than mercurials or similarly toxic substances), if the amount remaining with the seed is harmful to humans or other vertebrate animals, shall be labeled to show a caution statement, in type no smaller than 8 points, such as "Do not use for food, feed or oil," except;

   a. Seed treated with substances other than mercurials or similarly toxic substances and in containers of 4 ounces or less need not be labeled to show the caution statement; and,

   b. The following substances shall not be deemed harmful if present at a rate less than the number of parts per million indicated: Allethrin, 2 ppm; Malathion, 8 ppm; Methoxychlor, 2 ppm; Piperonyl butoxide, 8 ppm on oat and sorghum and 20 ppm on all other seeds; and Pyrethrins, 1 ppm on oat and sorghum and 3 ppm on all other seeds.

Names of Substances

The attached list contains the names of many of the substances that may

be used for treating seeds. No recommendation of the products is implied and no discrimination is intended. The first part contains the chemical names arranged in alphabetical order accompanied by abbreviated chemical names, commonly accepted coined names, and proprietary names. The second part shows proprietary names in alphabetical order accompanied by chemical, abbreviated chemical, or commonly accepted coined name, one of which is required to be shown on the labels of seed treated therewith. There may be additional proprietary names for these substances. The proprietary names may be shown on the labels as additional information, provided they are not misleading.

Form of Label

The information required for treated seed may be shown on the same label as used for other information (purity, germination, etc.) required under the Federal Seed Act, on a separate label, or on the container.

The following proposed forms of labeling illustrate minimum labeling requirements under the Federal Seed Act. Additional information may be shown, such as the rate of application, antidotes, specific purpose of treatment, etc., provided such information is not false or misleading.

Mercurials or similarly toxic substances

Treated with
(NAME OF SUBSTANCE)
POISON (in red)
(Skull and Crossbones)

Less harmful substances

Treated with
(NAME OF SUBSTANCE)
Do not use for food, feed or oil

Proprietary name not associated with the required labeling

XYZ DUST
This seed treated with
(NAME OF SUBSTANCE)
Do not use for food, feed or oil

Proprietary name associated with the required labeling

This seed treated with
NAME OF SUBSTANCE
(XYZ DUST)
Do not use for food, feed or oil

CHEMICAL NAME	ABBR.	COINED NAME	PROPRIETARY NAMES
*Anilinocadmium dilactate and Phenyl mercury formamide or Phenylamino cadmium dilactate and Phenyl mercury formamide			Puraseed
Benzene hexachloride Gamma Isomer		LINDANE	Abol Benesan Benezane Gamkil Hi-Gam Isomer 25 Isotox 75 Lincide Lindano 25 W
*Benzene hexachloride and Phenyl mercury urea			Mergamma
Bicyclopentene dicarbomixide and CAPTAN and Pyrethrins			Orthocide 75 (P)
Copper carbonate			
Copper 8-quinolinolate and Zinc trichlorophenate and FERBAM (Ferric dimethyldithiocarbamate)			
*Copper resinate and Phenyl mercury salicylate			
Cuprous oxide			
*Cyano (methylmercury) guanidine			
1, 1-Dichloro-2, 2 bix (p-chlorophenyl) ethane	TDE		

CHEMICAL NAME	ABBR.	COINED NAME	PROPRIETARY NAMES
Dichloro diphenyl trichloroethane or 2,2, bis (p-chlorophenyl)-1,1, 1-trichloroethane or 1,1,1-trichloro-2, 2-bix (p-chlorophenyl) ethane	DDT		Rhothane D-3
2,3-Dichloro-1, 4-naphthoquinone		DICHLONE	Phygon
*0,0-Diethyl-0-S-2-ethyl mercaptoethyl thiophosphate			Demeton Systox
*0,0-Diethyl S-(ethylthiomethyl) phosphorodithioate		PHORATE	Thimet
*0,0-Diethyl S-2-(ethylthio) ethyl phosphorodithioate		DITHIODEMETON	Bayer 19639 Disyston
0,0-Dimethyl dithiophosphate of diethyl mercapto-succinate		MALATHION	Dithiosystox
*Ethyl mercury acetate and Phenyl mercury acetate			Gallotox 51 Mer-sol 48 Mersol 51
*Ethyl mercury chloride			Ceresan 2%
*Ethyl mercury chloride and Phenyl mercury acetate			Agrox C Aldmer Quicksan 384 Quicksan 595 San
*Ethyl mercuric 2,3-dihydroxypropylmercaptide and Ethyl mercury acetate			Ceresan 75 Ceresan 100 Ceresan 200
*Ethyl mercury phosphate			Ceresan, New Improved

CHEMICAL NAME	ABBR.	COINED NAME	PROPRIETARY NAMES
*N-Ethylmercuri-1,2,3,6-tetrahydro-3, 6-endoemthano-3,4,5,6,7, 7-hexachlorophthalimide or 1,4,5,6,7-hexachloro-N-(ethylmercuri) bicyclo (2,2,1) hept 5 ene-2,3-dicarbomixide			Emmi
*Ethyl mercury p-toluene sulfananilide or N-(ethylmercuri)-p-toluene sulfananilide			Ceresan M Ceresan M2X
*Ethyl mercury p-toluene sulfonanilide and DIELDRIN			
Formaldehyde			Formalin
Formaldehyde and phenyl			Smut-Off
*Heptachloro tetrahydro methanoindene or 1,4,5,6,7,8, 8-heptachlor-3a,4,6, 6a-tetrahydro-4,7-methanoindene		HEPTACHLOR	Novagard H
*HEPTACHLOR and Ethyl mercury chloride and Phenyl mercury acetate			Merlane H
*HEPTACHLOR and Hexachlorobenzene			Bunt-No-More
HEPTACHLOR and THIRAM			
Hexachlorobenzene or Perchlorobenzene	HCB		Anticarie No-Bunt Sanocide Smut-Go
*Hexachloro hexahydro-1,4-endo exo, 8-dimethanonaphthalene	HHDN	ALDRIN	Drinox MKG Novagard S Puradrin

CHEMICAL NAME	ABBR.	COINED NAME	PROPRIETARY NAMES
*LINDANE and Ethyl mercury chloride and Phenyl mercury acetate			Mergamma C
*LINDANE and Ethyl mercuric p-toluene sulfananilide			Chlor-O-San
LINDANE and CHLORANIL			Lindane-Spergon 30-57
*LINDANE and THIRAM			Gam-O-San
*LINDANE and Phenyl mercury acetate			
*Hexachloro epoxy octohydro endo exo dimethanonaphthalene or 1,2,3,4,10-10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo exo-5,8-dimethanonaphthalene		DIELDRIN	
*DIELDRIN and THIRAM			Delsan A-D Panoran D-31
*DIELDRIN and Ethyl mercury chloride and Phenyl mercury acetate			Dieldrisan
Hexachloro epoxy octahydro endo endo dimethanonaphthalene or 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo endo-5,8-dimethanonaphthalene		ENDRIN	
*ALDRIN and Phenyl mercury formamide			Puradrin
*ALDRIN and Phenyl mercury acetate and Ethyl mercury chloride			Shell AM
*Hydroxymercurichlorophenol or 2-Chloro-4-(hydroxymercuri) phenol			Semesan
*[illegible]droxymercurichlorophenol and THIRAM			

CHEMICAL NAME	ABBR.	COINED NAME	PROPRIETARY NAMES
*Hydroxymercurinitrophenol and Hydroxymercurichlorophenol			Semesan Bel
*Hydroxymercuric cresol			Semesan, Special
*Mangamous ethylene bis (dithiocarbamate)		MANEB	
*Mercuric chloride		CORROSIVE SUBLIMATE	
*Mercuric chloride, paratertiary octyl phenoxy ethoxy ethyl dimethyl bensyl ammonium mercuric chloride, trioxy-methylete			
*Mercurous chloride			Calomel Calogreen
*Mercury pentadione			Merc-O-Dust
p-Methoxyphenyl trichloroethane or 2,2-(p-methoxyphenyl)-1,1,1-trichloroethane or 1,1,1-trichloro-2,2-bis(p-methoxy-phenyl) ethane		METHOXYCHLOR	Marlate Methoxo 25 W
*Methoxyethyl mercury acetate			Mema Mercuran Mema RM Quicksan M30
*Methyl mercury dicyandiamide			Panogen 15 Panogen 42 Liquid Panogen
*Methyl mercury hydroxide			

CHEMICAL NAME	ABBR.	COINED NAME	PROPRIETARY NAMES
*Methyl mercury 8-hydroxyquinolinate			Liqui-San Ortho LM
*Methyl mercuric nitrile or Methyl mercury cyanide			Agrosol Chipcote 25 Chipcote 50 Chipcote 75
Pentachloronitrobenzene	PCNB		Brassicol Folosan Terrachlor Tilcarex Tritisan
*Phenyl amino cadmium dilactate and Phenyl mercury formamide (see Anilinocadmium dilactate and Phenyl mercury formamide)			
*Phenyl mercury acetate			Gallotox Gallotox 50 Mer-kote Mer-sol Mer-sol 75 Mersolite Quicksan
*Phenyl mercury ammonium acetate			Setrete
*Phenyl mercury chloride			
*Phenyl mercury formamide			
*Phenyl mercury formamide and Cadmium dilactate			Mer-cad
*Phenyl mercury salicylate			
*Phenyl mercury urea			Agrox

CHEMICAL NAME	ABBR.	COINED NAME	PROPRIETARY NAMES
Pyrethrins			
Sodium dimethyldithiocarbamate, mercaptobenzothiazole			
Tetrachloroquinone or Tetrachloro-para-benzoquinone		CHLORANIL	Spergon Spergon SL
CHLORANIL and DDT			
Tetramethylthiuram disulfide or bis (dimethylthiocarbanyl) disulfide		THIRAM	Arasan Arasan SF-X Ferasan Nomersan Tersan 75 Tulisan
THIRAM and METHOXYCHLOR			Arasan SF-M
*THIRAM and Methyl mercury dicyandiamide			Panoram 75
N-Trichloromethylmercapto-4-cyclohexene-1, 2-dicarboximide or N-trichloromethylthiotetra-hydrophthalimide		CAPTAN	Orthocide 5% Dust Orthocide 50 Orthocide 65 Orthocide 75 SR-406 Orthocide 406
*CAPTAN and DIELDRIN			Orthocide Dieldrin 60-15
CAPTAN and LINDANE			Isotox 25 (F) Ortho Seed Guard (F)
Zinc trichlorophenate			Dow 9-B

*Indicates mercurial or similarly toxic substance

PROPRIETARY NAMES	CHEMICAL NAME	ABBR.	COINED NAME
Abol	Benzene hexachloride Gamma Isomer		LINDANE
*Agrox	Phenyl mercury urea		
*Agrox C	Phenyl mercury acetate and Ethyl mercury chloride		
*Aldmer	Phenyl mercury acetate and Ethyl mercury chloride		
Anticarie	Hexachlorobenzene or Perchlorobenzene	HCB	
Arasan	Tetramethylthiuram disulfide or Bis (Dimethylthiocarbanyl) disulfide		THIRAM
Arasan 42S	Same as Arasan		THIRAM
Arasan SF-M	Tetramethylthiuram disulfide and Paramethoxyphenyl trichloroethane		THIRAM and METHOXY-CHLOR
Arasan SF-X	Same as Arasan		THIRAM
*Bayer 19639	O,O-diethyl S-2-(ethylthio) ethyl phosphorodithioate		
Benesan	Benzene hexachloride Gamma Isomer		LINDANE
Benexane	Benzene hexachloride Gamma Isomer		LINDANE
Brassicol	Pentachloronitrobenzene	PCNB	
Bunt-No-More	Hexachlorobenzene	HCB	
*Calogreen	Mercury chloride		
*Calomel	Mercury chloride		
*Ceresan 2%	Ethyl mercury chloride		
*Ceresan 75	Ethyl mercury 2,3 dihydroxy propyl mercaptide and Ethyl mercury acetate		
*Ceresan 100	Same as Ceresan 75		

PROPRIETARY NAMES	CHEMICAL NAME	ABBR.	COINED NAME
*Ceresan M	Ethyl mercury p-toluene sulfananilide		
*Ceresan M2X	Same as Ceresan M		
*Ceresan New Improved	Ethyl mercury phosphate		
*Chipcote 25	Methyl mercury nitrile		
*Chipcote 50	Methyl mercury nitrile		
*Chipcote 75	Methyl mercury nitrile		
*Chlor-O-San	Benzene hexachloride and Ethyl mercury p-toluene sulfananilide		
*Delsan AD	Tetramethylthiuram disulfide and Hexachloro-6, 7-epoxy octohydro-1, 4-endo exo-5, 8-dimethanonaphthalene		THIRAM and DIELDRIN
*Demeton	0,0-Diethyl-0-S-2-ethyl mercaptoethyl thiophosphate		
*Dieldrisan	Hexachloro 6,7-epoxy octahydro-1, 4-endo exo-5, 8-dimethanonaphthalene and Phenyl mercury acetate and Ethyl mercury chloride		
*Di-syston	0,0-diethyl S-2 (ethylthio) ethyl phosphoro dithioate		
*Dithiostox	Same as Di-syston		
Dow 9-B	Zinc trichlorophenate		

PROPRIETARY NAMES	CHEMICAL NAME	ABBR.	COINED NAME
*Drinox	Hexachloro hexahydro-1, 4-endo exo-5, 8-dimethano-naphthalene		ALDRIN
*Emmi	N-Ethylmercuri-1,2,5,6-tetrahydro-3, 6-endomethano-3,4,5,6,7,7-hexa-chlorophthalimide		
Ferasan	Tetramethylthiuram disulfide		THIRAM
Folosan	Pentachloronitrobenzene	PCNB	
Formalin	Formaldehyde		
*Gallotox	Phenyl mercury ammonium acetate		
*Gallotox 50	Same as Gallotox		
*Gallotox 51	Same as Gallotox		
Gamkil	Benzene hexachloride Gamma Isomer		LINDANE
Gam-O-San	Benzene hexachloride Gamma Isomer and Tetramethylthiuram disulfide		LINDANE and THIRAM
Hi-Gam	Benzene hexachloride Gamma Isomer		LINDANE
Isomer 25	Benzene hexachloride Gamma Isomer		LINDANE
Isotox 25 Seed Treater (F)	N-trichloromethylmercapto-4-cyclo-hexene 1,2-dicarboximide (or N-trichloromethylthiotetrahydrophthali-mide) and Benzene hexachloride Gamma Isomer		CAPTAN and LINDANE
Isotox 75	Benzene hexachloride Gamma Isomer		LINDANE
Lincide	Benzene hexachloride Gamma Isomer		LINDANE

PROPRIETARY NAMES	CHEMICAL NAME	ABBR.	COINED NAME
Lindane-Spergon 30-57	Benzene hexachloride Gamma Isomer and Tetramethylthiuram disulfide		LINDANE and THIRAM
Lindano 25-W	Benzene hexachloride Gamma Isomer		LINDANE
*Liqui-San	Methyl mercury 8-hydroxyquinolinate		
Marlate	Paramethoxyphenyl trichloroethane or Trichloro-2,2-bis (p-methoxyphenyl) ethane		METHOXYCHLOR
*Mema	Methoxy ethyl mercury acetate		
*Mema RM	Same as Mema		
*Mer-cad	Anilinocadmium dilactate and Phenyl mercury formamide		
*Merc-O-Dust	Mercury pentadione		
*Mercuran	Methoxy ethyl mercury acetate		
*Mergamma	Benzene hexachloride and Phenyl mercury urea		
*Mergamma C	Benzene hexachloride and Phenyl mercury acetate and Ethyl mercury chloride		
*Mer-kote	Phenyl mercury acetate		
*Merlane H	Heptachloro tetrahydro methanoindene and Phenyl mercury acetate and ethyl chloride		
*Mer-sol	Phenyl mercury acetate		

PROPRIETARY NAMES	CHEMICAL NAME	ABBR.	COINED NAME
*Mer-sol 7	Phenyl mercury ammonium acetate		
*Mer-sol 48	Phenyl mercury acetate and Ethyl mercury acetate		
*Mer-sol 51	Same as Mer-sol 48		
*Mer-sol 75	Phenyl mercury acetate		
*Mersolite 8	Phenyl mercury acetate		
*Mersolite W	Phenyl mercury acetate		
Methoxo 25W	Paramethoxyphenyl trichloroethane		METHOXYCHLOR
*MKG Seed Treatment Concentrate	Hexachloro hexahydro-1,4-endo exo-5,8-dimethanonaphthalene	HHDN	ALDRIN
No-Bunt	Hexachloro benzene	HCB	
Nomersan	Tetramethylthiuram disulfide		THIRAM
*Novagard H	Heptachloro tetrahydro methanoindene		HEPTACHLOR
*Novagard S	Hexachloro hexahydro-1,4-endo exo-5, 8-dimethanonaphthalene	HHDN	ALDRIN
*Ortho LM Seed Protectant	Methyl mercury 8-hydroxyquinolinate		
Ortho Seed Guard (F)	N-trichloromethylthiotetrahydrophthalimide and Benzene hexachloride Gamma Isomer		CAPTAN and LINDANE
Orthocide 5% Dust	Same as Ortho Seed Guard (f)		
Orthocide 50	N-trichloromethylthiotetrahydrophthalimide		CAPTAN
Orthocide 65	Same as Orthocide 50		

PROPRIETARY NAMES	CHEMICAL NAME	ABBR.	COINED NAME
Orthocide 75	Same as Orthocide 50		
Orthocide 75 (P)	Bicyclopentene dicarboximide and Pyrethrins and N-trichloromethyl-thiotetrahydrophthalimide		
Orthocide 406	Same as Orthocide 50		
*Orthocide Dieldrin 60-15	N-trichloromethylthiotetrahydroph-thalimide and Hexachloro-6, 7-epoxy octahydro-1,4-endo exo 5,8-dimethanonaphthalene		CAPTAN and DIELDRIN
*Panogen 15	Methyl mercury dicyandiamide		
*Panogen 42	Methyl mercury dicyandiamide		
*Panogen Liquid	Methyl mercury dicyandiamide		
*Panoram D-31	Tetramethylthiuram disulfide and Hexachloro 6, 7-epoxy octahydro-1, 4-endo exo-5, 8-dimethanonaphthalene		THIRAM and DIELDRIN
Panoram 75	Tetramethylthiuram disulfide		THIRAM
Phygon	2,3-Dichloro-1, 4-naphthoquinone		DICHLONE
*Puradrin	Hexachloro hexahydro-1, 4-endo exo-5, 8-dimethanonaphthalene		ALDRIN
*Puraseed	Phenylaminocadmium dilactate (or Anilino-cadmium dilactate) and Phenyl mercury formamide		
*Quicksan	Phenyl mercury acetate		

PROPRIETARY NAMES	CHEMICAL NAME	ABBR.	COINED NAME
*Quicksan M30	Methoxy ethyl mercury acetate		
*Quicksan 384	Phenyl mercury acetate and Ethyl mercury chloride		
*Quicksan 595	Phenyl mercury acetate and Ethyl mercury chloride		
Rhothane D-3	Dichloro diphenyl trichloroethane	DDT	
*San	Phenyl mercury acetate and Ethyl mercury chloride		
Sanocide	Hexachlorobenzene	HCB	
*Semesan	Hydroxymercurichlorophenol		
*Semesan Bel	Hydroxymercurinitrophenol and Hydroxymercurichlorophenol		
*Semesan, Special	Hydroxymercuric cresol		
*Setrete	Phenyl mercury ammonium acetate		
*Shell AM	Hexachloro hexahydro-1,4-endo exo-5, 8-dimethanonaphthalene and Phenyl mercury acetate and Ethyl mercury chloride		
Smut-Go	Hexachlorobenzene	HCB	
Smut-Off	Formaldehyde and Phenol		
Spergon	Tetrachloroquinone or Tetrachloro-parabenzoquinone		CHLORANIL
Spergon SL	Same as Spergon		
*Sys[redacted]	0,0-Diethyl-0-2-ethyl mer[redacted]toethyl thiophosphate		

PROPRIETARY NAMES	CHEMICAL NAME	ABBR.	COINED NAME
Terrachlor	Pentachloronitrobenzene	PCNB	
Tersan 75	Tetramethylthiuram disulfide		THIRAM
*Thimet	0-0 Diethyl-S-(ethylthiomethyl) Phosphorodithioate		PHORATE
Tilcarex	Pentachloronitrobenzene		
Tritisan	Pentachloronitrobenzene		
Tulisan	Tetramethylthiuram disulfide		THIRAM

*Indicates mercurial or similarly toxic substance

COINED NAME	CHEMICAL NAME
*ALDRIN	1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-endo exo-5,8-dimethanonaphthalene or Hexachloro hexahydro endo exo dimethanonaphthalene
CAPTAN	N-Trichloromethylmercapto-4-cyclohexene-1,2-dicarboximide or N-trichloromethylthiotetrahydrophthalimide
CHLORANIL	Tetrachloroquinone or Tetrachloro-para-benzoquinone
DICHLONE	2,3-Dichloro-1,4-naphthoquinone or Dichloro naphthoquinone
*DIELDRIN	1,2,3,4,10,10-Hexachloro 6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo exo-5,8-dimethanonaphthalene or Hexachloro epoxy octahydro endo exo dimethanonaphthalene
*DITHIODEMETON	0,0-Diethyl S-2-(ethylthio) ethyl phosphorodithioate
*ENDRIN	1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octohydro-1,4-endo endo-5,8-dimethanonaphthalene
*HEPTACHLOR	1,4,5,6,7,8,8-Heptachlor-3a,4,6,6a-tetrahydro-4,7-methanoindene or Heptachloro tetrahydro methanoindene
LINDANE	Benzene Hexachloride Gamma Isomer
MALATHION	0,0-Dimethyl dithiophosphate or Diethyl mercaptosuccinate
MANEB	Mangamous ethylene bis-(dithiocarbamate)
METHOXYCHLOR	p-Methoxyphenyl-trichloroethane or 2,2-(p-methoxyphenyl) 1,1,1-trichloroethane or 1,1,1-Trichloro-2,2-bis-(p-methoxyphenyl) ethane
PHORATE	0,0-Diethyl S-(ethylthiomethyl) phosphorodithioate
THIRAM	Tetramethylthiuram disulfide or Bis (dimethylthiocarbanyl) disulfide

*Indicates mercurial or similarly toxic substance

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Grain Division
Washington 25, D. C.

QUESTIONS AND ANSWERS ABOUT THE FEDERAL SEED ACT

Nos. 1-78 1959 to 1960

By S. F. Rollin, Acting Chief, Seed Branch

These 77 questions and answers were previously published in nine separate issues of seed trade publications. They are being redistributed in this manner, together with an accompanying index, with the thought that they may serve as a convenient reference. This may enable you to more easily understand the requirements of the Federal Seed Act and the rules and regulations thereunder.

1. Q: Will seed of any quality be permitted into the United States if it is in the small quantities not ordinarily sampled?

   A: Usually it will be permitted to enter. It is not practical to sample and test all small shipments of seed offered for importation. The new regulations set forth the minimum amounts of about 60 vegetable and 190 agricultural seeds that will ordinarily be sampled. However, this regulation does not prohibit the sampling and testing of small shipments if there is reason to believe this section is being used to avoid complying with the quality requirements of the act.

2. Q: Must every container of imported vegetable seed be labeled to show the name of both the kind and variety of seed?

   A: Yes. Such labeling, together with the lot number, will help preserve the identity of the seed. This will help subsequent interstate shippers to correctly label seed from such imported lots. This is particularly important when the varieties of seed cannot be distinguished.

3. Q: How must imported agricultural seed be labeled?

   A: The label must show the name of each kind or variety of seed, but if both the kind and variety are shown on the invoice and other entry papers, then the label must show both the kind and variety. The lot number must always be shown. As with vegetable seed, this will help subsequent interstate shippers correctly label seed from such imported lots.

4. Q: One of the sections of the regulations allows the re-entry of seeds that were sent abroad from this country, even though the seed does not comply with the United States import regulations. Is a sworn statement of a foreign

processor sufficient to identify such a lot of seed?

A: No. Such identifying statements must be by a customs or other government official of the country to which the seed was sent. The official statement must set forth that the seed was not admitted into the commerce of the foreign country and was not commingled with other seed.

5. Q: Is it advisable to file a declaration that seed offered for importation is for experimental or breeding purposes before it is tested in this country to determine whether it meets the import requirements?

A: Only under circumstances where time is a factor. However, the accurate identifying information required on seed offered for importation is seldom available before the seed arrives at the port of entry. Some importers may wish to be prepared to file such a declaration as soon as possible in cases where they have knowledge that the seed may not meet import requirements.

6. Q: Is the restriction on the amount of seed that may be imported for experimental or breeding purposes based on the size of each importation, each lot, or the amount that can be imported in 1 year?

A: It is based on the amount of each lot of seed.

7. Q: Are inbred lines of seed, imported for the production of hybrids, considered to be for "breeding" purposes?

A: Yes. Seed imported for making selections, crosses, or tests is considered to be for experimental or breeding purposes.

8. Q: Can seed that is imported for the sole purpose of increasing the seed supply be classed as being for experimental or breeding purposes?

A: No. There is no provision for exempting seed from the import requirements merely for the purpose of increasing the supply

9. Q: Why was sorghum almum retained as the name of a kind of seed when the seeds of sorghum almum cannot be distinguished from Johnsongrass?

A: Sorghum almum has previously been recognized as the name of a kind of seed and described as a distinct species; therefore, to abandon the name now would create confusion. In addition, sorghum almum has been designated a noxious-weed seed in some States which do not wish to designate all sorghum x Johnsongrass and sorghum x sudangrass crosses as noxious. It is anticipated that some future releases of such crosses may be valuable for forage purposes and should be available to farmers. These crosses would not be available if they were all considered to be noxious-weed seeds. The problem of identification is no different than it is when two other

indistinguishable kinds are involved.

10. Q: Does the change in section 201.7 recognizing an invoice or other document as a basis for labeling indistinguishable seed as to variety mean that grower's declarations are not necessary?

    A: No. Grower's declarations as to kind, variety, or type of indistinguishable seed are still required to be kept by the person who purchases such seed from a grower if he intends to sell the seed under a variety name. However, subsequent handlers are permitted to rely upon other documents normally passing from seller to buyer, such as an invoice.

11. Q: Why must the germination be shown for each kind of agricultural seed listed on the label even though it is present in an amount less than 5 percent?

    A: This is to prevent the listing of small percentages of valuable ingredients in mixtures for the purpose of misleading the purchaser when the germination of such ingredients may be so low as to be worthless for seeding purposes.

12. Q: Why were aldrin, dieldrin, and heptachlor placed in the list of mercurials and similarly toxic substances used for treating seed so that seed treated with them must be labeled to show a skull and crossbones and the word "Poison"?

    A: The level of toxicity of these substances, determined by the lethal dose required to kill experimental animals, logically placed these substances in the highly toxic category. On the same basis, chlordane was removed from the list of the highly toxic substances. Although this labeling is not consistent with the requirements for labeling these substances when sold as such under the Federal Insecticide, Fungicide, and Rodenticide Act, the labeling required on seed treated with these substances appears justified because the product we are dealing with may be used for food or feed; whereas, the substances themselves are not likely to be so used, except accidentally.

13. Q: Do vegetable seed packets containing 4 ounces or less of seed treated with a substance other than a mercurial or similarly toxic substances have to be labeled with a caution or warning statement?

    A: No. Such packets are required to be labeled to indicate that the seed is treated and the name of the substance used in the treatment.

14. Q: Under what circumstances can treated seed in containers of over 4 ounces be shipped in interstate commerce without bearing a caution or warning statement?

A: When the seed is treated at a rate less than the number of parts per million specified for certain-named substances. These include allethrin (2 p.p.m.), malathion (8 p.p.m.), methoxyclor (2 p.p.m.), piperonyl butoxide (8 p.p.m.), and pyrethrins (1 p.p.m.). The seed would still have to be labeled to indicate that it was treated and the name of the substance used in the treatment

15. Q: Would you give some examples of coined names as distinguished from chemical or private trade-marks?

A: Some examples of coined names are aldrin, demeton, dieldrin, endrin, ferbam, lindane, maneb, nabam, thiram, zineb, and ziram.

16. Q: Can private trade-marks be used in lieu of coined or chemical names to satisfy the labeling requirements for treated seed?

A: No. The coined, chemical or abbreviated chemical name is required to be shown. The private trade-mark may be shown, in addition, providing it is not used in a manner that would be construed to be misleading.

17. Q: Do the complete chemical names of the mercurials have to be shown in labeling?

A: No. The term "mercury" or "mercurial" may be used in labeling seed treated with any one or combination of the mercurials.

18. Q: Does the consent of the consignee have to be obtained each time a large shipment is made to him without labels attached to the bags?

A: No. This can be an agreement covering a specified period or an indefinite period. It is suggested, however, that the agreement be in writing and be kept as part of the shipper's records.

19. Q: Can any commonly used synonym be used as a substitute for the name of a kind of seed in labeling seed subject to the act?

A: No. It is suggested that agreement be obtained from the Seed Branch that the term intended to be used is recognized as a synonym.

20. Q: Is it permissible to use variety names in labeling seed in interstate commerce when they do not appear in the lists of variety names in the regulation?

A: Yes, if they are new varieties introduced since the regulations were last amended or if no list for the particular kind appears in the regulations and the variety would otherwise meet the requirements for a variety as set forth in section 201.34(e) of the regulations.

21. Q: What is a grower's declaration of variety?

A: It is a signed statement of a grower establishing, to the best of his knowledge, the variety of certain identified seed sold by him.

22. Q: On what kind of seed is a grower's declaration necessary?

A: It is intended for use on seed which is indistinguishable as to variety on the basis of seed characteristics.

23. Q: What is the value of a grower's declaration as to variety?

A: The statement made by the grower is the basic record upon which all subsequent handlers of seed may rely for exemption from prosecution under the Federal Seed Act for having unknowingly made a false representation as to variety.

24. Q: If the seed is distinguishable as to variety on the basis of seed characteristics, is the declaration of any value as protection to the interstate shipper under the Federal Seed Act?

A: No.

25. Q: Who is held responsible for the fact that seed indistinguishable as to variety is falsely labeled?

A: The interstate shipper; however, if he keeps a complete record as required under the Federal Seed Act and other pertinent facts disclose that he took proper precautions to label the seed correctly he will not be held responsible.

26. Q: Who may finally be held responsible?

A: If every handler of the seed keeps a complete record, the responsibility may finally rest with the grower.

27. Q: What kind of records is the grower required to keep?

A: He is required to keep for 1 year a sample of any lot of seed sold to a dealer and represented as to variety and to keep for 3 years a copy of the signed grower's declaration of variety.

28. Q: What is the purpose of requiring the grower to keep a file sample of the seed?

A: To make it possible to determine whether seed which is indistinguishable as to variety by seed characteristics and which is found in interstate commerce to be falsely labeled is the same seed originally sold by the grower.

29. Q: How may a grower be construed to be subject to the Federal Seed Act if he doesn't ship the seed across a State line?

A: For having sold the seed for shipment in interstate commerce by someone

else. Insofar as labeling as to variety or origin is concerned, if seed is in that "current of commerce" usual in the merchandising of seeds whereby it is expected that such seeds will move in interstate commerce, it may be construed to be subject to the act.

30. Q: What should growers do to protect themselves from a charge of false labeling as to variety?

A: The grower should retain evidence of the source of his planting stock to establish that the seed planted by him was represented to him to be the variety claimed. Needless to say, the best possible precaution for signing a grower's declaration as to variety is to have planted certified seed. If the seed is of a cross-pollinated variety, it should be only a few generations away from certified seed--the fewer the better. The number of generations will depend upon the isolation of the growing crop. In some cases, seed one generation removed from certified seed may be pollinated by another variety to such an extent that the seed produced is no longer entitled to be labeled as a distinct variety. This determination is the growers responsibility as he is the person in the best position to know to what extent the crop was isolated to prevent pollination by another variety.

31. Q: What harm is done by growers who sign false declarations as to variety?

A: They may by their actions be harming another grower. He may be a neighbor or he may be a farmer in a distant State who relies on the subsequent labeling as to variety.

32. Q: What can a seedsman do to determine the variety of seed he buys and sells, other than to obtain a grower's declaration as to variety?

A: He can find out or supervise the source of the seed stock used by the grower, where and how it was grown, how well it was isolated, and how it was harvested and processed. Supervision can best be done under a contract arrangement with the grower.

33. Q: Where can I find information on how to correctly label and advertise seed as to the name of the kind so as to comply with the Federal Seed Act?

A: In the regulations under the Federal Seed Act which became effective November 21, 1955, and were amended in 1957, 1959, and 1960. They provide a clear guide for labeling and advertising seed as to kind. The proper names of the kinds are given in section 201.2(h) and (i).

34. Q: How can I obtain a copy of these sections?

A: By requesting a copy of Service and Regulatory Announcements No. 156 or a reprint of the regulations from the Seed Branch, Grain Division, Agricultural Marketing Service, United States Department of Agriculture,

Washington 25, D. C.

35. Q: How do the 1955 regulations and subsequent amendments differ from the regulations which were in effect before November 21, 1955?

A: Some of the names of kinds previously permitted can no longer be used in labeling seed in interstate commerce. This is particularly the case where certain varieties of seed have been labeled and advertised both as to kind and variety and the name of the kind has been abbreviated.

36. Q: What are some examples of kind designations being abbreviated improperly?

A: "Fescue" has been improperly used as the name of the kind in labeling and advertising the Alta variety of tall fescue. "Lespedeza" has been used as the name of the kind in labeling and advertising the Common and Kobe varieties of striate lespedeza. "Bluegrass" has been used as the name of the kind in labeling and advertising the Merion variety of Kentucky bluegrass. The terms "fescue," "lespedeza," and "bluegrass" are not in themselves sufficiently informative to the buyer as there are many species of each. The different species of fescue, lespedeza, and bluegrass differ in characteristics and adaptability and therefore must be clearly identified.

37. Q: How should millet seed be labeled as to kind?

A: Under the Federal Seed Act, all "millets" have two-word names. Examples are foxtail millet, pearl millet, and proso millet. There is no way of knowing what kind of seed is referred to if seed is labeled as "millet".

38. Q: What are some examples of violations of the Federal Seed Act in advertising and labeling the various millets?

A: The most frequent violation which comes to the attention of the Seed Branch is omitting part of the kind name. For instance, Starr variety of pearl millet is advertised and labeled improperly as Starr millet; German or Golden variety of foxtail millet is shown as German or Golden millet, and White Wonder variety of foxtail millet is shown as White Wonder millet. The words "pearl" and "foxtail" are parts of the respective kind names and are required to be shown.

39. Q: Does the Federal Seed Act require labeling as to variety of agricultural seed?

A: No. The act requires labeling as to kind, kind and variety, or kind and type of agricultural seeds; therefore, the name of the kind is always required to be shown. The variety or type may be shown, in addition, and if given must be truthful.

40. Q: What is a brand?

A: A brand is a term by which goods may be distinguished as coming from a certain source.

41. Q: What is the function of a brand?

A: It is to identify the manufacturer or distributor, not the product itself.

42. Q: How does a brand differ from a variety name?

A: A brand is private property and may be used only by the owner or with the owner's permission. A variety name is public property available for use by everyone to designate the variety to which it applies. It is our understanding that a variety name cannot be a valid brand.

43. Q: What has caused the confusion between brand and variety names?

A: Under the Federal Seed Act, the originator of a new variety has a right to name that variety. If the variety can be reproduced from seed it may be produced and sold by anyone. The name that was given the variety by its originator may be used by anyone. In fact, under the Federal Seed Act that name must be used. This is true even though the name was a privately-owned brand. When a brand name is made a name of a variety it is no longer protected as a brand. Protestations on the part of the brand owner that it is still a brand do not make it so.

44. Q: When can a person use a brand privately owned by another person?

A: If the owner of a brand uses it as a variety name or part of a variety name, he, in effect, loses the protection given brands and automatically permits other persons to use it as the name of the variety. This is possible in the United States because variety names are not valid brands.

45. Q: What are the regulations under the Federal Seed Act applicable to the use of brands?

A: They require that in labeling or advertising seed subject to the Federal Seed Act, the representations of the kind or of the kind and variety shall be confined to the name either of the kind or of the kind and variety. Brand names when used must be clearly identified as being other than a part of the name of the kind or of the variety. Registration of a variety name as a trade-mark does not change its status as a variety name under the Federal Seed Act--the variety name may be used by anyone to describe that variety.

46. Q: What are some examples of proper and improper use of brand names with kind and variety names in labeling and advertising seed?

A: In our opinion, it is not misleading to use the term "Supreme Brand Kindred Barley." We think it is misleading to use the term "Supreme Kindred Barley." We also are of the opinion that it is misleading to deliberately use a brand as a substitute for a known variety name.

47. Q: What difference would it make if seed were to be sold by brand names instead of variety names?

A: It would result in a loss of the varietal identity. This could eventually result in losing much of the benefit of all the efforts on the part of experiment station and private plant breeders to develop, distribute and publicise superior varieties. Conceivably, if no controls existed, one variety could be sold under hundreds of brands. There would also be no control over what variety would be sold under the brand name from year to year. In other words, the label would not help seed buyers select seed of the variety they wished to purchase.

48. Q: How could this confusion as to brand and variety names be clarified?

A: By an amendment to the Federal Seed Act requiring that the variety name of agricultural seeds be shown on the label, if known, or if not known, to be so labeled. The buyer would then have less difficulty in distinguishing the designated brand from the variety name, if given, or if clearly stated to be not known.

49. Q: When large shipments of seed are made without labels on each bag, as permitted under section 203(b) (2) (B) of the act, must the information required under section 201(a), (b), and (i) be on the shipping papers which actually arrive with the seed or can such information be shown on the invoice?

A: As long as the statements required under sections 201(a), (b), and (i) are on the invoice accompanying and pertaining to the seed shipped, these statements need not appear on the shipping papers which actually arrive with the seed.

50. Q: Is it acceptable to have a grower's declaration on a check or voucher?

A: Grower's declarations on checks are permissible under the present wording of the regulations so long as they contain all the information required in section 201.2(n) and (o) of the regulations. We are of the opinion, however, that the use of a grower's declaration on a check places a certain amount of duress upon the person who endorses the check. In addition, the grower's declaration on a check would not always be available for inspection and the grower would not have a copy as required under the regulations. For these reasons, we would not recommend that grower's declarations be placed on checks. If it becomes a general practice, we

would recommend that it be prohibited.

51. Q: Is it necessary to clearly identify as a "Brand" the brand or trade-mark each time it is used in a price list with the name of the kind and variety of seed?

A: No. We are of the opinion that it is in compliance with section 201.36 b(c) of the regulations to clearly identify in the masthead of a price list terms used as a brand or trade-mark without identifying the brand or trade-mark as such each time it is used on the same page; for example, "The term 'Blank' is our brand (or trade-mark) and not a part of the name of the kind or variety."

52. Q: Is it permissible to use an advanced date for the required date of test in labeling lawngrass cartons for interstate shipment?

A: No. The Federal Seed Act requires that the labeling shall show the calendar month and year the test was completed to determine the percentage of germination and hard seed. The use of an advanced date of test would, in our opinion, be a false statement and therefore would be in violation of the Federal Seed Act.

53. Q: It is in compliance with the act to label packets or containers of seed with the word "Poison" with or without a skull and crossbones, even though the substance used in the treatment would not fall in the category of a mercurial or similarly toxic substance?

A: Yes. In our opinion, a stronger caution statement than is required would serve as a greater protection to the public and therefore would comply with the intent of the act. The container, of course, must still be labeled to indicate that it was treated and to show the name of the substance used.

54. Q: If a mixture consisting of various seed-treating substances requiring different caution statements is used in treating seed, must each substance be labeled with the appropriate caution statement?

A: No. In our opinion, the use of the strongest caution statement required by any one of the substances in the mixture would comply with the intent of the act.

55. Q: Can the proprietary name of a seed-treating product be used in addition to the name of the substance required to be stated?

A: Yes, insofar as the Federal Seed Act requirements are concerned. The name of the substance must be given as the principal name. The proprietary name may be given in parentheses. The rate of treatment for the product can also be given in the same parentheses with the proprietary name,

if desired, thus eliminating the problem of showing the rate (when required) for each substance if a mixture of substances is used in treating seed. The question as to whether you can legally use a registrant's trade-mark is a matter to be settled between the labeler and the registrant.

56. Q: Is it necessary that the other crop seed percentage shown on the label include the total of all kinds of seed present to the extent of less than 5 percent, including those kinds present to the extent of less than 5 percent shown separately on the label?

A: No. Since the act was recently amended to specifically provide for the labeling of percentages smaller than 5 percent, we are of the opinion that it was the intent of Congress that these percentages, when shown separately, need not also be shown as a part of the total "other crop seed" percentage.

57. Q: How large must a file sample of an agricultural seed lot be which seedsmen are required to keep under the Federal Seed Act?

A: It must be at least the weight required for a noxious-weed examination, as indicated under section 201.46 of the regulations. For example, it is required that at least the following amounts be kept on file:

500 grams (slightly over one pound) of barley, bean, corn cotton, cowpea, lupine, peanut, pea, soybean, and seeds of similar size.

300 grams (slightly over 1/2 pound) of beet, broomcorn, buckwheat, burclover, hemp, sainfoin, and seeds of similar size.

50 grams (slightly over 2 ounces) of alfalfa, crimson clover, red clover, meadow fescue, Johnsongrass, lespedezas, and seeds of similar size.

35 grams (slightly more than 1 ounce) of yellow bluestem, reed canary grass, alsike clover, suckling clover, white clover, dallisgrass, red fescue, and seeds of similar size.

25 grams (slightly less than 1 ounce) of bentgrasses, bluegrasses, persian clover, redtop, velvetgrass, and seeds of similar size.

58. Q: How large must a file sample of a vegetable seed lot be?

A: At least 400 seeds.

59. Q: Is it absolutely necessary that the person subject to the Federal Seed Act keep in his possession the file sample or may it be kept for him by a commercial or State seed laboratory?

A: It can be kept by a seed laboratory acting as an agent for the person subject to the act. If, however, the seed laboratory fails to keep or make available the required sample, the person subject to the act will be held responsible.

60. Q: What precautions should be taken in drawing a file sample?

A: The sample should be obtained according to accepted sampling techniques. These include sampling the minimum number of containers with a probe or trier which reaches all parts of the container. Samples drawn from lots of seed not uniformly blended cannot be representative of each portion or bag in the lot. Test results obtained on a sample which is not representative of each portion or bag in the lot are not reliable for use in labeling.

61. Q: If I obtain a laboratory report from my supplier, is it necessary for me to have another test made before labeling seed for interstate shipment?

A: The basis for labeling seed in interstate commerce is left to the interstate shipper to determine. If the seed is labeled correctly, the basis upon which it was labeled will not be questioned. If, however, the seed is found to be falsely labeled, the shipper's basis for labeling will be subject to inquiry to determine whether he took proper precautions in labeling the seed. It would appear that a person who, in good faith, obtains his own representative sample from a properly blended lot of seed as it is received and has it tested by a qualified seed analyst would, normally, have taken proper precautions. On the other hand, a person who relies on a laboratory report furnished by his supplier is taking a certain amount of risk as he cannot know whether the sample reported on properly represents the seed he has received or that the seed lot is uniformly blended.

62. Q: If seed is held in storage until the date of test expires, is a retest of the original file sample considered a reliable basis for determining the percentage of germination and renewing the date of test shown on the labels?

A: No. Seed stored in a warehouse does not always retain its viability the same as a small sample stored under different conditions. A new sample of the seed actually in storage should be obtained for the purpose of retesting and relabeling.

63. Q: If part of a lot is treated with an insecticide or fungicide, and part of the lot is not treated, is it advisable to keep samples of both the treated and untreated seed?

A: Yes. The two portions should be considered as separate lots of seed. It is advisable to retest the treated seed for germination after treatment.

Treating the seed may cause the percentage of germination to be lowered more rapidly than for untreated seed, particularly if the seed has a high moisture content or if it is treated at too heavy a rate.

64. Q: Why are there frequently wide variations in tests made by different laboratories on the same lot of seed?

A: In the many check tests which our laboratories conduct on official samples and commercial seed laboratory samples, we seldom find any error in testing on the part of a laboratory. Differences beyond tolerance in results of tests reported are most frequently found to be caused by differences in the samples tested.

65. Q: How are the methods for testing seeds developed in enforcement of the Federal Seed Act?

A: Most of the methods for testing seeds promulgated in the rules and regulations under the Federal Seed Act have previously been adopted by the Association of Official Seed Analysts. Each proposed change in the regulations is published in the Federal Register and a public hearing is held before a change in the regulations is promulgated by the Secretary.

66. Q: Who can propose changes in the methods for testing seed in enforcement of the Federal Seed Act?

A: Anyone can propose to the U. S. Department of Agriculture changes in the rules for seed testing to be included in the rules and regulations under the Federal Seed Act. Recommendations should be supported by research date establishing that the proposed change will establish a more accurate method of determing the true planting value of seed. The public hearings provide an opportunity for everyone to be heard regarding proposed rule changes.

67. Q: When is a new kind of seed added to the list of those subject to the Federal Seed Act?

A: When it is determined by the Secretary that seed of the particular kind is in commercial channels, is being used for seeding purposes in the United States, and proper methods for testing are available.

68. Q: Do private and commercial seed laboratories generally follow the same rules for testing seed as do the State and Federal laboratories?

A: We believe they do even though there is no legal requirement that they must do so. The Federal Seed Act requires that seed be completely and correctly labeled. The rules for testing seed in the regulations indicate how seed will be tested in enforcement of the act. It behooves seedsmen labeling seed for interstate shipment to test seed in the same manner for

their own protection even though they are not legally required to do so.

69. Q: What guides for seedling evaluation are available in those instances when normal and abnormal seedlings may be difficult to differentiate?

A: Assistance may be obtained by using (1) check tests made in sterilized soil or sand, (2) photographs of seedlings as standard guides (available from the U. S. Department of Agriculture as specified in the rules for testing seed in the Federal Seed Act), and (3) seedling descriptions as published in the Federal Seed Act rules. The Seed Branch of the U. S. Department of Agriculture also conducts "seed schools" on a regional basis annually where commercial and official analysts may confer and reach agreement on interpretations and classification of problem seeds and seedlings.

70. Q: If a seedsman sends two samples of the same lot of seed to two different laboratories and the difference in the results reported exceeds the recognized tolerance, how can the seedsman determine how the seed is to be labeled?

A: Both laboratories should be informed of the results of both tests and retests should be requested. In addition, the laboratories should be asked to send portions of their samples to a third laboratory as a "referee." Such retests will usually establish whether one of the laboratories is in error or whether the two samples are actually of different quality. If time does not permit delaying labeling and sale of the seed in order to await the results of retests, the safest course is to label the seed according to the lease favorable test result from the labeler's standpoint. To label according to the most favorable test reported would be taking a certain amount of risk and does not demonstrate good faith on the part of the labeler.

71. Q: If a proprietary name or trade-mark is used on a seed treatment label, may it be in larger size print than the name of the substance required to be shown?

A: Yes, providing the proprietary name is not a part of the treatment statement or closely associated with the name of the substance required to be shown in the treatment statement. It is not construed to be misleading if the treatment statement reads, "Treated with Thiram" and elsewhere on the label a trade-mark appears, regardless of size of the print. It is construed to be misleading if the treatment label reads "Treated with ROLLINS (thiram)" or "Treated with thiram (ROLLINS)."

72. Q: Can a marketing association obtain a code designation from the Department and use it in lieu of a shipper's name and address on all seeds shipped interstate by its members?

A: No, not if the shipments are made by the members individually. A separate code designation would have to be issued for each interstate shipper. If the association collects the seed at one point, however, and then ships it interstate, the association would then be considered the interstate shipper and one code designation would suffice.

73. Q: What is the pedigree of the hybrid sorghum variety J999?

A: The pedigree of a privately produced hybrid, if filed with this Branch, is considered to be confidential.

74. Q: Is sorghum almum a variety of sorgrass?

A: Sorgrass is the name of the kind for rhizomatous derivatives of a Johnsongrass x sorghum cross or a Johnsongrass x sudangrass cross. Sorghum almum is a species of the Sorghum genus for which the botanical name is also the common name. Both of these kinds of seed are listed in section 201.2(h) of the rules and regulations and the seed of both is subject to the act when shipped in interstate commerce.

75. Q: What is the kind name to be used for hybrids of sorghum x sudangrass?

A: In order to distinguish such hybrids from sorghum hybrids and sudangrass hybrids, we have suggested that they be called "sorghum-sudangrass hybrid."

76. Q: Is "sorgo" recognized as a synonym for the kind name "sorghum"?

A: Yes. The term "sorgo" when used in connection with sweet-stalked sorghum varieties is considered a synonym for the kind name "sorghum." This recognition of synonyms is provided for in section 201.34(h) of the rules and regulations, as amended effective July 1, 1959.

77. Q: Is it permissible to label "Common" ryegrass as "Italian" ryegrass?

A: The term "Italian" is the common name for Lolium multiflorum Lam. This kind of seed is the annual species of ryegrass. If the "Common" ryegrass is at least 95 percent annual ryegrass, it may be labeled as "Italian" ryegrass. The name "Italian" can be used in labeling annual ryegrass, regardless of where the seed is grown.

Service and Regulatory Announcements No. 156, Rules and Regulations under the Federal Seed Act may be obtained from the Seed Branch, Grain Division, Agricultural Marketing Service, United States Department of Agriculture, Washington 25, D. C.

APPLICATION OF THE TETRAZOLIUM TEST TO COTTON AND SOYBEANS

James C. Delouche[1/]

Test methods for rapidly determining or estimating seed viability would contribute much toward greater efficiency in seed processing and marketing operations. Such tests would provide viability information upon which to base sound, timely decisions regarding bulking, blending, processing and marketing of various seed lots.

Rapid viability tests based upon the tetrazolium method are described below for soybeans and cotton. The procedures and methods outlined, if properly applied, will provide reasonably accurate information on germinability within 6 to 8 hours.

Selection of the Seed

The seeds used for the tetrazolium test are selected at random from the pure seed fraction of a purity analysis. If a pure seed fraction is not available, the seeds can be selected at random from a representative sample drawn from the lot of seed. In the latter case, the definition of pure seed used in seed testing should be closely observed, e. g., immature seeds or broken seeds over one-half the size of the original seed should not be discriminated against during selection.

One hundred seeds are generally sufficient for the test provided the seeds are properly selected. These one hundred seeds can be treated as a single replicate or divided into two replicates of 50 seeds each. If ample time and labor is available, two or more replicates of 100 seeds will increase the accuracy of the results.

Soybeans

Preparation of the Seeds

Preconditioning of the seeds before testing is necessary for satisfactory results. The most favorable procedure is to place the seeds between moist towels or blotters overnight (14 - 16 hrs.). However, three or four hours between moist towels are sufficient for preconditioning of the seeds if more time is not available.

The seed coats of most varieties of soybeans need not be removed prior to staining. In certain varieties, however, such as Ototan, Red Tanner and Laredo, tetrazolium will not penetrate the seed coats and it is necessary to remove them prior to staining. In such cases, the seed coats should be carefully removed with fingers and forceps. After removal of the seed coat the seeds are immediately placed in the tetrazolium solution.

1/ Dr. Delouche is Associate Agronomist, Seed Technology Laboratory, Mississippi Agricultural Experiment Station.

Staining of the Seeds

After preconditioning (and removal of the seed coats in the case of some varieties) the seeds are placed in a 1 percent solution of tetrazolium. A small beaker or jar can be used to hold the solution and seeds. The quantity of solution should be sufficient to completely cover the seeds. The tests are then placed at 40° C. in darkness. At this temperature the seeds stain adequately for evaluation in 2 - 4 hours depending on the variety. Lower temperatures (or room-temperature) are satisfactory, however, 5 to 7 hours will be required for staining. Regardless of the temperature, the seeds should remain in the solution until a good but not overly intense stain has developed.

Once an adequate stain has developed, the solution is drained off and the seeds placed in clean tap water in a Petri dish or other shallow dish. The seed coats are then carefully removed to permit examination of the staining patterns.

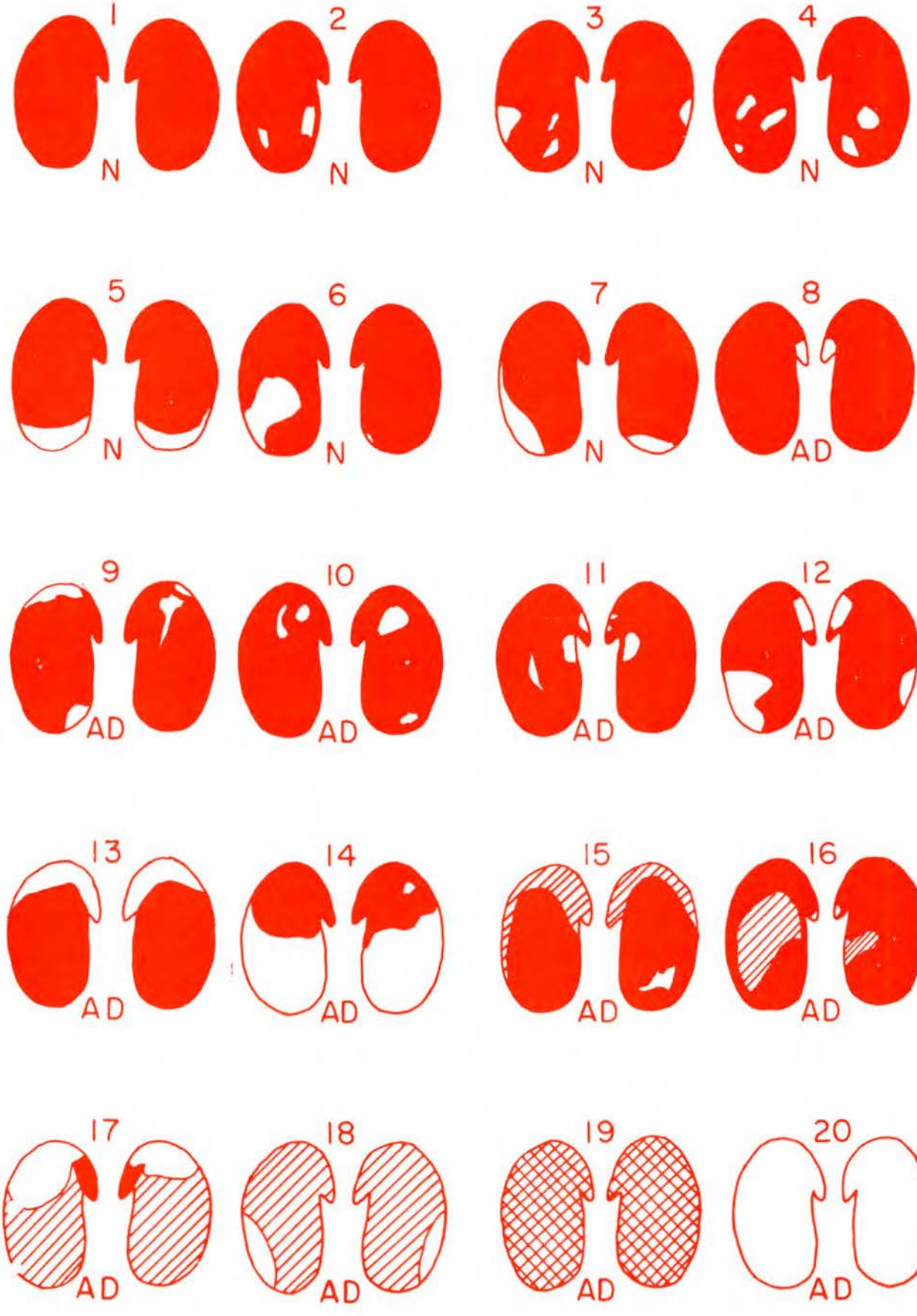
Interpretation (Plate 1)

At the end of the staining period, the seed coats of a majority of the seeds are still intact. These seeds are generally viable; however, the seed coats must be removed and the seeds examined before a definite decision can be reached. Badly deteriorated seeds develop severe ruptures in the seed coats and the cotyledons are cracked or split. The seed coats of other seeds develop slight splits, but no particular significance can be attached to this reaction.

Twenty typical staining patterns are illustrated in Plate 1. The drawings are paired illustrations of both sides of the seed. The symbol N indicates seeds which are capable of producing normal seedlings. The symbol AD indicates seeds which yield abnormal seedlings or are not capable of germination. An explanation of the significance of the various staining patterns depicted is indicated below.

Illustration	
No. 1	NORMAL. Seed completely stained; stain usually not perfectly uniform in color.
Nos. 2 - 7	NORMAL. Illustrations depict progressively larger dead areas on cotyledons; capable of normal germination; vigor reduced.
No. 8	ABNORMAL OR DEAD. Seed well stained except radicle; radicle white; root development abnormal.
Nos. 9 - 13	ABNORMAL OR DEAD. Unstained, dead areas at various position on radicle or in the critical region at juncture of radicle, cotyledons and epicotyl.

PLATE I — SOYBEANS



No. 14	ABNORMAL OR DEAD. Major portion of cotyledons unstained and dead.
No. 15	ABNORMAL OR DEAD. Seed usually intensely stained; radicle area milky or pearlish in appearance (appears as a cloudy film over stained area underneath).
Nos. 16 - 18	ABNORMAL OR DEAD. Various combinations of milky appearing areas and unstained areas in critical locations.
No. 19	ABNORMAL OR DEAD. Seed stained abnormally dark red; interfaces of cotyledons usually well stained; cutting through cotyledons reveals deep penetration of stain.
No. 20	ABNORMAL OR DEAD. Seed completely unstained; white or greenish in appearance.

There are several other points which should be considered in interpreting tetrazolium test results on soybeans. The interfaces of the cotyledons generally do not stain or they stain very faintly. This probably results from a lack of contact between this tissue and the chemical.

In some instances very faint staining of the seeds might be misinterpreted as a complete absence of staining. When soybeans are tested without removing the seed coats, the coats of vigorous seeds apparently restrict the penetration of the chemical so that some areas of the seed stain only faintly by the end of the period. Such areas usually have a faint yellow or pink cast and the tissue is quite firm. However, if there is any doubt the seeds should be placed in a tetrazolium solution for an additional 15 to 20 minutes and re-examined.

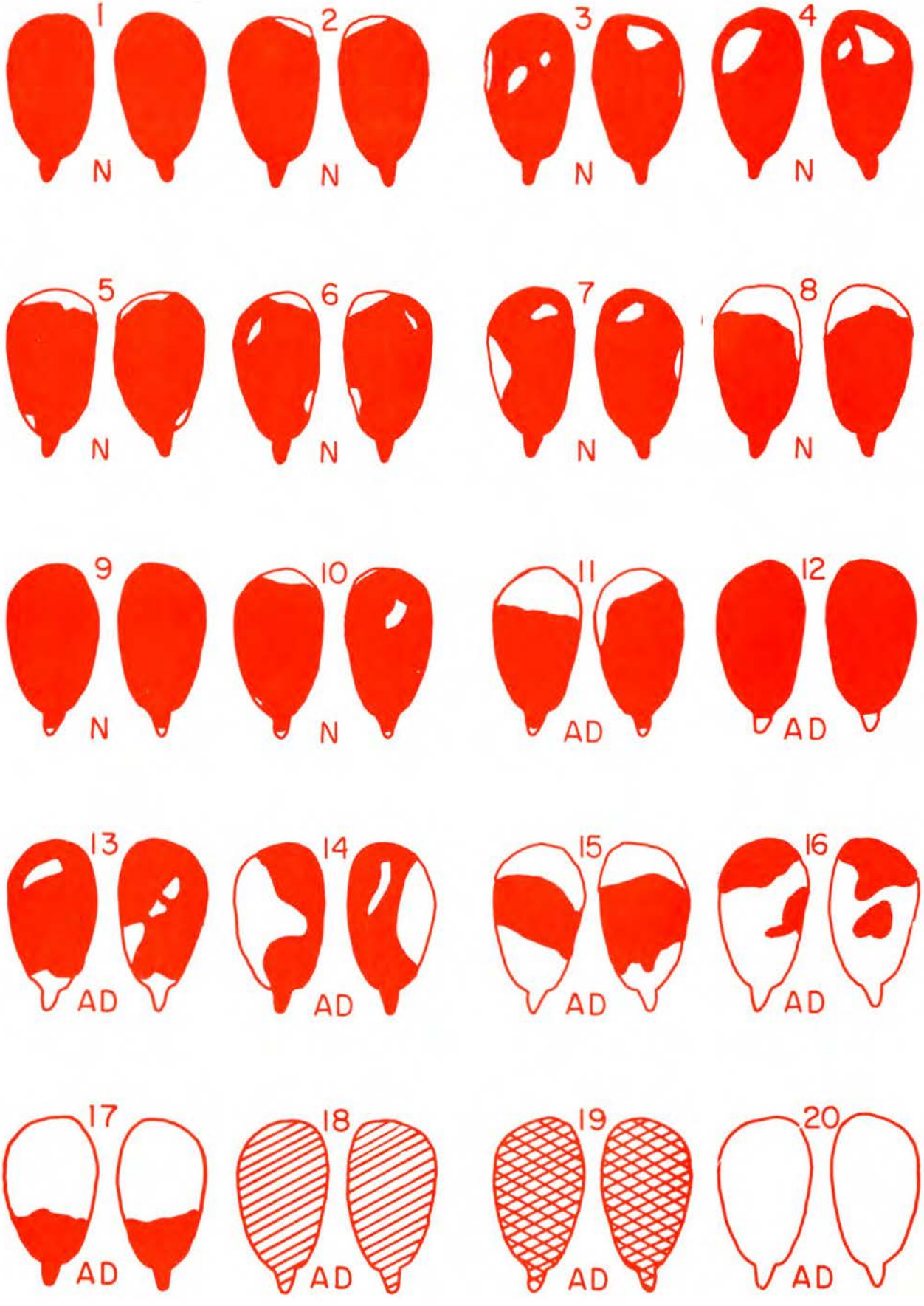
Seeds with wrinkled seed coats develop elaborate staining patterns. A well defined net work of red and yellow stripes and bands develop and apparently correspond to the wrinkles in the seed coat. The yellow areas should not be misinterpreted as dead areas.

As previously indicated, the seeds do not always stain uniformly. Dark, light and medium red areas occur on the same seed. This reaction is apparently normal. For example, the areas underneath splits developed in the seed coat during absorption are usually more intensely stained than other areas of the seed.

When the methods described above are properly applied, the tetrazolium test will usually yield quite accurate results. It should be pointed out, however, that in exceptional cases, the tetrazolium test can lead to very inaccurate conclusions.

The beginner in tetrazolium testing will find it profitable to make comparative germination and tetrazolium tests until he becomes familar with the colors and patterns developed in the tetrazolium test.

PLATE II — COTTON



Cotton

Preparation of the Seeds

Tetrazolium will not penetrate the seed coat of cottonseed. It is, therefore, necessary to remove it. Removal of the seed coat is most easily accomplished if the seeds are soaked in warm water (85 - 95° F.) for a minimum of 5 - 6 hours. After the seed coat has been removed, a thin membrane remains around the cotyledons. It is also necessary to remove this membrane for satisfactory staining. Generally, the membrane can be rubbed off with the fingers immediately after removal of the seed coat. A preferable procedure, however, is to soak the decoated seeds for 15 - 20 minutes in water to further soften the membrane before its removal. Care should be exercised during removal of the seed coat and membrane so that the seed tissues are not injured.

While removing the seed coats it will be observed that some seeds are obviously decayed and dead. These need not be tested. However, the number of dead seeds should be noted so that they can be included in the calculations after the test is completed.

Staining of the Seeds

The prepared seeds are placed immediately in a 1 percent tetrazolium solution. They should not be allowed to dry out. A beaker or small jar can be used to hold the seeds and solution. A sufficient quantity of tetrazolium should be used to completely cover the seeds. The tests are then placed at 40° C. in darkness. At this temperature the seeds usually stain adequately for interpretation in 2 hours or less. Lower temperatures are satisfactory but the time necessary for staining is greatly increased. Regardless of the temperature, the seeds should remain in the solution until a good but not overly intense stain has developed.

After the seeds have stained satisfactorily, the solution is drained off and the seeds are placed in clean tap water in a Petri dish or other shallow dish.

Interpretation (Plate 11)

Interpretation of tetrazolium tests on cottonseed is difficult. With a little experience, however, it is possible to estimate viability with reasonable accuracy. This situation is not too surprising as the standard germination test is also subject to considerable variability.

Twenty typical staining patterns are illustrated in Plate 11. The drawings are paired illustrations of patterns developed on both sides of the seed. The symbol N indicates seeds which are capable of producing normal seedlings. The symbol AD indicates seeds which yield abnormal seedlings or which fail to germinate. An explanation of the significance of the various staining patterns depicted is indicated below:

Illustration

No. 1 — NORMAL. Seed completely stained; stain not overly intense.

Nos. 2 - 8 NORMAL. Minor white, dead spots on cotyledons; capable of normal germination; vigor reduced.

No. 9 NORMAL. Extreme tip of radicle white; root growth normal or secondary roots develop.

No. 10 NORMAL. Extreme tip of radicle white; minor dead areas on cotyledons; capable of germination.

No. 11 ABNORMAL OR DEAD. Extreme tip of radicle white; large dead area on cotyledons; abnormal development.

No. 12 ABNORMAL OR DEAD. Most of protruding portion of radicle white and dead; abnormal root development.

No. 13 ABNORMAL OR DEAD. Major portion of radicle white and dead; small dead areas on cotyledons.

No. 14 ABNORMAL OR DEAD. Major portion of cotyledons white and dead; dead area extends into critical region at juncture of hypocotyl and cotyledons.

Nos. 15 - 17 ABNORMAL OR DEAD. Major portion of seed white and dead.

No. 18 ABNORMAL OR DEAD. Off-type stain; milky appearance (grayish red); cotyledons usually tightly appressed; not expanded.

No. 19 ABNORMAL OR DEAD. Seed stained abnormally dark red (purplish red); cotyledons not expanded.

No. 20 ABNORMAL OR DEAD. Seed completely unstained; white or greenish yellow in appearance.

Cottonseed usually stains fairly uniformly. Minor injuries resulting from removal of the seed coat sometimes stain dark red.

Normally, the cotyledons expand slightly during the soaking and staining periods. Seeds illustrated in drawings 19 and 20 usually do not expand; the cotyledons remain tightly wrapped and the seeds appear smaller than others.

Because of the difficulties in interpretation of tetrazolium test results, the beginner should run comparative germination tests along with tetrazolium tests. Upon the basis of the results of the comparative tests, the analyst can adjust his procedures to increase the accuracy of his estimate.

STUDY SEEKS TO IMPROVE QUALITY OF COTTONSEED[1]

William P. Caldwell[2]
Rayburn E. Parker[3]

The overall quality of cottonseed produced in Mississippi has been unsatisfactory for the past several years. Viability of the majority of cottonseed used for planting purposes since 1957 has averaged between 60 and 70 percent, with many lots going as low as 40 percent. This has necessitated lowering of certification standards and temporary alteration of state laws to meet the demands for planting seed.

Considerable interest has been expressed by farmers and seedsmen in a research program to investigate the causes of this deterioration in cottonseed quality. This is the object of a current cooperative research project of the Mississippi Agricultural Experiment Station and U. S. Department of Agriculture.

Field experiments were conducted at the Delta Branch Experiment Station, Stoneville, in 1960, to determine the effects of preharvest environment, from time of boll opening until picking, upon cottonseed and lint quality. The first step was to measure the effects of temperature and humidity on seed and lint deterioration. In order to establish plant microclimates of differing humidities, three levels of nitrogen fertility and two levels of irrigation were used.

Blossoms were tagged at three dates to give a large sample of like age bolls at the bottom of the plant, middle of the plant, and top of the plant. These bolls were harvested at three dates: 1 week, 3 weeks, and 6 weeks after opening. Recording hygrothermographs were placed in the plots to give a continuing microclimate record of temperature and relative humidity.

Although the levels of nitrogen fertility and irrigation have some effect on the temperature and humidity in the boll microclimate, the position of the boll on the plant and the length of exposure after opening had a greater effect.

Several measurements were made to determine the quality of the seed and lint. Viability, vigor, and emergence under field conditions were determined on the seed by the Mississippi Seed Technology Laboratory. Fiber color, fiber strength, upper half mean fiber length, and mean fiber length were determined by the Clemson Cotton Laboratory.

1/ Reprinted from Mississippi Farm Research, August 1961, Volume 24, No.8

2/ Mr. Caldwell is Assistant Agronomist, Mississippi Agricultural Experiment Station, State College, Mississippi.

3/ Mr. Parker is Agricultural Engineer, Agricultural Engineering Research Division, Agricultural Research Service, United States Department of Agriculture.

Table 1 lists means of the various measurements taken. It was found that field exposure of 3 and 6 weeks caused a significant loss in seed quality over that exposed for 1 week. Also, significant losses in seed quality occurred in bolls on the bottom and middle portions of the plant when compared with those in the top of the plant.

The degree of lint quality deterioration in nearly all cases paralleled that of seed quality deterioration. It was found that fiber strength was significantly reduced when bolls were exposed from 3 to 6 weeks before they were harvested. Also, in irrigated cotton, fiber strength was significantly less for the bottom crop than for the middle or top crop. Fiber upper half mean length was significantly reduced by field exposure of 3 to 6 weeks in plots which received a high rate of fertilizer (135 pounds N per acre). The length of the fibers from the bottom crop was significantly lower than that of the fibers from the middle and top crop. As shown in Table 1, the best fiber color was realized when the open bolls were exposed only 1 week. It also appears that the higher the boll on the stalk, the better the fiber color.

It is evident that if one is to realize maximum fiber length, strength, and color, and overall seed quality, he should harvest as soon after the boll opens as possible.

Correlations were made of the various quality measurements with the temperature-humidity index. With the exception of fiber strength and mean fiber length, these correlations were all highly significant.

Although this particular set of data indicates that the greatest amount of deterioration occurred in those bolls located on the bottom and middle portions of the plant, this may not necessarily hold true for every season. In the 1960 season, the highest combination of temperature and humidity occurred while the bottom and middle bolls were opening, and had decreased by the time the top bolls opened. In another season, the highest temperature and humidity might occur at some other time, in which case the portion of the crop exposed at that time would be damaged most.

It is important to remember that the deterioration which occurred was caused by exposure to high temperature and humidity. Nitrogen and irrigation levels, boll positions, and dates of harvest are secondary factors which controlled the intensity of the temperature and humidity to which the bolls were exposed. In seasons when the temperature and humidity is lower than the 1960 season, less deterioration may be expected.

Several factors are evidently contributing to the present lowered quality of seed and lint produced in Mississippi. Last year over 50 percent of the cotton produced in the Mississippi Delta was picked by machine. In many fields, only one picking was made - after all the bolls were open. The lower bolls may have been open for as long as 2 months before being picked. This prolonged exposure undoubtedly lowers the quality of the seed as well as the lint. Modern cultural practices, including high plant populations, high fertility levels, and irrigation, all contribute to higher humidity in the microclimate surrounding the lower bolls. This will tend to lower the quality of the seed and lint.

Table 1. Averages of seed and lint quality measurements from test conducted in 1960.

Variables	Seed measurements				Lint measurements			
	Viability	Vigor[1]	Field Emergence	Fiber Color[2]	Fiber Strength	Upper Half Mean Length	Fiber	Temperature-Humidity Index[3]
	Percent		Percent		Gms/tex	Inches	Inches	
Field exposure after boll opening								
1 week	78.99	28.72	28.25	93.6	23.19	1.06	.76	149.0
3 weeks	64.64	24.58	23.42	90.0	21.83	1.03	.73	378.1
6 weeks	54.11	21.86	19.70	87.2	22.13	1.04	.75	637.8
Boll position on plant								
Top	82.10	31.54	36.53	92.2	22.49	1.05	.76	264.8
Middle	64.32	25.27	21.73	90.6	22.44	1.05	.75	423.5
Bottom	51.32	18.34	13.11	87.9	22.23	1.03	.73	476.5

[1]A vigor index based upon rate of germination.

[2]Measured as percentage of value of 1 inch white Middling grade.

[3]Number of hours exposure to temperature plus relative humidity over 140.

Practices which would minimize the length of exposure of open bolls to high temperature and humidity would be expected to improve quality. This might be accomplished by lowering the humidity in the boll microclimate and also by picking as soon after boll opening as possible.

Research is in progress on various means of improving the quality of Mississippi's cotton lint and seed. These efforts are being directed toward reducing humidity in the boll microclimate by various cultural practices and toward effecting means of earlier machine harvesting. Work is also being done in the laboratory to clarify the effects of specific humidity and temperature levels upon cotton deterioration.

PRODUCTION OF HYBRID SEED CORN IN MICHIGAN

Michigan's largest producers of Michigan Certified Hybrid Seed Corn are Mantey's Pedigreed Seed Producers of Fairgrove, Michigan. The business of producing Certified Seed Corn was started in 1921 with open-pollinated varieties. Hybrid Seed Corn was added to the production in 1939. This year, 1961 marks the 40th consecutive year that a crop of seed corn will be produced and marketed by the Mantey's. Fritz the father and Carl and Ed the sons have operated as a partnership for several years. Two years ago they decided to change their drying operation and at that time installed a tower dryer and began to field shell their Hybrid Seed Corn.

Carl E. Mantey[1]

"We are firmly convinced after two seasons of field shelling Hybrid Seed Corn that it is both possible and practical.

In 1959 we had reached the position in our Hybrid Seed Corn operation that made it necessary to make a major change in our drying system. We had gradually changed through the years from a system of placing the individual ears on a lath rack and circulating warm air around the racks to a crib or bin system using forced warm air. The repeated elevating and handling of our ear corn not only damaged the seed, but was costly. Our dryer was so small and slow that it held up our harvest. We considered a new crib type dryer of the size which would give us the capacity we wanted. The cost and labor involved in the construction of this type of dryer seemed prohibitive. At this point the idea was presented that we might install a tower type, continuous flow dryer for our shelled seed corn. As we first thought about this, we believed that field shelling Hybrid Seed Corn was impossible but the thought did intrigue us because of the possibilities of the amount of labor it would save and the simplicity of the harvest operation. At this time it was brought to our attention that a few people in the Hybrid Seed Corn business were harvesting their seed this way. We decided that if it were possible for some to field shell Hybrid Seed Corn, then we could adapt it to our Michigan conditions. With some logical actions and an amount of knowledge which has accumulated through forty years in the Seed Corn business we made the change from drying seed corn on the ear to field shelling and tower drying.

We believed from past experience that there would be two possible places in the harvest which would be trouble spots. One could be the shelling, the other might be through exposing the germ face of the seed to forced warm air.

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[1] Mr. Mantey is Co-owner of Mantey's Pedigree Seed Producers and President, Michigan Seed Dealers Association.

In the shelling operation, logic and common sense must be followed. We found that we should run the combine cylinder as slowly as possible and still get the corn from the cob. We use a self propelled combine with a rasp bar cylinder. We definitely feel that the weakest link in the harvest or shelling is the elevator or conveyor which equipment companies place on their combines to carry the shelled or threshed grain to the bin. The equipment manufacturers could help the seed producer greatly if they would use an elevator at this point suitable for handling of seed. This would help not only the Hybrid Seed Corn producer, but any and all seed producers from beans to wheat. We feel now that we have suddenly become more "damage conscious" than we were before we decided to try our new operation. In examining samples of the same variety of seed corn which was dried in an ear-crib-type dryer and corn which was field shelled and dried, we actually found less damage in the latter. We believe that each variety of corn must be handled as an individual, that there are some characteristics which affect the handling of some varieties. It is possible that some varieties can be harvested at a higher moisture content than others. We feel that optimum moisture content for our corn harvest is from 18 - 22%. Local conditions of humidity and varietal characteristics may cause this to vary. We think that it is possible that a heavy coating of husks on the ear when it hits the combine cylinder may have a beneficial affect. We have found that a variety which tends to flinty type corn may give more trouble than some others. It may be true that a long kernel shells more easily than a short one.

We now believe that our fears regarding the actual drying of shelled Hybrid Seed Corn were groundless. In our tower dryer, the kernel is actually exposed to warm air for a much shorter time than in our old crib-type dryer, where the ear was held in a stable, fixed position and warm air was continuously forced past it for between 50 and 100 hours. The temperature of the seed itself is held at a much lower level in our tower dryer than it was in the crib-type dryer.

We find that field shelling actually gives us an increase in yield of seed as we have practically no loss of shelled corn either in the field from the snapping rolls of the picker, or from handling through the husking beds and conveyors necessary for handling ear corn.

The germination reports on our seed corn which was field shelled and dried in our continuous flow tower dryer have been very satisfactory. This year we have our first cold germination reports on field shelled seed corn which was carried over for one year. These cold germination reports also came up to all our expectations and hopes.

Since production costs from the standpoint of equipment and labor have risen so tremendously in the past 15 years and the price of seed corn has remained practically the same, the only way that we can realize and maintain a reasonable measure of profit is by increasing the efficiency of our operation.

We feel that going to a field shelling operation at harvest is the first major "break-through" in increasing our efficiency. We also feel that in doing this, we have eliminated many of the steps of handling and re-handling which were necessary in harvesting ear corn for seed. In eliminating these steps which were costly, we have also eliminated much chance for damage to the kernel cap or the seed coat.

We strongly feel that in this type of a seed drying operation, the dryer must be of the tower-type with a continuous flow, and should be constructed so that it can be easily cleaned. Special care must also be given to the installation of the legs and conveyors as it should be whereever seed is handled. We feel that these points contribute much in the production of high quality seed.

We installed our continuous flow tower dryer ourselves, with only supervisory assistance from the manufacturer. The cost was less than half what it would have been to install a crib type dryer of the same capacity.

We have found that by harvesting and drying our Hybrid Seed Corn this way, we have eliminated two-thirds of the labor which was necessary for harvest when we dryed the corn on the cob.

We cannot emphasize too strongly that any common sense or practical knowledge which has been accumulated through any kind of harvest or handling of seed can be applied to this type of operation. This line of thinking dictates that if corn is field shelled for seed and it cannot go directly to the dryer, it must be placed in a bin which is equipped with some type of aeration.

We are very confident of the success of our venture into this system of harvesting Hybrid Seed Corn. The ease and simplicity of harvest involved in this kind of operation is incomparable when considering any major change in fall harvest."

A HISTORY OF SEED TREATMENT

Cecil H. Andrews[1/]

Introduction

Seed treatment is the principal method by which disease-free seed may be obtained. Seed treatment is intended to do two things: (1) to destroy disease-producing organisms on the seed and thus prevent seedling infection, and (2) to coat the seed with a fungicide that will protect it from decay-producing organisms in the soil. For a seed treatment to be satisfactory it has to be effective, yet, reasonably safe from seed injury in case of over dosage. It must also be economical, readily available, easily applied, chemically stable, and not overly poisonous or disagreeable to operators or corrosive to metal.

Seed treatment may be divided into three categories depending upon the nature and purpose of the treatment. They are designated here as follows:

1. Seed Disinfection. This refers to cases where treatment is directed toward eradication of the fungus which has infected the seed and is established within the seed coat or in more deep-seated tissues. The pathogen has penetrated, infected and thus has become established within the seed. When Jensen reasoned that heat might be more penetrating than chemical ions and less phytotoxic, he suggested for the first time the principle of seed disinfection.

2. Seed Disinfestation. When seed are contaminated on the surface by spores or other forms of pathogenic organisms, without being penetrated or infected, we then say that the seed are infested with the pathogen. Chemical dips, soaks, and fungicides, applied as a dust or slurry are eminently successful as seed disinfestants. The early success of copper sulfate against bunt was as a disinfestant.

3. Seed Protection. Seed protection is based on the principle of surrounding the seed and the young seedling with a fungicide which will prevent infection and damage by soil organisms, to which the plant is particularly vulnerable during its early period of growth.

Seed protection refers to the treatment of seed, usually with chemicals, neither to kill organisms on the surface of the seed nor to kill organisms which have penetrated beneath the surface of the seed, although there is frequently a combination of killing organisms on the surface and seed protection. Rather, this type of seed treatment is designed to protect the seed and the young seedling from organisms in the soil which might otherwise cause decay of the seed before germination. The first successful use of a seed protectant was by Thaxter in connection with onion smut. He had determined that the smut spores infest the soil and that the seedling is susceptible for a short time after

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1/ Mr. Andrews is Assistant Agronomist, Seed Technology Laboratory, Mississippi Agricultural Experiment Station, State College, Mississippi

germination of the seed. He reasoned that a chemical in close proximity to the seed in the soil might protect the young seedling during this short susceptible period. Chemicals used with this objective are known as "seed protectants."

A given fungicidal treatment may serve in one or more of the categories of seed treatment. Practically all effective seed-treatment materials are disinfestants. Many are also disinfestants and protectants. The formaldehyde and hot-water treatments, however, are disinfestants and disinfectants but are not seed protectants. In fact, seeds that have been treated with formaldehyde or hot water frequently are attacked by soil-borne fungi more severely than are untreated seeds and therefore should be treated with a protectant before planting.

Why Treat Seeds

The application of protective fungicides and insecticides to seed has become an important business to seed treater operators and to farmers. The reason, of course, is that no other agricultural practice produces such vast benefits for a few cents per acre.

1. Treated Seed is Recommended. The United States Department of Agriculture and State Experiment Stations recommend that most kinds of seed be treated to destroy seedborne fungi, check soil-borne fungi or insects, establish stronger stands, and produce bigger yeilds of better quality crops.

2. Use of Treated Seed is Profitable. As a commercial treater or seedsman you make money in charges for treating, but the most important reason is the result of the seed in the field. Elevators, ginners, or peanut-shelling plant operators find that treated seed assures them of a better quality crop to market. Seedsmen satisfy their customers with treated seed that will generally assure a better crop.

3. Treated Seed is Easier to Sell. Farmers do want treating service. In every case where high quality service has been offered and advertised in areas of good potential the response has been extremely good. Many plants have found it necessary to operate around the clock or turn away customers in the busiest seasons.

Importance of Seed Treatment

In the past several years it has become evident that each new variety of a crop released will sooner or later have a new disease to plague it. For the diseases that are seedborne, this build-up may be prevented or delayed by seed treatment, thus extending the useful life of a variety.

Weathered grain usually carries molds which reduce germination and weaken seedlings even though they produce no specific disease. Seed treatment eliminates these molds, giving better stands and stronger seedlings. Poor lots of seed are likely to show greatest benefits.

Besides controlling diseases carried on the seeds, the proper chemicals have a "residual" or carry-over action, especially on some crop seeds (corn).

This means that the chemical also protects the seeds and very young seedlings against soil organisms which may be damaging where weather conditions are not favorable for plant growth.

Seed treatment does not have to pay off very often to repay the small expense involved. The response to seed treatment varies according to the crop variety, the vitality of your seed, the season, the diseases present on your seed and in your soil, and the type of seed treatment you choose. Therefore, it is impossible to predict exactly how much increase in stand or yield you can expect. But year in and year out, it will pay you to have every bushel of your seed treated with one of the materials recommended by your agricultural college.

When to Treat Seed

1. When Seed is Damaged. Seed may be injured by disease, weather, harvesting, or improper storage and handling. Seed treatment will be especially profitable in these instances. Unless this damaged seed is protected by proper seed treatment, it lacks the strength and vitality to fight off the diseases which may be found on the seed or in the soil.

2. When the Soil is Cold and Damp. Unfavorable germinating conditions for seed may be favorable germinating conditions for disease or fungus spores. If the seed are protected by a good seed treatment, they are capable of resisting the attack of these enemies until soil conditions become favorable for the seed to begin growth.

3. When the Soil is Dry. Seed fail to germinate and continue normal growth in very dry soil. While these seed lie in the dry soil awaiting moisture, some disease spores are able to thrive under this dry condition and are able to attack and damage the seed. Therefore, seed treatment is beneficial under dry conditions.

4. Under Favorable Conditions. Even with sound healthy seed and favorable growing conditions, seed treatment is still beneficial. Seed treatment is good insurance and should be practiced in order to cover any conditions which may arise when planting seed.

Historical

Seed treatment for the prevention of plant diseases, whether accidental or experimental, dates many years back. At first, in the absence of definite knowledge concerning the nature of plant diseases, preventive measures were of a more or less superstitious nature, such as sowing in the dark of the moon, or sticking branches of laurel in the grain fields "to draw the blighting vapors to them."

Powdery mildews and bunt of wheat are ancient and honorable diseases, presumably because the fungus and its effects are quite prominent. Hence, fungicides for these two diseases were discovered first. The earliest reference so far found to a fungicide is the reference of Pliny to Democritus who reported

around 470 B.C. that amurca of olives should be sprinkled on plants to prevent attacks by blight. Amurca of olives is the press cake left after making olive oil. Martin and E. S. Salmon rediscovered some 2400 years later the fungicidal properties of vegetable oils as fungicides for powdery mildew. Here we find an organic compound as the first fungicide.

Cato in 200 B.C. according to Mason advocated for the vine-fretter (whatever that is!) a fumigation of the plant with a smoke from amurca of olives, sulfur, and bitumen. This shows an early use of sulfur and also a coal by-product -- a substance that was to produce hundreds of fungicides and bactericides by 1945.

Seed treatment for wheat mildew (Could it have been smut?) was recommended by Pliny. Pliny proposed that the seed be soaked in wine plus a mixture of bruised cypress leaves. If Pliny really referred to wheat smut he was several hundred years ahead of Tillet and Prevost in using seed treatments.

Wheat smut has fathered many new fungicides. About 1637, R. Remmant in England suggested an unnamed seed treatment. The treatment was probably sodium chloride (common salt) because at this early date (some say 1650 and some 1670) a sailing vessel loaded with wheat encountered a storm and ran aground near Bristol, England, and the salvaged grain was planted and produced a crop that was relatively free of the dreaded smut disease.

When, where, and how the grain smuts originated we do not know but we do know that they have existed for several hundred years for we find reports of heavy losses from smut in England in the 17th century. Probably one farmer noticed that the wheat produced by the salvaged seed was fairly free from smut, while nearby fields grown from normal seed were heavily smutted. Quite probably he resolved to try soaking his seed wheat in sea water before planting. Whether he followed good experimental practice or not, we do not know but we do know he must have succeeded in proving to his fellow farmers that soaking seed wheat in sea water or sprinkling it with brine helped to grow cleaner crops of wheat. The writings of the next century indicate that the brining of seed wheat was a common practice.

It was not until almost 100 years after the sailing vessel met with disaster that Schulthuss of Germany suggested the use of blue vitriol in place of salt. Thus, for an entire century, men treated seed wheat with salt water before anyone had the curiosity to search for a better way. It must be remembered also that no one knew why treating seed wheat helped to reduce smut. In the case of severely smutted wheat they undoubtedly noticed that the seed coat was darkened with the black powder from the smutty heads, but it did not occur to anyone to connect this black powder on the seed with the smutty crop which such seed produced.

At the beginning of the 19th century, Prevost in France observed the germination of the smut spores in water and found that a small amount of copper sulfate in the water prevented their germination. This observation really

furnished the key to the problem. It was not, however, until 1853 that Anton de Bary, a German botanist, proved that smut was caused by a parasitic fungus living on and at the expense of the wheat plant.

This fundamental discovery by de Bary facilitated the search for more effective means of controlling smut. Scientific workers now understood what was needed to control smut, and why. They could describe the properties a good seed treatment should possess. It must be a chemical or other agent highly toxic to smut spores and yet non-injurious to the seed. Other desirable features were that the method of applying the treatment must be simple, practical and relatively inexpensive.

Other new fungicides were slowly to be acquired, some to be kept, most to be discarded, some to be rediscovered.

We have only mentioned sulfur and copper. They are so commonly in use by civilization that their fungicidal properties could hardly have been missed. Both materials seem to have been discovered and rediscovered several times. Homer mentioned sulfur in about 1000 B.C. Lime soon showed up in the sulfur treatment as it did in copper treatments.

Copper sulfate probably was the first standard fungicide used, and its intelligent application dates back in 1761. It did not come into general use, however, until a century later when Kuhn's experiments established a basis for making definite recommendations regarding its use. Later investigators made other recommendations concerning the use of copper sulfate, the most important of which was that after treatment the grain be dipped in lime-water to prevent injury.

Another seed treatment method of early origin still in use is the hot-water treatment developed by Jensen in 1887. It still is the only known treatment that will kill certain deep-seated fungi like that causing the loose smut of wheat which are not controlled by surface disinfectants.

Formaldehyde was first advocated as a seed treatment in Germany by Geuther in 1895 and in the United States by Bolly in 1897. It still ranks among the foremost liquid treatments because of its cheapness and its general effectiveness, in spite of its tendency to injure the seed.

Copper sulfate and formaldehyde continued as the outstanding seed treatment materials up to about 1914. Mercuric chloride and other materials were tried but not generally recommended. In 1912 organic mercury compounds were introduced as seed disinfectants in Germany. In early experiments, Riehm, along with others found them effective in cereal-disease control. Among the first of these to be marketed was a chlorophenol mercury compound known as "Uspulum", placed on the market in Germany about 1915. Similar compounds under the trade names "Chlorophol" and "Semesan" soon appeared in the United States.

Dust disinfectants first came into prominence as a result of the work of

Darnell Smith with copper carbonate in Australia in 1915. Due to certain apparent advantages, this form of seed treatment met with immediate popularity and started the era of dust fungicides. At first the use of dust fungicides was restricted to the control of diseases due to surface-borne organisms such as bunt of wheat, but experiments soon showed that the more deep-coated organisms, like those causing the smuts of oats and covered smut and stripe of barley, could be reached by certain dust fungicides. From then on liquid fungicides which were applied as a dip lost favor and dust fungicides gained in popularity, not only for treating cereal seeds but also seeds of other crops.

This dry treatment which saved so much time and trouble soon became very popular, and by 1925 one-tenth of all the wheat sown in the United States was treated with the dry copper carbonate powder for the control of the bunt. Attempts were then made to get other seed-disinfectants into powder form. Even the gas formaldehyde was tried. It was absorbed in chalk or talc powder for churning with the seed, but this was not very successful.

The greater interest in and acceptance of seed treatment immediately following Worl War II is probably due to a number of factors. One was the tremendous increase in the use of hybrid seed corn. In 1936 only 3.1 percent of the total corn acreage in the United States was planted to hybrid seed. In 1946 this had increased to 67.5 percent. Since hybrid seed corn is almost invariably treated before planting, this change did much to popularize seed treatment, especially the organic non-mercurials.

With the advent of the second Worl War and the urgent need for greater food production, seed treatment was advocated to increase yeilds by eliminating losses due to plant diseases. Extensive cooperative experiments were undertaken by State and Federal agencies to test different fungicides on the market. The tests provided the basis for crop recommendations and helped eliminate worthless seed treatment material from the market.

Along with this renewed interest in seed treatment materials, interests become directed to new and better methods of applying the recently developed materials. Soon the dust application gave way to the slurry method. This method involves the use of a small quantity of water which is employed to distribute the seed protectant over the surface of the seed and not to soak the seed. The slurry method of applying fungicides became very popular, not because of the ease of application and handling, but because of the relative safe method of applying a seed treatment without causing discomfort or ill effects to workers as had been experienced during dust applications.

Still a later development in the method of applying a seed treatment is the liquid or "quick-wet" method. This method is particularly advantageous when applying the organic mercurials most of which can be formulated as liquids. A concentrated solution of a volatile fungicide is applied to the seed and

thoroughly mixed with it. The dosage may range from one-half to five fluid ounces to a bushel and adds less than one percent of moisture to the seed.

Paralleling the development of the different forms of fungicides has been the development and improvement of equipment for the application of the treatment. Seed treaters used for applying the dust formulations gave way to slurry treaters. Since the most widely used organic mercurials are liquids and the non-mercurials are slurries, the aim of the equipment manufacturers at the present time is to build seed treaters which will treat seed satisfactorily with both the slurry and liquid formulations.

Some of the latest developments in seed treatment consist of treating the seed with hormones. Application of plant hormones or growth promoting materials on seeds indicates that our present knowledge concerning their use in seed treatment needs to be greatly increased before definite recommendations can be made.

The subject of synergism and antagonism between different fungicides and insecticides has received considerable study recently. As early as 1946, experiments were started to study the effect of mixing insecticides with fungicides and then applying this to seed. From the results observed of the few cases tried, information suggests that caution must be used in mixing such materials in farm practice and further work on fungicide-insecticide combinations must be done before large scale recommendations. However, success has been made in treating seed of beans and corn with lindane, aldrin, dieldrin, methoxychlor, or chlorodane in combination with a good non-mercurial fungicide such as thiram or captan. These insecticides cannot be used on seed without seriously injuring it unless a fungicide is first applied to the seed or incorporated with the insecticide.

With the extensive amount of research being conducted by commercial firms and also by State and Federal agencies, on the development of seed disinfectants, disinfestants, and seed protectants for the control of plant diseases, the composition of fungicides will continue to change. Materials not being widely used will either be further improved or will be replaced by other materials that will be more effective, cheaper, less harmful to the seed, or more acceptable in other respects. The constant aim will be to find or develop seed treatments that are highly toxic to parasitic fungi and bacteria but relatively harmless to the seeds and plants which are parasitized by them. Modern science and industry have made great progress in the development of some rather satisfactory weapons in our war with the pathogens and injurious insects. However, with the possiblity of systemic fungicides, antibiotics, and other materials yet undiscovered, we hope that we can advance to a still stronger position in this continuing struggle.

Bibliography

1. The Benefits of a Modern Seed Treatment. Bulletin 6-129, Panogen, Inc., Ringwood, Illinois. 15pp.

2. Horsfall, James G. Fungicides and Their Action. Waltham, Mass., Chronica Botanica. pp. 1-5, 159-171. 1945.

3. Hough, Walter S. and A. Freeman Mason. Spraying, Dusting and Fumigating of Plants. New York, The Macmillan Company. pp. 398-218. 1951.

4. Large, E. C. The Advance of the Fungi. New York, Henry Holt and Co., pp. 384-414. 1940.

5. Leukel, R. W. Present Status of Seed Treatment, with Reference to Cereals. The Botanical Review 2:498-521. 1936.

6. Leukel, R. W. Recent Developments in Seed Treatment. The Botanical Review, 14:235-262. 1948.

7. Seed Treatment - Its Origin and Application. Bayer-Semesan Company, Inc., Wilmington, Delaware. 23 pp. 1939.

8. Tisdale, W. H., J. W. Taylor, and R. W. Leukel. Further Studies on New Seed Disinfectants. Phytopathology 14:43. 1924.

9. Walker, John Carles. Plant Pathology. New York, McGraw-Hill Book Co., Inc. 2nd Edition. pp. 658-663. 1957.

SEED TREATING IS VALUABLE INSURANCE[1/]

H. Dean Bunch[2/]

How many seedsmen and farmers reading this do not carry insurance? How many sell or plant seed not treated with a fungicide? These two questions are not entirely unrelated. A seed which has been treated with a good chemical fungicide is in much the same position as a man with an accident or hospitalization insurance policy. Under conditions of good health and trouble-free days the policy rides along giving no assistance. But in darker days when the vitality gets a little low and hard knocks bein to take their toll the policy can be very useful in helping carry the insured over until he "gets on his feet" again. It is not the intention here to sell insurance per se, but to draw a parallel between insurance and seed treatment.

Just as some people are more prone to poor health and others to accidents so it is with seeds. Some crop seeds deteriorate faster than their relatives, others are more easily damaged. Although the protection of seed treatment will not restore life to a weakened or injured seed it will help ward off the bill collectors (disease producing organisms) until germination and emergence enables the new plant to support itself.

Seed treatment will not pay off every year no more than will insurance. In fact, we would like to have conditions when we don't collect on the policy - years when we plant seed in which treatment does not pay. Because such circumstances would indicate that disease producing organisms are well under control and no help is needed. Unfortunately, such conditions do not exist with regularity, but fortunately there are means of combatting the ravages of the ever present enemies we call pathogens (a word meaning disease-producing organisms.)

Modern fungicides used in seed treatment may be classified in two principle groups, based upon chemical composition, the non-mercurial protectants and the mercurial disinfestants (some pathologists say disinfectants.)

The non-mercurials generally contain thiram, captan or chloranil as the active ingredient. These materials are used on such crops as corn, beans, peanuts, vegetable seed, etc. They provide a measure of protection to the germinating seed from soil borne organisms causing seed rot and damping-off. Since they are generally non-toxic to the seed, there is hardly any danger to seed viability by overdosage. These non-mercurials are especially useful in protecting weakened seed or seeds with damaged coats against soil borne organisms during germination.

As mentioned before, the treatment does not make seed any better, but

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2/ Dr. Bunch is an Agronomist and Director of the Seed Technology Laboratory, State College, Mississippi.

it will provide a protective area about the seed enabling it to develop the potentialities it does have. Treatments with these protectants are also helpful in keeping the seed free of attack during periods of adverse environmental conditions at the time of planting or immediately following. Cold, wet, or dry soil or other conditions that tend to slow the germination process leaves the seed exposed to soil borne pathogens a longer time than normal and decreases its chance of emergence. A seed which has been treated has a better chance of surviving under these conditions.

In spite of all the attributes of the non-mercurial protectants, they have their limitations. Being non-volatile they are not effective in killing pathogens which may be on the seed. This is especially true of spores (the "seeds" of some pathogens) which may be lodged in the crevices on seed surfaces, such as the crease of the wheat kernel, or under grain coverings as the hulls of oats or barley. Therefore, let us discuss briefly the mercurial fungicides.

Certain organic compounds of mercury have had long and wide usage as seed treatments for the control of covered smut of wheat and barley and both covered and loose smut of oats. In this capacity these fungicides give very satisfactory control and are essentially the only materials on the market that do. They are also used on cotton and in some conditions on sorghums. The chemicals kill surface borne-organisms and through absorption by the seed coat give a measure of protection to the seed during the germination period. Since seeds can be injured by the mercuries certain precautions must be observed. When seed damage occurs it is usually associated with (1) dosage, (2) seed storage conditions or (3) mechanical condition of the seed.

The range of safety in dosage recommendations is rather narrow if too little treatment is applied it is ineffective, on the other hand, an overdosage may injure the seed. The safety range is wide enough, however, to insure safe treatment with modern treaters if the equipment is properly adjusted. The weight of seed in the dump pan and the size of the metering crops must be carefully checked. The treater should then be checked in operation, weighing several bushels of seed during which time the treatment material is caught outside the treater and measured.

After treatment, seed should be placed in bulk or in open mesh bags for 24 to 48 hours in a well aerated place to allow escape of excess fumes. The drier the seed and the cooler the storage area the less likely seed injury will occur. High seed moisture causes increased absorption by the seed and high temperature increases the volatility of the mercury, either condition being potentially dangerous.

Even with recommended dosage and desirable storage conditions seeds may be damaged if seed coat is severe, especially the seed coat over the germ. For this reason it is advisable that a sample of the seed be carefully checked for excessive damage.

These precautions are not given to frighten you away from using mercurial seed treatments because they are the only type that will kill smut spores and other organisms present on the seed coat. Used judiciously they are an important part of a complete processing job for high quality seed.

Finally, if you haven't taken out an insurance policy which includes the treatment of seed, we suggest that you consider the step and see a reliable agent today.

DRYING AND CONDITIONING SEEDS[1/]

J. W. Sorenson, Jr.[2/]

Until the last few years, drying grain and seeds with forced ventilation was considered only as an emergency measure for handling high-moisture crops. Now, it is rapidly becoming a standard practice in most areas.

Artificial drying has the following advantages: (1) Makes it possible to harvest earlier, thus reducing chance of losses in field from weather, insects and birds; (2) Reduces storage losses since it removes the hazard of damage caused by storing high-moisture seed; (3) Crops can be harvested faster, by operating combines more hours per day; and (4) Reduces losses due to shattering.

Principles of Drying

Before we go into a discussion of methods and procedures used for drying seed, it may be a good idea to review the basic principles involved in drying.

Drying grain consists of at least two stages - the evaporation of surface moisture and the removal of internal moisture (1)* as pointed out by Barre (2) and Fenton (3), many of the problems connected with drying are easier to understand when approached from the standpoint of vapor pressures. Two basic principles are involved:

1. Grain will gain or lose moisture when there is a difference in vapor pressure between the grain and the surrounding water vapor. When the vapor pressure of the grain is higher than the pressure in the air surrounding it, moisture will move from the grain and cause a reduction in moisture. When the opposite condition exists, moisture will flow into the grain and there will be a gain in moisture.

2. The rate at which grain will lose its moisture will depend primarily on the magnitude of the difference in pressures between the grain and the surrounding space. This rate is affected by the resistance to the movement of water vapor through the surface layers of grain.

In order to dry grain or seed effectively with forced air circulation, the vapor pressure of the air flowing around the seed must be lower than the vapor pressure of the moisture in the kernels of the grain itself. To obtain fast drying, large vapor-pressure differences are required. This can be accomplished with heated air. Drying rates are usually low at ordinary temperatures since vapor-pressure differences are relatively small.

1/ Presented at the 1958 Short Course for Seedsmen, April 30 - May 2, State College, Mississippi

2/ Mr. Sorenson is Professor, Department of Agricultural Engineering, Texas Agricultural Experiment Station, College Station, Texas

*Numbers in parenthesis refer to appended references.

Methods of Drying

There are three methods of drying being used today. They are: (1) unheated-air drying; (2) unheated-air drying with supplemental heat; and (3) heated-air drying.

Unheated-air drying refers to the use of forced ventilation with normal atmospheric air for the removal of moisture. Drying with unheated air is a rather slow process, but when grain is to be held in storage for a period longer than is required for drying, the time element is not so important.

When crops are harvested in the fall or during prolonged periods of high humidity, it may be desirable to use supplemental heat in conjunction with unheated-air drying installations. By supplemental heat we mean adding a small amount of heat to the atmospheric air, usually a maximum of 15 degrees, in order to increase the water holding capacity of the drying air and thus accomplish drying before spoilage occurs.

Heated-air drying is the use of forced ventilation with the addition of large amounts of heat for removing moisture.

Unheated-Air Drying

When the subject of drying with unheated air is discussed, it immediately associates itself with a method of drying known as bin drying. By bin drying, we mean the drying of grain or seed in the same bin in which it is to be stored; or, drying in storage.

The advantages and disadvantages of unheated-air drying are:

Advantages:	Disadvantages:
1. Less investment in equipment.	1. Dependent on weather conditions.
2. Reduces fire hazards.	2. Slow drying rate.
3. Less supervision required.	3. Prolonged drying may cause damage by mold growth.

Equipment required for drying with unheated air consists of a structure for holding the seed, an air distribution system and a fan driven by an electric motor or gasoline engine.

Properly constructed conventional steel, wood or concrete buildings and bins are satisfactory. A false floor drying system is recommended for drying grain to be used as seed. Centrifugal and axial flow fans are suitable for drying seed in storage.

An important consideration in drying seed with unheated air is the maximum time permissible to complete drying without allowing damage by molds (4). The maximum permissible time varies with the conditions of the drying air and with the moisture content of the seed. There appears to be a definite time limitation for reducing the moisture content of grain and seeds to 15 to 16 percent. Research conducted by the Texas Agricultural Experiment Station in South Texas (5) showed that the moisture of the wettest portion of

sorghum grain at 78° F. must be reduced to 15 to 16 percent in 6 to 8 days, or less to prevent undesirable mold development. In Central Indiana, Foster (6) found that shelled corn dried satisfactorily when it was reduced to 15.5 percent moisture in 18 to 27 days. Drying seed from a moisture content of 15 to 16 percent to a moisture level considered safe for storage can be accomplished over a longer period of time since mold growth is greatly reduced below this level.

In South Texas, a minimum air flow rate of 3.0 cubic feet per minute (cfm) per bushel (5.4 cfm per 100 pounds of grain), with a recommended rate of 4.0 cfm per bushel (7.2 cfm per 100 pounds), is needed for drying seed with a maximum initial moisture content of 18 percent. In Georgia (7), a minimum air flow rate of 4.5 cfm per bushel is recommended for drying seed at this moisture content.

Static pressures against which fans much operate to develop an air flow rate of 4.0 cfm per bushel for various crops at 6 and 8 foot depths are given below:

	Static pressure, inches water	
Crop	6'	8'
Wheat	3.25	5.80
Sorghum grain	3.00	5.00
Oats	2.25	4.10
Shelled corn	1.50	2.50

It is important to provide drying equipment of sufficient capacity to insure drying seed without loss in germination under different weather and moisture conditions as they occur from year to year. One way to accomplish this is to have a uniform standard for design basis and then vary the depth of the seed to increase or decrease the air flow rate as needed for the different conditions encountered. For example, suppose you decided on a design condition of 3.0 cfm per bushel through an 8 foot depth of 16 percent moisture seed; then, if the initial moisture was above 16 percent the depth could be decreased to increase the air flow rate, as shown in Figure 1. If you intend to dry several different crops, the system should be equipped with a fan and motor of sufficient capacity to supply the required air flow rate through the crop that offers the greatest resistance to the flow of air.

Unheated-Air Drying with Supplemental Heat

Bin drying with supplemental heat has the following advantages and disadvantages:

Advantages:

1. Can dry regardless of weather.
2. Reduces drying time.

Disadvantages:

1. Increases fire hazard.
2. Increase initial equipment cost.
3. Requires close supervision.
4. Possibility of overheating which may result in loss in germination.

A structure for holding the seed, a fan and an air distribution system as described for bin drying with unheated air are satisfactory for bin drying with supplemental heat. In addition, a heating unit is required to heat the air to the desired temperature.

Recommendations for Using Supplemental Heat

Based on results of research conducted in the Gulf Coast Area of Texas, supplemental heat is recommended for use during cool and humid weather or during prolonged periods of high humidity (above 75 percent). The temperature of the air entering the seed may be raised 10 to 15 degrees, but should not exceed 90°F. after heating. Supplemental heat should be used until the moisture content of the top foot of seed is reduced to 14 to 15 percent. After the moisture is reduced to this level, use unheated air to complete the drying to a safe storage level. During the time unheated air is used, operate the fan only when the relative humidity is less than 75 percent (usually during daylight hours on clear, bright days).

Heated-Air Drying

Advantages and disadvantages of using air for drying seed are as follows:

Advantages:

1. Short drying time.
2. Can dry regardless of weather conditions.
3. High drying capacity.

Disadvantages:

1. Higher initial equipment costs.
2. Fire hazard.
3. Close supervision required.
4. Possibility of overheating which may result in loss in germination.

Types of Dryers

Three types of heated-air dryers in common use are: (1) sack dryers; (2) batch dryers; and (3) continuous-flow dryers.

A sack dryer is one which dries seed in sacks.

A batch dryer is one which dries a fixed quantity of seed at one time,

with additional batches dried on a repeating basis. Usually seed is dried in layers 4 to 12 inches thick. High drying capacities are obtained by using large volumes of heated air.

Drying is accomplished in a continuous-flow dryer by continuous movement of seed through heated air.

Sack Dryer. A sack dryer is suitable for drying a small quantity of seed, but is not applicable where a large amount of seed is to be dried. It is particularly suited for drying seed since it eliminates the problem of mixing with other seeds. The chief disadvantages of this type of dryer are the high labor and equipment costs involved in sacking and handling seed, the low drying capacity and the close supervision required.

The following recommendations and operating procedures for sack dryers are based on experiments conducted with seed rice in Texas:

1. To obtain good germination, use a maximum air temperature of 110°F.
2. The fastest rate of drying is obtained with an air volume per sack of 200 cubic feet per minute for large sacks (162 pounds of dried seed) and 140 cubic feet per minute for small sacks (100 pounds of dried seed).
3. Turn the bags of seed once during the drying operation for best results.

Batch Dryer. A batch dryer consists of two basic parts - a bin or container to hold the seed and a fan-burner combination. In some cases, round, steel bins equipped with unloading augers and perforated floors have been used as containers in batch drying set-ups.

Another type of batch dryer used to some extent is known as a wagon dryer. With this method, the drying wagons usually are equipped with perforated floors over some type of air chamber. A fan and heater unit, connected to the wagon, forces heated air through the seed.

There are two general types of fan-burner units used on batch dryers - the direct heating system, where the gases from the burning fuel pass through the seed being dried and the heat exchanger system, where only heated air passes through the seed. Both systems should be equipped with automatic controls to eliminate fire hazards caused by fan stoppage and flame failure. In addition, each should have a device to shut off the fuel supply if the temperature goes too high.

Continuous-Flow Dryer. Continuous-flow dryers can be classified as: (1) nonmixing type; (2) mixing type; (3) belt type. The nonmixing and mixing types are most commonly used and will be discussed in this paper.

In both types seed is usually fed in at the top and flows through the dryer by gravity. The rate of discharge is mechanically regulated at the bottom. Drying is accomplished by forcing heated air through the seed as it flows downward. Fan-heater units used for these dryers are usually the direct-heat type with automatic safety controls.

In the nonmixing dryer, seed descends between two parallel screens set 4 to 6 inches apart while heated air is blown through the screens and intervening seed.

The most popular mixing-type dryers are the baffle design and the Louisiana State University (LSU) design. In the baffle design seed flows downward in a zigzag path by means of baffles while heated air is forced through the seed. The LSU design consists of a bin with alternating layers of air-inlet and air-exhaust channels. Each layer is offset so that the tops of the inverted channels divide the streams of seed. Seed flows downward between channels in a crooked path. Heated air passes from the air-inlet channels through the seed and out through the air-exhaust channels.

Cooling Seed After Drying

Seed should be cooled with unheated air as the last step in drying. In a batch dryer this usually is done by cutting off the burner and operating the fan 20 to 30 minutes. In some cases, an increase in drying capacity is obtained by using a separate cooling bin in connection with batch dryers. Most of the continuous-flow dryers on the market today have separate sections for cooling seed as it flows through the dryer.

Even though seed is cooled as a part of the drying operation, the temperature of the seed is suaully above normal when it is placed in storage. For this reason, some provision should be made to cool seed after it is stored. A practical and economical method of doing this is with an aeration system using a motor driven fan to move air through the stored seed.

Aeration refers to the moving of air through stored seed at low air flow rates, for purposes other than drying, to maintain or improve its value. Aeration provides a quick method of removing dryer heat and is effective in applying fumigants to seed while in storage. It also provides a fast method or reducing seed temperatures during cool weather and thus reduce insect activity.

Air flow rates ranging from 1/10 to 1/4 cfm per bushel are suitable for aeration. These small amounts of air are not costly to provide. For example a 9-1/2 inch diameter centrifugal fan driven by a 1/4 horsepower electric motor will deliver air at a rate of 1/4 cfm per bushel through a 14 foot depth of sorghum seed in a 2,750 bushel capacity bin.

Effect of Heated-Air Drying on Germination

An important consideration in determining the maximum temperature for drying seed is the time required for drying, since this determines the length of time the seed remains in contact with heated air. Under similar weather and moisture conditions, the time required to dry seed depends to a large extent on the type of dryer and the rate of air flow.

Large volumes of heated air can be used economically in both batch and continuous-flow, column-type dryers with seed columns 4 to 10 inches thick. For this reason, seed can be dried at a faster rate in these dryers than in bin

dryers with seed 4 to 8 feet deep. Therefore, higher air temperatures can be used for drying 4 to 10 inch layers of seed than for drying seed at greater depths.

Results in tests in Texas (1) indicate the following recommendations for drying 10 inch layers of sorghum seed in a column-type batch dryer when aeration is provided to cool the seed to atmospheric temperature as soon as possible after the seed is removed from the dryer. These recommendations are based on a minimum air flow of 90 cubic feet per minute per square foot of column area.

Initial moisture content, percent	Maximum drying air temperature, degrees F.
15 - 18	150
18 - 20	125

Summary

Three methods of drying are: (1) unheated-air drying; (2) unheated-air drying with supplemental heat; and (3) heated-air drying.

Unheated air is used for drying grain or seed in the same bin in which it is to be stored; or, drying in storage. An air flow rate of 4.0 cfm per bushel is recommended for drying seed with a maximum initial moisture content of 18 percent.

When crops are harvested in the fall or during prolonged periods of high humidity, it may be desirable to use supplemental heat in conjunction with unheated-air drying installations. The temperature of the air entering the seed may be raised 10 to 15 degrees, but should not exceed 90° F. after heating.

Three types of heated-air dryers in common use are: (1) sack dryer; (2) batch dryers, and (3) continuous-flow dryers.

A sack dryer is suitable for drying a small quantity of seed, but is not applicable where a large amount of seed is to be dried. It is particularly suited for drying seed since it eliminates the problem of mixing with other seeds. Disadvantages are the high labor and equipment costs involved in sacking and handling seed, the low drying capacity, and the close supervision required.

The most common type of batch dryer is the column-type. These dryers are used to dry a fixed quantity of seed at one time, with additional batches dried on a repeating basis. Usually seed is dried in layers 4 to 12 inches thick. High drying capacities are obtained by using large volumes of heated air.

Nonmixing and mixing types of continuous-flow dryers are in common use. In both types, seed is usually fed in at the top and flows through the dryer by

gravity. The rate of discharge is mechanically regulated at the bottom. Drying is accomplished by forcing heated air through the seed as it flows downward.

Even though seed is cooled as a part of a heated-air drying operation, some provision should be made to cool seed after it is stored. A practical and economical method of doing this is with an aeration system, using a motor driven fan to move a small amount of air through the stored seed.

An important consideration in determining the maximum temperature for drying seed is the time required for drying. Under similar weather and moisture conditions, the time required to dry seed depends to a large extent on the type of dryer and the rate of air flow.

References

1. Sorenson, J. W., Jr., H. P. Smith, J. P. Hollingsworth and P. T. Montfort. Drying and Its Effect on the Milling Characteristic of Sorghum Grain. Bulletin 710. Texas Agricultural Experiment Station. 1949.

2. Barre, H. J. Vapor Pressures in Studying Moisture Transfer Problems, Agricultural Engineering. Vol. 19, No. 6. June 1938.

3. Fenton, F. C. Storage of Grain Sorghums. Agricultural Engineering. Vol. 22, No. 5. May 1941.

4. Teter, N. C. and C. W. Roane. Molds Impose Limitations in Grain Drying. Agricultural Engineering. Vol. 39, No. 1. 1958.

5. Sorenson, J. W., Jr., G. L. Kline, L. M. Redlinger, M. G. Davenport, and W. H. Aldred. Research on Farm Drying and Storage of Sorghum Grain. Bulletin 885. Texas Agricultural Experiment Station. 1957.

6. Foster, G. H. Minimum Air Flow Requirements for Drying Grain with Unheated Air. Agricultural Engineering. Vol. 34, No. 10. 1953.

7. Simons, J. W. How to Dry and Store Grain and Seed on Georgia Farms, Bulletin N. S. 33, Georgia Agricultural Experiment Station. 1956.

This presentation was accompanied by colored slides showing different types of drying installations.

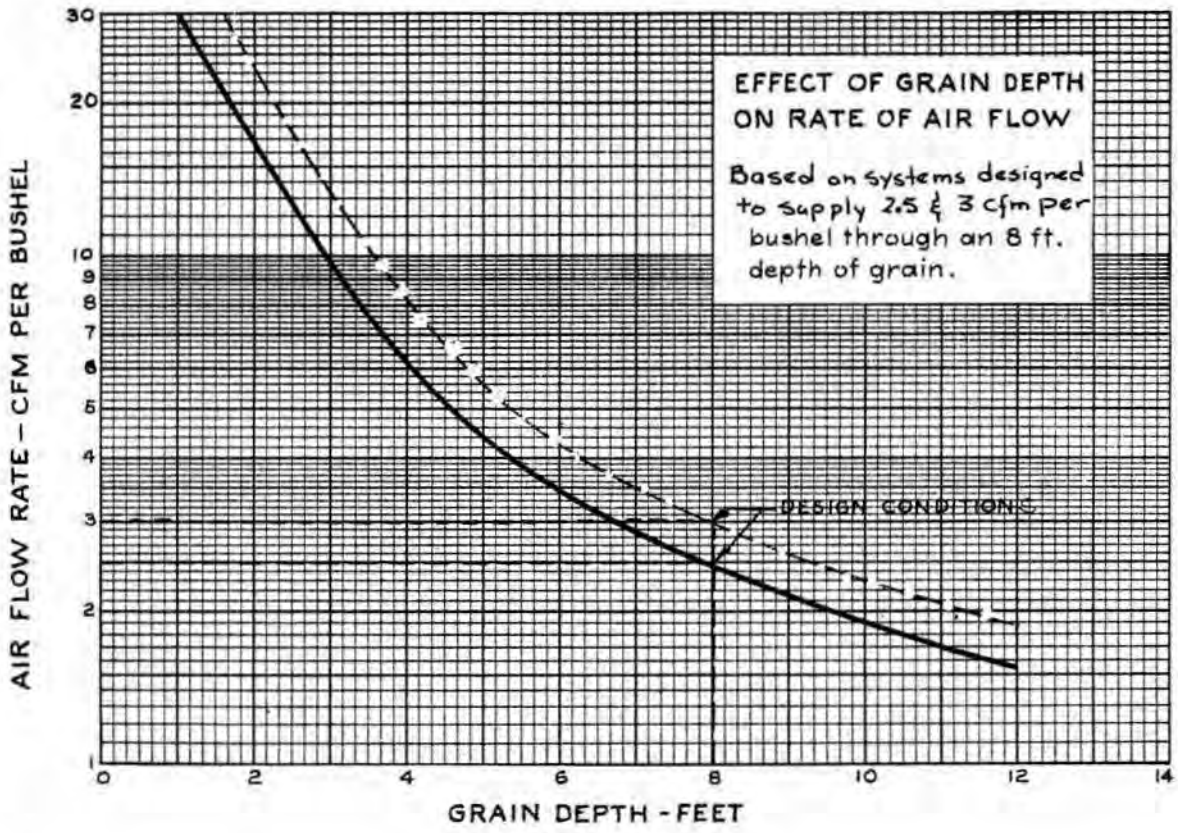

Figure 1

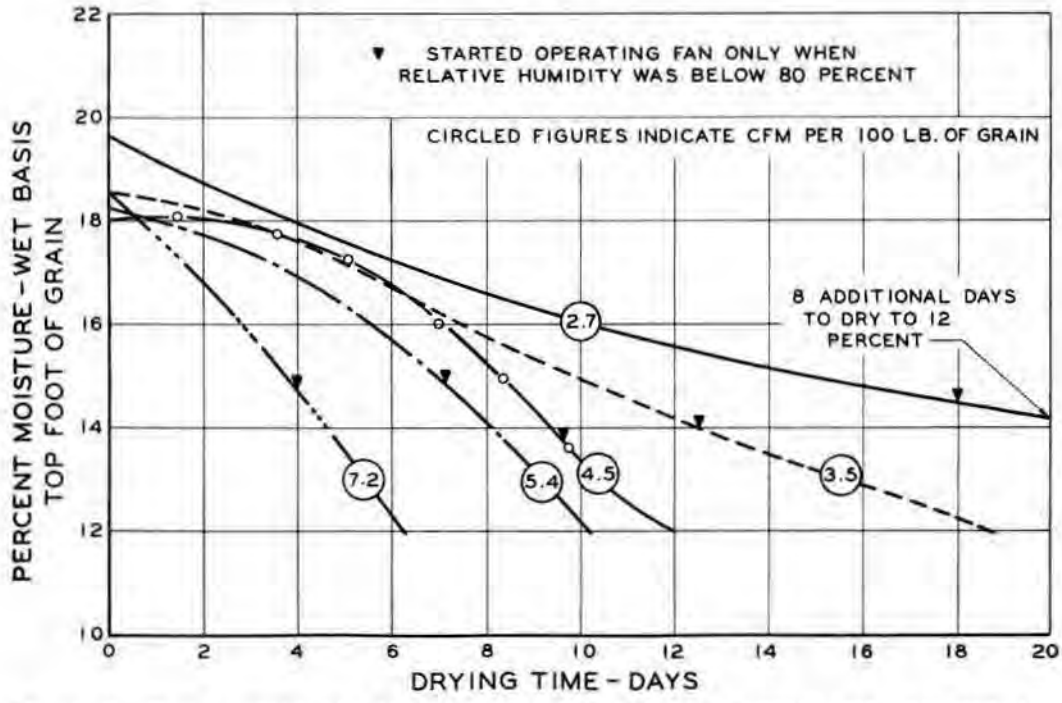

Figure 2. Time required to dry an 8-foot depth of sorghum grain with unheated air supplied at air flow rates of 2.7, 3.5, 4.5 and 7.2 cfm per 100 pounds of grain (1.5, 2.0, 2.5, 3.0, and 4.0 cfm per bushel). Tests were conducted in South Texas. An air flow rate of 7.2 cfm per 100 pounds is recommended for drying seed with a maximum initial moisture content of 18 percent.

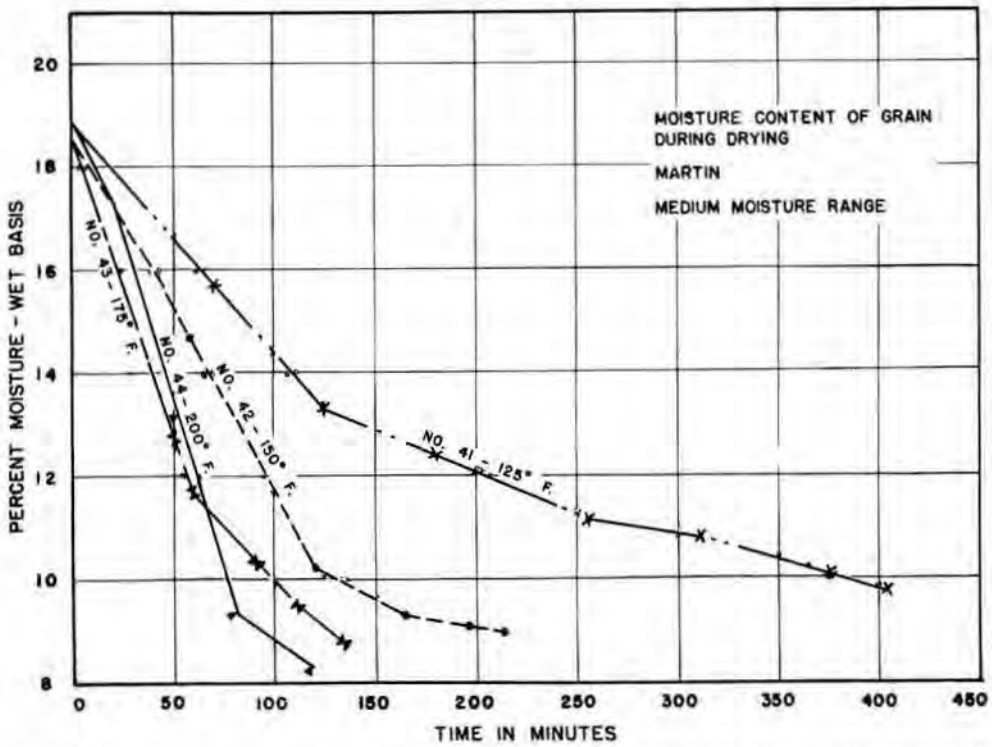

Figure 3. Time required to dry Martin sorghum grain with air temperatures of 125°, 150°, 175° and 200° F. A column-type, batch dryer was used with columns 10 inches thick. An air flow of 90 cfm per square foot of column area was used.

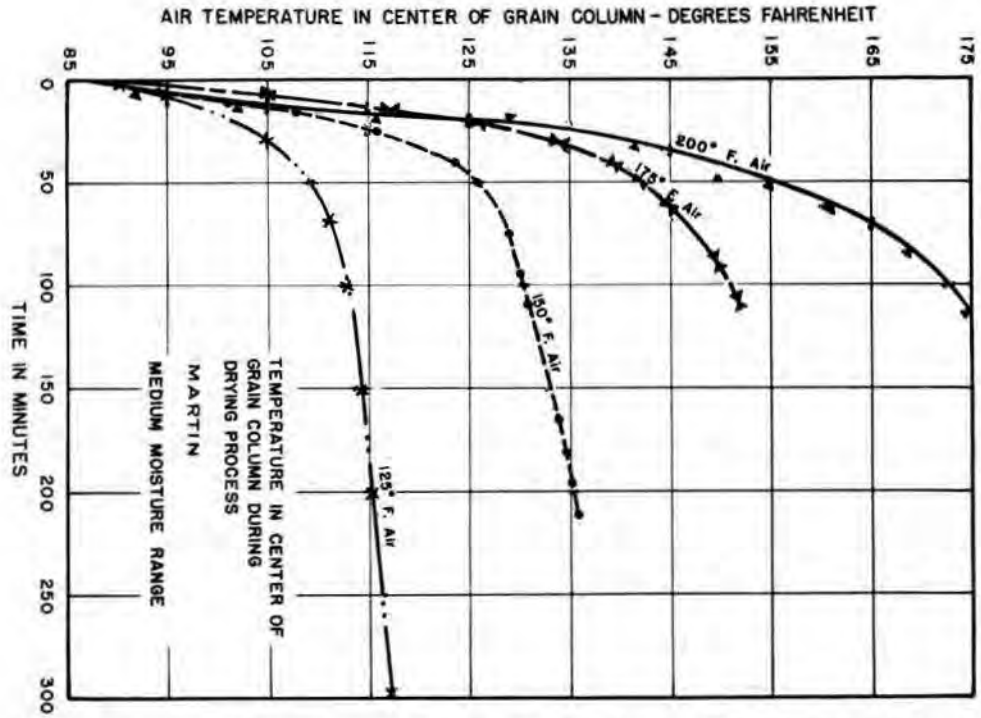

Figure 4. Temperature of sorghum grain during drying in a column-type batch dryer with columns 10 inches thick. Initial moisture content of grain was 18 to 19 percent.

REQUISITES OF SAFE SEED STORAGE

William P. Caldwell[1/]

Whether a seed will grow when removed from storage depends upon several factors. Of course the conditions under which the seeds are stored are important but equally if not more important is the treatment that the seed received prior to being placed in storage. Seed can be no better after storage than it is before storage.

Let us look at a few of the pre-storage factors which have an effect upon the storability of seeds. Environmental conditions during the growing season of the seed crop are important. If a seed crop is grown under conditions of poor nutrients, temperatures or moisture, chances are the seed produced will be of lower quality than a crop produced under favorable conditions. High quality seed will store better than low quality seed.

The environmental conditions in the period from seed maturity to harvesting can be damaging to the quality of seed which in turn determines its storability. Many crops, especially those of indeterminate flowering habit, mature differentially. With crops such as cotton, some seeds will reach maturity 6 weeks to 2 months before other seeds on the same plant. After reaching maturity, seeds exposed to adverse conditions in the field will deteriorate in vigor and viability. In order to produce seeds which will store well, they should be harvested as soon after maturity as possible. Immature seeds will also be lower in vigor and viability than will those which are fully mature.

Mechanical damage to seeds during harvesting and processing can affect their storability. Seeds which are injured are more likely to deteriorate during storage than are sound seed. Improper setting and operation of combines or harvesters, cleaning equipment, scarifiers, dryers, or conveying equipment may be sources of mechanical damage to seeds. This injury should be kept to a minimum.

Efforts should be made to insure that freshly harvested seed does not "heat" or absorb excessive amounts of moisture. Seed should be carefully dried as soon as possible after harvest to minimize post harvest damage.

Field infestations of insects and diseases can cause considerable damage to seeds in the field, as well as being a source of contamination in actual storage where further damage is likely to occur.

Let us now consider some of the factors affecting seed during actual storage. The factors of most importance are, of course, temperature and moisture. High temperatures and seed moistures tend to increase respiration of the seeds which in turn increases deterioration. High levels of moisture and temperature are also condusive to rapid growth of disease organisms and injurious insects. It is generally agreed that a low moisture level of seed will

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1/ Mr. Caldwell is Assistant Agronomist, Seed Technology Laboratory, Mississippi Agricultural Experiment Station, State College, Mississippi.

compensate for a high temperature and vice versa. However, if both moisture and temperature are at high levels in the storage environment, seed deterioration may be expected to be very rapid.

Of these two factors, temperature and moisture, moisture is the easiest and most practical to control. Efficient drying procedures have been developed for many crops which enable seeds to be dried down to a level which is safe for storage.

There are several types of storage conditions available and several means of controlling the storage environment. First, uncontrolled or open storage, is the type most commonly used by seedsmen today. Seed is stored either in textile bags or in bulk in warehouses with no control of temperature or moisture. This type of storage is dependent upon the environmental conditions of the location for its success. In the far Western areas where humidities are low, this type of storage can be very successful and seeds may be carried over several seasons with very little deterioration. In the more humid regions of the country, as in the Southeast, seed deterioration may be very rapid, and storage with no loss in quality may be limited to only a few months.

In an attempt to prolong safe storage time in the less favorable storage areas, several ways have been developed for controlling the storage environment. One of the first methods tried was temperature control or cold storage. This method has been useful in prolonging the storage life of seeds but has its disadvantages. The method tends to be expensive and is therefore limited to seeds of high value. Also, if humidity is not controlled, seed while in cold storage will pick up moisture and when removed from storage will deteriorate very rapidly. For this reason they must necessarily be planted very soon after removal from cold storage. This limits the usefulness of this system.

Seeds have also been stored in humidity controlled rooms with no temperature control. This method is very effective and does not have the disadvantages of the previous system. It is however, expensive to operate.

Ideally, the best system of course is one in which both temperature and humidity are controlled. This system is quite costly but very effective. It is used to a limited extent today mostly for high priced seeds, such as breeding materials and foundation seed stocks.

A more practical approach to controlling the storage environment is rapidly gaining favor. In this method, seeds are dried down to a level which has been determined to be safe for sealed storage, then packaged in moisture-proof containers. The advantages of this system are obvious: costs are reduced over other controlled methods and much more versatility in seed movement is possible. The seeds are protected up until the moment of planting.

Basically three types of containers are being used for moisture-proof packaging. The first to be used was sealed tin cans. This container is very effective but is limited to those seed kinds which are normally packaged in small containers such as vegetables and tobacco.

Containers being used for field seeds, which are normally packed in larger containers, include polyethylene bags and various types of multiwall paper bags with moisture barriers. These barriers may be free polyethylene films, polyethylene-coated papers, laminated polyethylene-aluminum foil paper, or asphalt laminates. Some of these barriers are essentially moisture-proof while others may be classed as moisture resistant, that is some exchange of moisture vapor will occur through them.

A survey of the literature was made concerning safe moisture levels of various kinds of seeds. This information is presented in Table 1. The first column lists the seed kind, the second column lists the moisture content safe for sealed storage and the third column lists the literature citation from which the information was obtained.

One precaution which should be rigidly observed is not to package seed in moisture-proof containers which is above the safe moisture content. Seeds sealed in these containers at a higher than safe moisture level will deteriorate much more rapidly than if they were stored under open storage conditions.

Many improvements have been made in methods of storing seeds in the past few years. Currently, it is a subject which is receiving a large amount of attention from researchers throughout the country. It is reasonable to believe that in the future, better methods of seed storage will be made available to the seedsman.

Table 1. Moisture levels necessary for safe sealed storage of seeds.

Kind	Moisture Content for Safe Sealed Storage	Reference
	Field Seeds	
Alfalfa	6%	(11)
Barley	12%	(24)
	10%	(11)
	11%	(10)
Bentgrass	9%	(11)
Bluegrass	9%	(11)
Bromegrass		
Smooth	10%	(11)
	8-9%	(21)
Mountain	7-9%	(27)
Reed Canary Grass	8%	(22)
Clovers	8%	(11)
Red	8%	(15)
	8%	(14)
	4%	(35)
Crimson	6-8%	(10)
	Less than 10%	(36)
Corn	10%	(11)
	11%	(10)
	5-13%	(26)
	8%	(19)
	5%	(31)
Fescue	9%	(11)
Chewings	8%	(25)
	5%	(16)
	10%	(18)
Flax	7-8%	(13)
	Less than 10%	(12)
Oats	10%	(11)
	11%	(10)
Rye	10%	(11)
Ryegrass		
Perennial	8%	(11)
	8-10%	(11)

Table 1. Moisture levels necessary for safe sealed storage of seeds. (Continued)

Kind	Moisture Content for Safe Sealed Storage	Reference
	Field Seeds	
Italian	10%	(11)
	11%	(20)
Soybeans	8%	(11)
	9%	(10)
	8-9%	(33)
	7.1%	(32)
	9.4%	(29)
	10-14%	(28)
Timothy	9%	(11)
Trefoil	7%	(11)
Vetch	9%	(11)
Wheat	10%	(11)
	10-12%	(10)
	12%	(24)
Wheatgrass Crested	7-9%	(27)
	Vegetable Seeds	
Beet	10%	(7)
	8%	(37)
Broccoli	6-8%	(2)
Cabbage	6%	(7)(34)
	5%	(37)
Carrot	10%	(17)
	5.2%	(4)
	8.2%	(34)
	6.5%	(7)
	7.0%	(37)
Cauliflower	6-8%	(2)
Celery	9.0%	(34)
	7.0%	(37)
Cucumber	7.5%	(34)
	8.0%	(37)

Table 1. Moisture levels necessary for safe sealed storage of seeds. (Continued)

Kind		Moisture Content for Safe Sealed Storage	Reference
		Vegetable Seeds	
Egg Plant		6-8%	(2)
		5.2%	(4)
Lettuce		6.5%	(34)
		4.1%	(4)
		5.0%	(37)
Onion		9.3%	(34)
		7.5%	(7)
		6.0%	(37)
		6.2%	(4)
		9.0%	(17)
		6.4%	(8)
	Less than	6.0%	(5)
		6.8%	(2)
		6.0%	(37)
Parsnip		9.0%	(7)
	Less than	6.0%	(23)
	Less than	4.0%	(6)
Pepper		5.2%	(4)
		8.4%	(8)
		6-8%	(2)
		7.0%	(37)
Spinach		11.0%	(34)
		9.0%	(37)
Tomato		9.0%	(37)
		8.7%	(34)
		8.4%	(7)
Turnip		6.7%	(34)
		6.0%	(37)
Watermelon		7.0%	(37)
		8.5%	(34)
Sweet Corn		8.0%	(37)
		7.5%	(7)
		7.0%	(9)
Peas		9.0%	(37)
		9.6%	(8)

Table 1. Moisture levels necessary for safe sealed storage of seeds. (Continued)

Kind	Moisture Content for Safe Sealed Storage	Reference
	Vegetable Seeds	
Beans	8.0%	(37)
	10.0%	(34)(7)
	Flower Seeds	
Aster	6.7%	(2a)
Verbena	4.2%	(2a)
Sweet Pea	9.6%	(2a)
Pansy	3.8%	(2a)
Venidium	3.5%	(2a)
Regal Lily	4.5%	(3)

References

(1) Akamine, E. K. The effect of temperature and humidity on viability of stored seeds in Hawaii. Hawaii Agr. Exp. Sta. Bul. 90. 1943.

(2) Barton, Lela V. A further report on the storage of vegetable seeds. Contr. Boyce Thompson Inst. 10:205-20. 1939.

(2a) Barton, L. V. Storage of some flower seeds. Contr. Boyce Thompson Inst. 10:399-427. 1939.

(3) _____. Storage of seeds of the Regal Lily. Amer. Lily Yearbook. 1948.

(4) _____. Seed storage and viability. Contr. Boyce Thompson Inst. 17(2):87-103. 1953.

(5) Beattie, James H. and V. R. Boswell. Longevity of onion seed in relation to storage conditions. USDA Circ. 512. 1939.

(6) _____ and Tatman, E. C. Long-term storage of parsnip seed. Proc. Amer. Soc. Hort. Soc. 55:435-7. 1950.

(7) Boswell, V. R., E. H. Toole and D. F. Fisher. A further study of rapid deterioration of vegetable seeds and methods for its prevention. USDA Tech. Bul. 708. 1940.

(8) Brown, E. Preserving the viability of bermuda onion seed. Science 89: 292-293. 1939.

(9) Brunson, A. M. The effect of storage conditions on the longevity of seed corn. Ind. Agr. Exp. Sta. Rept. of Dir. 59:8-9. 1946.

(10) Ching, Te May. Moisture content of seed as it affects storage practice and seed viability. Proc. Ore. Seed. Prod. Short Course. 1959.

(11) _____. Keeping field seed quality in storage and transit. Western Feed and Seed. Oct. 1959.

(12) Calhoun, J. The prevention of seed-borne diseases of Flax. 3. The dusting, short wet, and fixation methods of seed disinfection in relation to storage of the seed. Ann. Appl. Biol. 32:34-7. 1945.

(13) Dillman, A. C. and E. H. Toole. Effect of age, condition, and temperature on the germination of flax seed. J. Amer. Soc. Agron. 29:23-9. 1937.

(14) Evans, G. The preservation and maintenance of basic stocks of herbage plants. Proc. 6th Int. Grassld. Congr. 1:906-11. 1952.

(15) _____. Red clover seed storage for 23 years. Brit. Grassland Soc. J. 12:171-177. 1957.

(16) Fay, N. R. Deterioration problems in New Zealand Chewings Fescue. N.Z.J. Agr. 49:10-24. 1934.

(17) Gane, R. The effect of temperature, water content and composition of the atmosphere on the viability of carrot, onion and parsnip seed in storage. J. of Agr. Sci. 38. Part 1, Cambridge. 1947.

(18) _____. The effect of temperature, humidity and atmosphere on the viability of chewings fescue grass seed in storage. J. Agr. Sci. 38: 1947.

(19) Goodsell, S. F., G. Huey, and R. Royce. The effect of moisture and temperature during storage on cold test reaction of Zea Mays seed stored in air, carbon dioxide or nitrogen. Agron. Jour. 47: 1955.

(20) Garman, L. W. and R. M. Greenwood. Effect of moisture content on the viability of Italian ryegrass seed in storage. N.Z.J. Sci. Tech. Sect. A. 33:58-61. 1951.

(21) Grabe, D. F. Artificial drying and storage of smooth bromegrass seed. Agron. Jour. 49:161-165. 1951.

(22) Griffith, W. L. and C. M. Harrison. Maturity and curing temperatures and their influence on germination of reed canary grass seed. Agron. Jour. 46:163-167. 1954.

(23) Joseph, H. C. Germination and keeping quality of parsnip seeds under various conditions. Bot. Gay. 87:195-210. 1929.

(24) Kaihara, H. Comparative storage-tolerance of some cereal grains in Japan. Ber. Ohara Inst. 9:435-40. 1951.

(25) Kearns, V. and E. H. Toole. Relation of temperature and moisture content to longevity of chewings fescue seed. USDA Tech. Bul. 670. 1939.

(26) Kiesselbach, T. A. Effect of artificial drying upon the germination of seed corn. J. Amer. Soc. Agron. 31:489-496. 1939.

(27) McAlister, D. F. The effect of maturity on the viability and longevity of the seeds of Western range and pasture grasses. J. Amer. Soc. Agron. 35:442-53. 1943.

(28) Oathout, C. H. The vitality of soybean seed as affected by storage conditions and mechanical injury. J. Amer. Soc. Agron. 20:837-855. 1928.

(29) Ramstad, P. E. and W. F. Gaddes. The respiration and storage behavior of soybeans. Minn. Agr. Exp. Sta. Tech. Bul. 156. 1942.

(30) Robertson, D. W. and A. M. Lute. Effect of relative humidity on viability, moisture content, and respiration of wheat, oats and barley seed in storage. J. Agr. Res. 59:281-291. 1939.

(31) Sayre, J. D. Storage tests with seed corn. Fm. Home Res. 32:149-54. 1947.

(32) Toole, E. H. and W. A. Davidson. The influence of storage conditions on the viability of soybean seed. AOSA Proc. 1936.

(33) _____ and V. Toole. Relation of temperature and seed moisture to the viability of stored soybean seed. USDA Circ. 753.

(34) Toole, E. H., V. K. Toole, and E. A. Garman. Vegetable seed storage as affected by temperature and relative humidity. USDA Tech. Bul. 972. 1948.

(35) Toole, E. H. and V. Toole. Report of committee on seed moisture and seed storage. Proc. Int. Seed Test. Assoc. 18:142-5. 1953.

(36) Ward, H. S., Jr. and J. L. Butt. Hygroscopic equilibrium and viability of naturally and artificially dried seed of crimson clover. Agron. Jour. 47:576-579. 1955.

(37) Toole, E. H., V. K. Toole and E. A. Garman. Storage of vegetable seeds. USDA Leaflet 220. 1957.

THE BELT MOUNTED BUCKET ELEVATOR

Jim McKillip, Jr. 1/

Up to now, the conventional belt mounted bucket elevator is the most near perfect piece of machinery for elevating all bulk, dry, granular materials. The reasons I say this are as follows. More work can be done, using less power, with the bucket elevator than any other method. Original cost is at a minimum as is upkeep and maintenance. If it is of an approved construction, it is easily purged of one material before running a different material to reduce contamination and mixing. Last, but not least depending on the speed of the unit, breakage of fragile materials will be at a minimum.

The conventional bucket elevator, as simple as it is, is also the most misunderstood. If a few basic rules are followed and some thought given to the problem, some of these mysteries will be cleared up here, today.

Because we are interested in seeds, and because most seeds are considered fragile, let's see if we can determine first the cause of the breakage. One of the basic laws of physics can easily clear this point up, so lets apply it to our industry and see what comes of it.

I think we can say that pressure is our big enemy here. Place a seed on the floor, place your foot on it, and press. The pressure exerted by your weight on one side of the seed, and by the floor on the other, ruptures the seed and renders it useless. This type of pressure damage is not too common, but it does help us to prove our point.

Anytime extreme pressure is applied to one side of the material, we have damage. How does this happen, and what can we do about it? Everytime anything is required to change direction and velocity, a pressure is exerted on one side of it. Compare the action at this point to that of billiard balls during a pool game. The shock of one ball contacting the cue or the other balls is tremendous, not only to itself but to the target. Also, the shock transmitted is in direct proportion to the velocity of one ball to another and the extremeness of the angle.

In order to reduce or eliminate damage to our seeds, we must do two things: reduce velocity and change the direction of the material only as often as necessary.

The one thing most affecting the material being handled, as far as damage and contamination are concerned, is design of the complete unit including hoppers, discharge spouts, cleanouts and that part of the elevator that comes in contact with the material.

From intake to discharge, the points to press here are these; hopper design and placement. The hopper should be of such a design that a maximum

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1/ Mr. McKillip is Sales Manager, Universal Hoist Company, Cedar Falls, Iowa, Manufacturers of bucket elevators and belt conveyors.

amount of material will be directed into the buckets to prevent churning in the boot. The hopper should be placed high on the up leg side and never on the down leg side. The material should flow in a straight line from the front of the hopper into the buckets and not from the side of the hopper.

The type of bucket, their shape and size, does not directly affect material damage, though the manufacturers of plastic buckets maintain that the thickness of the lip of their buckets reduces the shearing action at this point. My personal thought on this argument is that if a shearing action is taking place with a steel bucket, the speed is too fast. Later on we will talk about speed and this will be discussed at that time.

The design of the elevator head should be compatible with the type of elevator and of such a design so as to not be contacted by the material unnecessarily, or while the material is traveling at a high rate of speed, or at a severe angle to the casing.

The discharge throat, or spout adapter should, as in the hopper, flow the material directly into the spout with as little swirl or change of direction as possible.

The biggest thing we can do to reduce or eliminate material damage is to use the proper belt speed. Actually, there are two basic types of belt mounted bucket elevators. The only difference is in the type of buckets and the belt speed. Different speeds actually give us different types of elevators.

The continuous discharge type, sometimes called continuous bucket type, we refer to as an "Easy Dump." Continuous discharge elevators run at an extremely slow speed. The v-type buckets are mounted continuously or one immediately following the other. As the loaded buckets pass over the head pulley, the material slides, by gravity, out of the bucket, across the back of the preceeding bucket and out the discharge spout.

The same elevator, speeded up considerably, would be a centrifical discharge type and would throw the bucket load into the discharge spout. It is easy to see that the velocity attained by the material could easily damage it. The damage in the boot too, would be greater because of the higher speeds. If there is a shearing action of the bucket against the material, this of course, would be greater at the higher speed.

Exact speeds too, are critical. If we were to view the discharge action of a well designed unit with a 6" head pulley at various speeds, we would observe the following: at speeds below approximately 100' per minute, the material would fall from the bucket and rain down the legging as the bucket passed over the head pulley. Between approximately 100 to 120' per minute belt speed, the continuous discharge action takes place. Speeds will vary slightly, depending on the material and its angle of repose. For this reason we provide a variable speed sheave for the motor. In correctly engineered elevators, there will be no down legging and this then would be the speed that is least

likely to damage materials. These speeds are used for, of course, extremely fragile seeds, nutmeats, glass marbles and so forth.

If we speed the unit up further to the speed of between 120 to 200' per minute, we will only succeed in throwing the material out of the buckets to just short of the discharge spout, and again it will fall by gravity down the down leg.

Above 200' per minute, we find a mild centrifical action where the material is "lobbed" into the discharge spout in a lazy manner. Material that is not too easily damaged can be handled at this speed which, because of the faster belt speed, will produce more capacity with the same size unit.

As the belt speed is increased above the 200' per minute, the discharge action, as well as the receiving action, becomes more violent and capacity is increased as is the damage to fragile materials. At a point somewhere above 400' per minute, the centrifical action holds material in the cups too long and improper discharging will again occur. This high speed action is similar to swinging a bucket of water around your head; the faster you go, the less chance you have of getting wet.

Now that we have the material elevated, we must clean out our equipment. Because we have selected a properly designed unit, there will be no ledges in the legging or head for material to lodge. Providing bucket cushions or round washers are placed behind belt and buckets, we should not have to clean at this point. The boot bottom will, of course, contain a small quantity of material and it can be cleaned by raking the material out the cleanout door provided, or by dropping it out the bottom if the unit has this feature. As an added precaution, we can vacuum the belt, cups and boot bottom while rotating the belt by hand.

A good thing to throw in here is that you should exercise extreme caution when working on the moving parts of the elevator. Render the starting switch useless by removing a fuse or placing a cover over the switch. Signs are to be ignored, so don't rely on them and don't just trust to luck. People with one arm have not been very lucky.

Most bucket elevator manufacturers show horsepower rating for a standard material such as wheat, which weighs 60# per bushel. Material that varies greatly from this weight will require a different horsepower. A good rule to use when calculating horsepower is to double the tons per hour of capacity, multiply by the discharge height, and divide by 1,000. About 80% of this power is converted to the actual lifting force and the remaining 20% is figured as friction loss and the amount of power necessary to load and discharge the material. Because of the lack of friction between the material being handled and the casing and internal parts, the bucket type, belt mounted elevator is considered the most efficient and gentleness handling device known to man.

The roll of the belt mounted bucket elevator in the seed plant is an important one. The most important things to consider with this equipment is

proper design and correct speeds. Since Oliver Evans invented the bucket elevator in 1792, all industries have used them as an important link in automation.

Probably the most important pieces of equipment in your seed plant today are your bucket elevators. Without these ideal units, it would be necessary to lift the materials either with much more expensive systems, or by hand. Just like with your automobile and truck, periodic preventitive maintenance and adjustment is necessary to keep them running properly. If it is synchronous with your other pieces of equipment, the materials will flow through your plant smoothly and at a low cost. Profits will be higher because of less capital expenditure and less labor and probably the most important, quality will be increased because of a minimum amount of contamination and mixing.

PREPARING SEED FOR CLEANING

James Henderson[1/]

Many older seedsmen will remember that the purity of seed coming from the old time threshing operations was such that it was almost good enough to bag and tag without further cleaning.

On the other hand, seeds harvested with modern combines may contain as much as 60 to 70% foreign material -- consisting of trash, weed seeds, stems, leaves and freshly killed insects. Much of this material may be green, making the seeds difficult to handle and dangerous to store until this foreign matter has been removed. Therefore, in many seed cleaning plants today the first machine used is a scalper. The scalper removes the bulk of the foreign material so that the seeds can be mechanically handled and safely stored until the cleaning operation can be finished. Scalper machines may consist of simple reels to remove the long straws, or they may incorporate a flat screen to separate the long straws and the green material. They may also be a combination of top screens or bottom screens necessary to handle the kind of seed coming in. These machines are built with a fan if it is desirable to have an air separation while the seed is being scalped. The scalper with air takes off large foreign material with the top screen and sifts out sand and small weed seeds with the bottom screen.

After most of the foreign material is removed further special processing of the commodity may be required to prepare it for final cleaning. Clipped bluegrass seed may have to go through a beater machine to break the seed free from the plant even before scalping. Other seeds may go to a debearder, which in effect finishes the threshing of the seeds by removing awns, points of attachment, beards and excess chaff and delivers them as individual seeds to the finishing cleaner for accurate cleaning.

The debearder is made up of a horizontal steel drum in which stationary arms are positioned along the inside to prevent the mass of seeds from swirling inside the machine and a central beater shaft with hardened arms extending out into the body of the debearder which turns through the seeds to finish the threshing. One function of the debearder is to break apart grass seed doubles. Another is to remove the awn and outer glume from watergrass seed harvested with sudangrass seed and in the process to break apart clusters of sudangrass seed. When the glumes and awns have been removed by the debearder, the size of the watergrass seed is greatly reduced so that a very easy and quick separation can be made with a screen.

Other uses for the debearder are the shelling of unthreshed wheat kernels commonly called whitecaps, the debearding of barley and the removal of

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1/ Mr. Henderson is Sales Manager, A. T. Ferrell & Company, Saginaw, Michigan; Manufacturers of Clipper grain, seed and bean cleaners and Randolph grain driers.

barley points of attachment, removing the whiskers from carrot seed and the partial decortication of sugar beet seed. The most common use is for clipping seed oats. When seed oats are clipped by the debearder, those oats that are still wrapped in the outer glumes are detached from the glumes, double oats are separated, awns (if the oats carry awns) are removed, fuzzy tips of chaff on the oats will be clipped, the oats will be polished and their test weight greatly increased. Oats thus processed can be easily elevated and accurately fed through a cleaner hopper. The cleaner in turn can then make a very accurate separation since there will be no doubles or unthreshed glumes riding over the top screen into the screenings. The finished product will not be exceptionally clean but the appearance of the oats will be greatly enhanced. While clipping the oats greatly improves the test weight, the removal of the chaff, awns, and other material hardly affects the actual weight of the product. This trashy material is so light that the loss of weight can hardly be measured.

Some seeds must be hulled with special hulling machinery before they are ready for cleaning; therefore, in many seed plants seed hullers are used before the finishing cleaners.

Many kinds of legume seed carry a percentage of hard seeds making it desirable to scarify (slightly scratch the surface of the seed so that it will absorb water and germinate the first year that it is planted) the seeds either before or after the final cleaning. Some varieties of seeds will be scarified long after they have been thoroughly cleaned, since the scarification may reduce the length of time that the seeds will maintain viability in storage. Scarification in those varieties may be performed shortly before the actual planting time. Other kinds of legume seeds may require both hulling and scarification. The hulling of many kinds of grass seeds in the hulling and/or scarification of legume seeds is generally accomplished with a huller and scarifier machine which in some manner causes the seeds to be abraded by a rough surface to effect the hulling and scarification. The machine our company makes performs its hulling and scarifying by impelling the seeds at controlled velocity against carborundum surfaces within the unit which abrade the coat of seed and either remove the outer coat or scratch the inner coat as is required. This same machine is available with rubber huller surfaces for use in hulling only. It is especially useful in the case of thin skinned legume seeds which have an inner coat that is too thin to resist the abrasion of the carborundum yet which seedsmen desire to hull before planting or finish cleaning.

After the seeds have been properly scalped to remove the excess foreign material harvested with the seed and after they have been clipped, debearded, hulled and if necessary scarified, they are ready for additional processing by means of the cleaning machines normally used by a seed cleaning plant.

SELECTION OF SCREENS FOR CLEANING SEED

James Henderson[1/]

There are now over 200 sizes and shapes of screens in either perforated steel or wire cloth. Some 50 or 60 new screens have been added in recent years to permit seedsmen to make special separations with a screen and air seed cleaner that could not otherwise be made. One example is the size 3 x 16 Special -- a new screen woven of tempered steel wire and planned for use as a top screen for market cleaning flax. This same size has developed into a very popular screen used as a top separation of small ragweed from small Korean lespedeza seed. The size 3 x 17 Special, also made of tempered steel wire and especially designed as the top screen for cleaning seed flax, has proved to be excellent as a top screen for red clover and sweet clover. It separates dock, ragweed and other plump seeds as efficiently as the 3/64 x 5/16 perforated metal screen that has long been used for this purpose. The new wire screen gives greater capacity.

Triangular perforated screens make special separations of weed seeds from grains and grass seeds. Oblong cross slotted screens permit good separations of split beans from flat beans. Many special sizes of bottom screens for grains have been added to the previous list to permit special separations and perfect cleaning of new varieties of seed grains. The size 6 x 60 wire has a specific usage as a screen to separate yarrow seed from red top seed. These examples will emphasize that it is important to understand the various screens available today in order to get the most from a screen machine.

Large Round-Hole Perforations: The number of a large round-hole perforated screen gives the diameter of the perforation as measured in 64ths of 1". For example, a 64 is 64/64ths of an inch in diameter or 1". This system is used for numbering screens where the diameter is 5 1/2/64ths and larger.

Small Round-Hole Perforations: Round hole perforations smaller than the size 5 1/2 carry numbers showing the diameter of the perforation as expressed in fractions of 1". Fractions of an inch relative to small screens are used to permit furnishing perforations that are much closer together as compared to the numbering system used on the larger perforations.

Large Slotted Screens: The size of the perforation of a large slotted screen consists of two numbers -- the first indicating the width of the slot as expressed in 64ths of one inch and the second number expressing the length of the slot in fractions of one inch. Generally speaking, the direction of the slot will be in the direction of the flow of seeds on the screen. In many large

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slotted screen sizes, however, the screen can be had as cross slots with the direction of the slot across the direction of the flow of seed. These are particularly useful as bottom screens for separating split beans from varieties having a relatively flat shape.

Small Slotted Screens: The first number given shows the width of the slot in fractions of one inch. The second number shows the length of the slot in fractions of one inch. An exception to this system is the size 3/64 x 5/16. This size is almost exactly the same in width as a 1/21 slot, which being one of the very earliest slotted screens used in seed cleaners, is familiar to many seedsmen who have used the older numbering system for years. Among the group of small slotted screens there is a 1/22 x 1/2 diagonal which has its slots turned at a 45 degree angle from the usual direction of seed flow. This screen is useful in some instances when it will allow relatively short seeds to go through or causing relatively longer seeds to float over the screen.

Triangular Perforations: The size given for triangular screens represents the length of each side of the triangle as measured in 64ths of an inch. The 11 Triangle, therefore, measures 11/64ths of an inch for each side. A. T. Ferrell and Company uses this method whereas another common system expresses the size of a triangle perforation by giving the diameter of the largest circle that can be inscribed.

Wire Mesh Screens: The size of both square wire mesh and rectangular wire mesh screens indicates the number of openings per inch in each direction of the screen. There are two sizes that are sometimes considered oblong for their openings are not perfectly square, yet which are so near to square that the eye cannot detect the difference. These are sizes 18 x 20 and 20 x 22. When the letters "SP" are added to the wire mesh screen numbers it indicates that a special tempered wire is used. The 4 x 24 Sp. is an old screen designed many years ago to be used as a bottom screen for separating buckhorn seeds from clover. It had 24 openings per inch across the screen but the screen was woven from thinner wire than usual so that the openings were larger than the openings of the regular 4 x 24 screen. This screen is becoming less popular, because while it was satisfactory years ago for use in cleaners that did not have brushes to sweep beneath the screens and keep the perforations open, the wires are so thin that the action of the brushes tends to distort them. A 6 x 21 screen is recommended today to do the same job. It is much sturdier and has the same width of opening.

Indented Perforations: Round and oblong screens with the perforation indented below the top surface of the screen are available for corn sizing machines. The purpose of these indented screens is to encourage the kernels to turn on end and fall into the opening rather than to lie flat and slide over. These screens are recommended only in corn sizers which have rubber rolls

beneath the screens to keep the perforations clean.

It is of prime importance to select screens which will accommodate the shape of the seed being cleaned. Crop seeds are generally round, long or lens-shaped.

Round-Shaped Seeds: Generally a round-hole top screen is used to clean round shaped seeds. The round-hole top screen will not accept straw, trash, pods and other large and long material, while the slotted bottom screen will drop broken seeds and weed seeds thinner than the round crop seeds.

Long Seeds: The screens generally selected for cleaning long seed are an oblong top screen and an oblong bottom screen. The oblong top screen will separate any weed seeds or large foreign material that are rounder or thicker than the crop seed. The oblong bottom screen drops thin weed seed, broken crop seed or hulled crop seed and any other material thinner than the long crop seed.

Lens-Shaped Seed: An oblong or rectangular top screen and a round-hole bottom screen are generally selected for cleaning lens-shaped seeds. The oblong or rectangular top screen will permit the lens-shaped seed to turn on edge and go through while rounder or plumper seed and foreign material will go over the screen. The round-hole bottom screen will hold up the lens-shaped crop seeds while permitting any round weed seeds so small that they pass through the top screen to be sifted through the openings and be separated. If the cleaner is a two-screen type the above principle achieves the best cleaning possible.

Most seed cleaning plants today use cleaners having more than two screens to permit special separations with other shapes of openings in the same cleaning operation. As an example, oats containing freshly killed insects with bodies about the same thickness as the oat kernel, yet which are considerably longer, can be cleaned very effectively with a round-hole top screen. The oats in this case drop quickly through the round-hole screen and the very light insects will lie flat on the screen and be scalped over.

In using cleaners having more than two screens it is generally recommended that the top screen in the cleaner be a round-hole screen as this opening will screen over straw and long weed seeds better than any other shape. It is recommended that the first screen for use on the lens-shaped Korean lespedeza be a No. 6 Round which will take off the straw, stems, leaf material and cheat seeds before the main separation is made with the rectangular wire mesh top screen. Because Korean lespedeza seeds are lens-shaped, when they are placed on a square wire mesh top screen, the seeds fit diagonally across the square and drop through a smaller mesh than other seeds that have a more round shape. The seeds of rough button weed (also known as pojo) are not distinctly lens-shaped, so the 12 x 12 wire mesh makes a good

separation of this weed seed from Korean lespedeza -- at the same time the seed are so near the same size and shape as the lespedeza that neither round or slotted screen will give a clear-cut separation.

The seeds of Kobe lespedeza are also relatively lens-shaped but unfortunately are slightly wider across the seed than Korean seeds so they will not go through the square wire mesh opening that drops the Korean. Consequently, a larger mesh must be used to drop Kobe lespedeza seed. Unfortunately in this case the larger mesh also passes the rough button weed seeds so that a worthwhile separation will not be made. If this common weed is present in a relatively small percentage, as the seeds come from normal cleaning with a round-hole and slotted top screen the percentage in Kobe will be reduced so that the seeds are saleable. On the other hand, if this percentage of weeds is very high no screen or combination of screens will remove enough of the pojo from unhulled Kobe lespedeza seed to make those seeds pure. The answer is to hull the Kobe and change its relative size making it comparatively easy to remove the rough button weed seeds. It is advantageous to have a mental picture of the crop seed size and shape and a mental picture of the relative size and shape of the weed seed to be separated before choosing the screens that will be used. A good set of hand testing screens are instrumental in determining the size and shape of the screens needed.

The current screen size chart listing the various sizes of the various shapes available emphasizes that several different lengths of slots of screens are available or offered. A 1/18x 1/4 is a good top screen for Korean lespedeza. The short 1/4" long slot drops the small Korean seed and at the same time causes longer weed seeds such as cheat to lie flat and be floated over. The use of this screen, however, reduces the normal capacity that is expected from the cleaner by about three-quarters. The reason is that the width of the Kobe lespedeza seed lying flat on the screen is almost as great as the length of the slot so that each seed has to fit very exactly into the perforation in order to get through. The 1/18 x 1/2" and 1/18 x 3/4" slots which have a longer opening yet retain the width, will drop Kobe lespedeza much faster while making the same good separation of plump or round-shaped weed seed.

In selecting a bottom screen for wheat, the purpose is to drop split kernels of wheat as well as long, grassy weed seeds such as cheat and wild oats. The wheat kernels are relatively round and the length of slot whether it be short or long is immaterial relative to holding up the commodity. This length of slot, however, can very drastically affect the long weed seed which must drop through. The best job, then, is done with a slot long enough to quickly and easily accept these long weed seeds permitting them to be quickly screened from the wheat as soon as possible.

When selecting a bottom screen for oats the fact must be considered that a long slot will give the oats an extra opportunity to pass through, therefore, while a better separation might be possible with a 3/4" long slot it might be far

more economical to use a 1/2" long slot instead.

The constant brushing of the screen cleaning brushes under wire screens causes them to wear out faster than the perforated metal type. Many seedsmen have asked if perforated metal slotted screens were available in the same sizes as wire mesh screens for cleaning small legume seeds. There are two major reasons why a substitute of this kind would not be practical. One is that the irregularities of the surface of a wire mesh screen permits it to do a better job of sifting than is possible with a flat perforated metal screen. The other basic reason has to do with the percentage of open area. Obviously it is possible to weave a wire mesh screen with a much higher percentage of open space than would be possible with a perforated metal screen having the same size opening. A wire mesh screen has literally tens of thousands more openings, therefore, we find tens of thousands more opportunities for small material to be sifted through, with the end result that a wire mesh bottom screen will give much greater capacity and a better separation than could be had with an equal size of perforated metal.

ADJUSTMENTS FOR EFFICIENT AND PRECISION SEED CLEANING

James Henderson[1/]

One of the recent developments that has contributed to more efficient and exact seed cleaning is the metering hopper for screen and air cleaners. The fluted roll with extended flights feeds a metered quantity of seed into the air leg and onto the screen. While the gate is adjustable for large changes of rate of feed, the basic adjustment is made by increasing or decreasing the speed at which the fluted roll turns and thereby increasing or decreasing the number of measured quantities fed into the air stream.

Spiked fingers on a shaft turning in the mass of seed in the hopper eliminate bridging of trashy seed across the hopper and tend to force the seed down to the fluted roll so that the flutes can pull the seed through into the air leg.

A variable drive mechanism is required for accurate control of feed with this hopper. If you have occasion to clean very trashy seeds with your seed cleaner, which is equipped with another type of hopper, you can change the speed of your hopper roll by simply switching the two outside gears on your hopper drive. The normal arrangement has a 15-tooth gear driving a 60-tooth gear. These are reversible so that you can have the 60-tooth gear driving the 15-tooth gear. This will cause a regular roll-feed hopper or a roll-feed brush hopper to feed very trashy seeds regularly and evenly to the screens. However, if the seed are not extremely trashy, you may find that the extra high speed you obtain by this reversing of gears will make it impossible for you to control the quantity fed onto the screen. For that reason, we offer an intermediate set of gears having 30 and 36 teeth, respectively, which you can substitute for the 15 and 60 tooth gears to give you two intermediate speeds and accomplish results similar to those obtained with the metering hopper.

Possibly you have observed the action of seed on a hand screen when you tap or jar the hand screen with your fingers. It causes seeds to be turned and tumbled so that they present themselves to the openings of the screen and go through faster. You can have a similar action on top screens of your cleaner by simply installing knockers that are adjustable to lightly tap the screens or to strike the knocker pads on the screens a sharp blow for heavy vibration. This serves a dual purpose of enabling you to vibrate the screens so that seeds will pass through very close and small openings and to jar loose any long weed seeds that become up-ended and wedged so tightly into perforations that brushes cannot remove them.

When you attempt to make a very close and accurate separation with a perforated metal bottom screen and at the same time attempt to put a heavy layer

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of seed over that screen, there is always the danger that some of the seed you must separate will be carried over the top of the screen without contacting the perforations and will not be separated. Screen dams can be fastened across the top of the screen to interrupt the smooth flow of the seed down the screen and cause them to be turned, tumbled and heavily sifted. These screen dams, if properly placed, will permit you to put a heavier layer of seed on that bottom screen with assurance that the separation will be correctly made.

Round seed, such as soybeans, have a tendency to bounce and roll over the top of a screen so that some of the beans never contact a perforation but pass over the top of the screen with the screenings. A scalper apron made of canvas can be draped over the upper half of the screen to cause these beans to stop their bouncing, settle and contact the perforations that go through. The apron should not be so long and heavy that pods and trash will be held up in its movement down the screen, but can serve as a baffle to make the bouncing seed settle to the screen and be passed through.

At other times you will be faced with the problem of long stems or weed seeds turning on end to go through a top screen when they could be separated if they would lie flat and slide over. If you drape oil cloth with the slick side down over the top screen, these long pieces of stem or weed seeds cannot turn up on end to go through the round hole top screen but will slide down the screen underneath the smooth oil cloth and be screened over.

You can assure a better separation of these long stems and weed seeds by blanking off the lower section of a top screen. After your good seed have gone through the screen, there is no reason to leave the rest of the perforations down the length of that screen open for trash and weed seeds to find their way through. A temporary blank-off section can be accomplished by putting masking tape and brown paper over the lower section. Permanent blanking off can be accomplished by simply making the screen with a blank metal lower section.

One of the most useful controls on a precision seed cleaner is the variable screen shake adjustment mechanism. This permits the operator to adjust the speed at which the screens are shaken from a very slow speed to a very fast speed. The variable shoe shake mechanism should be operated to accomplish a desired action of the seeds on the screen, not to attempt to get more capacity by shaking the screens faster. For example, if you are putting fescue seed through a small round hole screen, it will be necessary for you to shake the screens rapidly in order to cause the fescue seed to turn on end and go through the round screen. If you shake the screen slowly, they will lie flat and float over the top of that screen. Also, if you're putting bluegrass seed or canary grass seed through a small square wire mesh screen, it is necessary for you to shake the screen rapidly or the seeds will not travel down the wire mesh screen but will pile up on top of the screen and lie dead and will eventually be flooded over with the dirt and weed seed. On the other hand, if you are attempting to make a very accurate and close separation of a small round seed through a small

round screen, either top or bottom, you must shake the screen slowly to allow the seed to come in exact contact with the opening and pass through. Soybeans on a top screen without the apron will bounce if you shake the screen rapidly, therefore, a slow speed is required. Examples of cleaning operations requiring slow speed are a separation of dodder from Korean lespedeza with a 1/16 round hole bottom screen and cleaning of timothy using 1/23 or 1/25 round hole top screen.

Each screen in a precision seed cleaner must be adjustable for different degrees of pitch. Common ranges of pitch adjustment in seed cleaners range from four to twelve degrees. High capacity grain receiving separators may have greater screen pitch in order to move the grain over the screens rapidly but in a precision seed cleaner, these pitches are sufficient to give adequate cleaning capacity while remaining able to make the exact separations required in seed cleaning.

Screen pitch has a much greater effect on the speed at which seed moves through the machine than does shaker shaft speed. The latter can be increased with little effect on capacity, but seed will pass over a screen in the steep position almost twice as fast as over the screen in the flat position at the same shaker shaft speed. The speed at which the seeds pass over the screen has to be considered from the angles of the desired capacity and the desired separation. If the separation is a difficult one, and capacity is secondary, you will naturally want to leave the seed on the screen as long as possible in order to give every possible opportunity to make the separation. If capacity is the important thing and the separation is secondary, then a steep pitch is in order to accomplish a greater capacity. If the separation is quickly made and you wish to move the material separated over the top of the screen quickly, you will want to use steep pitch.

Since it is possible that you will have a different requirement of speed of travel over and through every screen in your cleaner, it is mandatory that every screen be adjustable for pitch and independent of any other screen, and of course, the best time to make a screen pitch adjustment is while the cleaner is operating so that you can observe the results that the changes of the pitch adjustment cause.

For the convenience of those seed processors who do not have multi-screen cleaners but who on occasion need to make more than one type of separation as the seed are passing over the bottom screen, we offer what we call combination screens. These will have two or more different perforations or meshes on one screen frame; for example, if you are attempting to separate hulled oats and wild buckwheat from oats and have only one bottom screen, you may be able to make this separation by using a combination screen that has one section of slotted screen material to drop the hulled oats and another section of triangular perforations to drop the wild buckwheat. There is one very popular combination screen used as a bottom screen for fescue which has four different

sections covered by different meshes or perforations and designed to accomplish a specific combination of separations that a processor requires.

When a manufacturer knows that the seed cleaner he is shipping will be used for cleaning one kind of seed it is easy enough to prescribe a fan speed that will give optimum results and maximum adjustability when cleaning only that kind of seed; however, seed cleaners are generally intended for cleaning several different kinds of seed and it is not unusual to see a cleaner being used in season for cleaning the seed of soybeans and the seed of red top. If the machine is shipped with the proper drive for the fans to supply enough air for cleaning soybeans, then the air adjustment when it is used for cleaning red top will be in the lowest portion of the adjustment and will be rather sensitive. On the other hand, if it is shipped with the fans adjusted for red top, there will not be enough air to make a good separation when heavy seeds such as soybeans are being cleaned. Since precision seed cleaners are equipped with a variable shoe shake mechanism and since the fan speed may be varied over a wide range and the variable shoe shake mechanism permits all other drives to be driven at normal speed, it is possible to furnish a dual drive for a cleaner that will be used for cleaning both heavy and light seed. This dual drive permits the operator to change the fan speed from a high speed supplying plenty of air for heavy seeds to a low speed offering wide range of adjustment for small and light seeds. To make it possible to accomplish this change of speeds quickly and easily, the motor pulley furnished can have double the usual number of grooves and the driven pulleys on the fan shaft be side by side of two different sizes. With different belts, it is possible just to change belts in order to change the fan speeds and this quick changeover assures that the cleaner will offer the best possible air separation for all weights of seeds.

Some of the things that can be built into a seed plant to give efficiency of operation are not necessarily a part of a cleaner but are part of the design of the equipment used in that plant. For example:

1. Every bin used should be self-cleaning with no ledges or flat slopes that will hold up seed, necessitating clean up by hand when changing over from one kind of seed to another.

2. Every elevator should be provided with clean-out slides at the bottom to permit quick and perfect removal of small, residual quantities of seed left in the bottom of the elevator when changing to another kind of seed.

3. Elevator buckets should be held away from the elevator belt by spacers between the bucket and belt to permit the easy and quick blowing out of seeds lodged between the bucket and belt. It is impossible to prevent seeds from getting behind the bucket no matter how tightly you may bolt the bucket to the belt, so the best solution to this problem is to give them room to be removed by a blast of compressed air.

4. Every spout leading from an elevator into a bin should be at a pitch

that will insure that it is self cleaning. Every feed from an elevator to a bin or cleaner should be equipped with an overflow device which could be a pressure sensitive device or an overflow spout. The installation of an alarm system or an overflow spout in a spout between an elevator in a bin or cleaner will prevent backing up of seed into the elevator and stopping and jamming the elevator full to stop its operation.

5. A seed cleaning plant that receives seed in bulk from trucks should be equipped with a receiving pit having a vibro pit that is self cleaning so there is no requirements for an operator to sweep out the truck dump between lots.

6. The pit which houses elevator boots must be large so that an operator can get into it and have free access to the clean out slide and room for vacuum equipment for cleaning up between lots.

7. A vibrating conveyor mounted beneath the cleaner to convey the cleaned seed from one side to the other cleans itself perfectly between lots so that there is no residue for the operator to sweep out and offers the advantage of an installation above floor level with plenty of room beneath the cleaner so that spilled seeds may be quickly and easily cleaned from the floor.

8. Pneumatic unloading installation eliminate the clean-up problem and add great efficiency to plants which must maintain identity without mixtures of lots of seeds coming in one after another.

Following some of these suggestions will assist you to increase the efficiency of your seed cleaning plant and properly adjust your machines for precision cleaning.

CORRECT AIR DUCTING FROM A CLEANER

James Henderson[1/]

Improper air trunking installations from the cleaner and into the dust house or collector causes up to 90% of the difficulties our salesmen have had in conjunction with improper air movements. Sharp turns, improper junctions, poor connections and poor collection equipment will all contribute to air deficiency in a cleaner. Improper air clearance also results in a very dirty, dusty plant operation. The following are a few of the common errors found in various plants and how each can be avoided or corrected:

A single fan cleaner having only the variable speed bottom blast fan must have a booster fan between it and a cyclone dust collector if a cyclone is to be used. These single fan cleaners are generally installed with the fan discharge near an outside wall so the fan can discharge out into the open air. In some cases, it is necessary to blow the dust so that it is run into a large expansion chamber that will permit dust and light chaff to settle while permitting the air to continue on through and be discharged relatively clean.

The dustless cleaners with top suction fans and the bottom blast fan develops sufficient velocity that cyclone type collectors or dust houses can be used to settle the dust and chaff from those air streams without a booster. Usually the dustless model cleaners have two top suction fans discharging side by side. Some larger models have as many as three fans, in which case the third fan must be handled separately. Separate collectors, one for each fan, are the ideal set up. However, unless too much air volume is to be handled, it is cheaper to bring them together by means of a junction with a divider valve installed into a single air pipe and use a single air collector or single dust house. When such a junction is made, the approach angle should be held to a minimum and, I repeat, the junction divider is very important. If the pipes are brought together too abruptly or if the divider is not installed, back pressures are created which impede the proper flow of air. In fact, as the two air streams converge one opposes the other and it is found that when air adjustment is made on one fan it will affect the separation that is being made with the other fan.

Refrain from installing elbows which have a sharp change of direction. Back pressures are created at such points and in most cases light chaff will be dropped into the pipe and finally plug the entire run. A rule of thumb used at our plant is that the inside radius of the elbow should be at least two times the diameter of the pipe.

The final source of trouble is in the cyclone or dust house itself. If it is either too large or too small or isn't designed properly or has a cap over the pipe discharging from the top of it or in some other way causes back pressure or

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pressure drop or turbulence that interferes with the cycloning action of the air inside of the collector, the installation will cause real trouble.

Many seedsmen build their own dust houses. If a house is properly designed and is large enough, it will serve the purpose very well. Space does not permit detailed explanations of the following eight basic rules governing good dust house construction:

1. The dust house should be deep.
2. The entry duct should be horizontal.
3. The entry duct should be below the pitch of the roof.
4. The entry duct should enter along one side.
5. The exhaust opening should be greater than the entry area.
6. The exhaust pipe should extend below the entry duct.
7. The exhaust pipe cover should not restrict the opening of the exhaust pipe.
8. The clean-out opening should be as large as possible.

A common mistake is the use of a single dust house to handle the air from two separate cleaners. If the individual air streams from each cleaner were adjusted exactly the same, it is possible that a single dust house or cyclone would be satisfactory, however, so many times the plant will be cleaning large seed on one cleaner and small seed on the other and the air streams from the fans will seldom be identical. If one cleaner is operating and the other is idle, there will probably be a blow back into the air ducting of the inoperative machine. This will either plug that cleaner's piping with dust or cause the dust to be blown back into the work room. It is impossible to adjust one cleaner in this situation without affecting the standing adjustment of the other cleaner.

CYLINDER SEPARATOR

Charles E. Vaughan[1/]

The cylinder separator is a length sizing separator which lifts undersize particles out of a mass of seed. In this respect it is similar to the disc separator, but in other ways it is quite different. Before the operation will be explained the parts will be named and described.

Feed Hopper. The feed hopper is that part of the machine that receives the seed yet to be cleaned from the elevator or from some other means. From the feed hopper the seed are fed into the machine for the cleaning operation. If desired, the feed hopper can be equipped with a mechanical roll feeder, which provides uniform feeding when very light materials or small volumes are being handled. Most feed hoppers on cylinder machines are small and provides only for the receiving of the seed into the machine.

Cylinder. The cylinder is similar to a drum with both ends removed, that revolves about a horizontal central shaft. The walls of these hardened steel cylinders are lined with semi-spherical indents. The size of the shells will vary from machine to machine. They will range from 17 inches in diameter to approximately 24 inches in diameter. They also vary greatly in length. Some measure 56 inches long, others measure as long as 90 inches.

Indent sizes are listed in 64ths of an inch, similar to screens used in the air and screen machines. They range from a number 4 to a number 36.

There are many possible shapes of indents. The two basic types are the hemispherical shape and the cone shape. The hemispherical shape or round bottomed indent would be excellent for round seeds. A cone shaped indent would discharge better for seed which do not roll as easily.

It is not practical to install more than one size or shape of indent in any one cylinder.

A change in the angles of the sides, the shape of the sides and bottom, the depth of the indent in relation to the width, etc. will affect the operation of an indent cylinder. It would be impractical for the indents to be changed to take out each shape of seed separately, so a happy medium must be reached whereby the combination of the depth of the indent, the angle of the sloped sides, etc., will do the most good on the most seeds which will normally be encountered.

Receiving Trough. A receiving trough is provided to accumulate the lifted particles and convey them to a discharge spout. The trough is in a horizontal position extending the length of the cylinder. It is located near the center of the cylinder with the separating edge adjusted to the desired position for proper

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1/ Mr. Vaughan is Assistant Agronomist, Seed Technology Laboratory, Mississippi Agricultural Experiment Station, State College, Mississippi.

cleaning. The lifted particles are conveyed through the trough to the discharge spout by means of an auger.

Leveler or Conveyor. It is necessary to have some means of conveying seed through the machine in order to discharge the particles too large for the indents. In most machines this is done by one of two methods. In some of the smaller, especially shorter cylinder type machines this is accomplished by elevating the feed end of the machine to a point that will allow the rejected material to flow uniformly through the cylinder. Most machines, however, use some mechanical means inside the cylinder to perform this operation. A screw conveyor in the bottom of the cylinder will break up the rotation of the core and also convey the material. Another method is the use of grain line blades which break up the mass and also convey.

Retarder. The retarder is described as a dam at the discharge end of the machine. It may be adjusted to hold the seed at any desirable level. Without the retarder, the seed mass would be less at the discharge end of the machine. This is due to the smaller particles being lifted out of the seed mass. Without the use of the retarder, surging might possibly result. Surging is the rocking back and forth of the seed mass as the cylinder rotates. By retarding the discharge, the depth of the seed can be increased to the point where no surging occurs and the best separation can be accomplished.

Operation of Cylinder Separator. Indented cylinders operate on the centrifugal force principle in which the speed of the cylinder holds the shorter seeds in the indent, lifting them out of the mass until the indent is inverted to the point where gravity causes the lifted particles to fall out of the indent. The shape and size of the indent, the size, shape, seed coat texture, the moisture and the weight of the seed combine to make certain seeds lift close to the vertical center at the top of the revolution before they fall out. It is only practical to use one size and shape of indent in a cylinder so variation in separations is accomplished by two adjustments: speed change, which increases or decreases centrifugal force, and the setting of the edge of the trough which catches the desired liftings. The two adjustments give the cylinder separator extreme flexibility, and the adjustments are supplemented by the fact that the physical characteristics of the seed, other than its size, also affect the height or distance the seed will carry before it falls out of the indent.

Since centrifugal force holds a particle in the recess of an indent with sufficient force to lift it out of a mass of seed, the indented cylinder is most efficient in lifting materials which weigh over 45 pounds per bushel. The speed may not be increased beyond the point where it will carry the material in the indents beyond the center of the cylinder (above the center shaft) otherwise the material will not fall out of the indents before they are lifted high enough to be caught in the trough. Between these extremes of speed the maximum efficiency can be obtained.

The combination of centrifugal force and indent size lift the shortest particles or seeds the fartherest out of the main mass. Intermediate sized seeds fall out sooner than the small seeds, and the longest fall out of the indents first. Some materials are too large to lift at all and roll along in a thick "rope" on the bottom of the cylinder. Without a means of stirring this mass as it works its way to the tail end of the cylinder, stratification of light weight and chaffy seeds would take place. Some separators are equipped with a screw conveyor, without a housing around the flights, which runs in this mass. The screw has the triple function of conveying the mass toward the tail end of the machine, eliminating stratification and maintaining a level mass in the bottom of the cylinder. Other separators have leveling blades mounted inside the cylinder to aid in maintaining a level mass of seed. If some method of leveling the seed were not provided the seed mass would tend to pile up at the head end of the cylinder where the seed enter the machine. This is especially true of the lighter material. Under such conditions the upper side of the grain level at the head of the cylinder would be so high that material could fall into the trough at the feed end due to sheer volume being raised by centrifugal force. At the tail end of the cylinder where the seed mass would be practically depleted, the seed would very quickly be lifted out of the restraining mass and would have too high a lift to get to the edge of the selection trough.

At the feed end of a cylinder separator there is naturally a large quantity of considerably undersize particles, two or three of which may fall into an indent at one time. As these are depleted, the intermediate sizes are lifted out of the mass at approximately the center of the cylinder length. At the tail end of the cylinder the final and most critical size selection by the indent is accomplished.

As mentioned earlier, lightweight seeds whose bushel weight is less than 45 pounds cannot be separated as sensitively as heavier weight seeds. For this reason the cylinder is more practical to apply on small grains, corn and soybeans, than it is on grasses. The larger the indent used, the more critical the weight factor becomes. Centrifugal force requires weight to be effective. Dropping a seed out of an indent requires a relatively heavy specific gravity, and the rounder the seed, and the slicker the seed coat, the easier the indent will affect the distance it will travel circumferentially. Hence, a wet seed will not slide out of the indent as readily as a slick dry one.

Adjustments on Cylinder Separator.

1. Rate of feed. It is necessary that the rate of feed be controlled. If the rate is too slow, then the failure to reach capacity becomes a problem. If the rate is too fast, then not enough time is allowed for cleaning. If the feed varies, all particles will not have the same length of time to be separated as did other particles. The procedure for controlling the rate of feed is simple; it is done by the opening and closing of a gate.

2. Position of trough. The degree of separation is controlled by the position of the separating edge of the trough. The separating edge is that edge adjacent to the rising side of the cylinder. If some of the long seed are lifted out by the indents, the trough is set too low. If the trough is set too high, the short seed picked up by the indents will fall back into the mixture and be discharged with the long seed at the end of the cylinder.

3. Speed of cylinder. The desirable speed can be determined by setting the trough level and then adjusting the speed of the cylinder so that the seed picked up by the indents will fall into the trough from the top of the cylinder. It is important that the cylinder be run at the correct speed. If the speed is too fast, the indents will pick up some of the longer seed that would normally be rejected. If the speed is too slow, the indents will reject some of the short seed that should be lifted. The speed is adjusted by changing a variable speed drive.

4. Action of leveler or conveyor. In those machines that use an increase in elevation of the feed end of the machine as a means of conveying, an adjustment is sometimes necessary. This is done by increasing or decreasing the elevation the desired amount to properly convey the material through the cylinder.

5. Position of the retarder. The retarder is adjusted to maintain a proper level throughout the entire length of the cylinder. The adjustment of the retarder will depend on the type of seed being processed, and the amount and size of the material being lifted.

In summarizing length separators, one cannot say that an indented cylinder is better than a disc or vice versa. Each performs certain separations better than the other, although their uses overlap in some instances. The disc is accurate, flexible, and consistent in the middle-sized seed groups. The cylinder is flexible without changing the cylinder size. In general, it performs best on seeds having a high weight per bushel. Each machine is better in certain groups of seed mixtures. Neither can eliminate the other completely.

THE DISC SEPARATOR

M. C. Cecka[1/]

The disc separator is a length sizing separator which lifts uniformly shaped and dimensioned under-size particles out of a mass. Disc separation is not affected by surface texture, weight per cubic foot or bushel, nor moisture content of seed to any appreciable extent.

Flexibility within a machine can be achieved by varying the size of pocket, the number of discs of each pocket size, and provision within the machine for returning to the main mass liftings of the various pockets which it may not be desirable to remove. In a normal arrangement the disc pockets are furnished in a progressively larger size from the intake end to the discharge end. In this way, the smallest particles are lifted out of the mass first, with progressively larger liftings being removed as the material passes through the machine.

The disc pocket consists of an undercut recess in the side face of a special, hardened, cast-iron disc. Thousands of these pockets are cast on both sides of a disc. In the center of the disc is a round opening called an "Eye". In the center of the eye are three spokes protruding from a hub which fastens to the "Rotor Shaft" which carries the discs. Midway on each spoke a sheet metal conveyor blade may be bolted. These conveyor blades act as a screw conveyor to move the main mass of material through the eye of the discs from the inlet to the tail end of the machine.

The mass must pass through the eye of each disc in order to reach the tail end of the machine, and is brought in contact with the face of each disc in the course of its travel. The spacing between the outer edge of the disc and the body of the machine is kept as close as possible, without being close enough to squeeze or crush the material being separated. The conveyor blades are made removable so that they can be removed or added (in older model machines) in whatever quantity is needed to make the material travel through the machine at the most efficient rate for complete separation. Since in any separator the capacity and efficiency is determined by the ratio of small particles to be taken out; to the number of apertures, indents or pockets to take them out with; the speed of travel of the main mass through the machine affects the efficiency of the separation.

As mentioned before, disc pockets are a cast recess in the face of a flat disc which operates vertically. The disc pocket functions like an elevator bucket, scooping up seed which will fit into it as the pocket passes through the mass at the bottom of the machine, holding the material in the pocket by centrifugal force. The materials discharge from the pocket in just the same fashion as an elevator bucket discharges its load. This accounts for the minimum speed tolerances allowable in a disc separator. Too slow a speed would allow the material to fall out of the pocket before it should; and too fast a speed

could prevent the material from falling out of the pocket at all.

Disc Pocket Design

Disc pockets are made in three basic shapes. Each shape is made in a number of sizes. There are over 75 different pockets to choose from. Generally speaking, the pockets are consistent in their proportionate dimensions. The pocket size is always referred to, designated and measured by its width, measured radially from the center of the disc. The length or height of the pocket is essentially the same dimension as the width; and the depth is approximately 1/2 the dimension of the width. The lifting edge, or undercut part, of the pocket, is the "bottom" and the width measurement is from side to side.

The "V" Pocket: The V pocket derives its name from Vetch, and is so designed as to pick up, and hold for discharge round shaped materials. This pocket has a round "lifting edge" and a squared horizontal "leading edge". Tubular, cylindrical or elongated particles have no flat surface at the bottom of the pocket to "sit" on, and tip out of the pocket as the disc revolves around the shaft. (In speaking of sizes in this instance we are referring to round shaped particles which have a diameter approximately the same as the width dimension of the pocket. Obviously, tiny particles much smaller than the width of the pocket could be retained in the pocket in multiples and would lift out of the mass regardless of their shape. In all cases in this discussion, we are referring to separations where the smallest materials have been removed and close sizing between relatively uniformly dimensioned particles is to be accomplished.)

The "R" Pocket: This pocket shape derives its name from Rice, and was designed to remove cross broken grains from whole grains. This pocket looks like a "V" pocket, except that it is up-side-down. The lifting edge is flat and horizontal, while the leading edge is round. This pocket will reject round particles, but will lift out cross broken or short tubular, or elongated particles since they have a flat surface to "sit" on.

Both the "V" and "R" pockets are made only in small sizes, seldom exceeding 6 millimeters in width and length. They are made from 2 1/2 mm. up to 6. These pockets are usually used in combination in a set of discs, particularly where a variety of sizes of liftings are to be encountered and versatility is desired.

The letters V and R are always followed by a number, such as, V4, V5 1/2, R5, etc. The number following one of these letters indicates the width dimension in millimeters, i.e., a pocket designated as V4 1/2 is a round lifting edged pocket which is 4 1/2 mm. wide, etc.

Alphabetically Designated Pockets, Other Than V or R: Unfortunately these pockets with alphabetical designations are not consistent in sequence as to size, nor do they carry a numeral to indicate their width. The story of the development of the size designations is a rather lengthy one and will not be

discussed at this point. It is sufficient to say that the alphabetically designated pocket, without a numeral suffix, is square-faced.

Those square-faced pockets which are approximately less than 1/4 inch in width have, in most cases, been supplanted by the V and R pockets, although they are still available, and in some specific instances can probably be used to definite advantage over the V and R type pockets.

Generally, the square pockets have two basic functions. One is to rapidly scalp out a small fraction of extremely long undesirables from a more uniformly sized bulk to make the material smoother flowing and reduce unnecessary bulk. The other is to provide a dividing or "splitter" separation, where each fraction thus produced is to be resized in separate operations, or on different types of machines. Dividing a material which has a broad range of particle sizes and resizing the fractions separately provides much faster overall capacity and more precise separations.

Disc Separator Adjustments and Separation Control

The disc pocket can make extremely sensitive length sizing selection. In most applications the material consists of varying degrees of length or shape, and it may be desirable to separate the stock into more than one length size or to remove one or more differently shaped particle groups from the main mass. As mentioned previously, it is possible to arrange a group of discs on a single shaft using one to as many as six different pocket sizes and types to provide selective fractioning of the input material.

As the disc pocket lifts and ejects a particle of a particular shape or size the particle falls on a "liftings discharge trough" set between each disc, which directs the material to a "liftings discharge hopper" at the front of the machine. At the outside end of the liftings troughs is a small screw conveyor which is covered by hinged trap doors. If the doors are "down" the lifted material passes over the door into the liftings discharge hopper. If, for any reason, the operator does not want the liftings of a particular disc or group of discs to fall into the discharge hopper, he can raise the trap door which will deflect the liftings into the screw conveyor and be returned to the feed end of the machine where it feeds back into the main mass. This "return conveyor" adjustment is most frequently used at the tail end of the machine where particles may be lifted which the operator would prefer to discharge from the machine with the longer size disc rejects. It literally permits the operator to shorten his machine by blocking off the last few discs, if he finds he is lifting out too much.

The lower edge of the liftings discharge hopper outlet at the front of the machine can be provided with one or two draw-off valves, one near the feed end of the machine and one at the tail end. Since the smallest particles lift out of the mass on the first few discs it may be desirable to draw off the smallest liftings separately from the longer liftings discharged at the center of

the disc shaft. The liftings of the last few discs may be too short to join with the tailings and too long to mix with the center disc liftings or may be in large enough quantity to overload the small return conveyor, so the operator can use the draw off wing valve at the tailings end of the liftings hopper. Using both adjustable valves permits the operator to keep separate three sizes of material falling into the liftings discharge hopper producing three lengths of liftings in addition to the oversize material tailing off the end of the machine which was too long for the disc pockets to lift.

Grain Level Control

In the latest design Carter Disc Separators a new feature has been added to provide more positive control, and quick selective adjustment to the rate of travel of material through the eye of the discs without removing or adding conveying blades. Known as the "Grain Level Control" it consists of crescent shaped blades, somewhat similar in appearance to the broad end of a canoe paddle. In the No. 1522 size machine the blades hang from a rod at the back of the disc machine just under the lid. A blade is placed between each disc of the last two-thirds of the disc assembly. Each blade has a steel collar with a square headed setscrew at its upper or "hinge" end, and each retarder blade can be adjusted independently. By loosening the setscrew the blade may be moved forward so as to block off part of the eye of the disc where the grain mass is heaviest. By shutting off a portion of the disc-eye opening the blade retards the rate of travel of the material, causing it to fill the body of the machine more deeply at that point. This makes the material ride higher at the back of the machine, reducing the distance which the disc pocket has to carry the undersize material from the mass to the liftings discharge point. The higher the grain level is at the back of the machine the larger particles the disc pocket can lift. If the grain level is low, the particle has more time to fall out of the pocket before it reaches the ejection or discharge point. By this control the pocket can lift slightly larger or smaller particles and is more flexible in its selectivity.

In most cases (particularly in small pocket layouts) as many as six different sizes and shapes of pockets can be used on a single disc shaft. The smallest pockets are mounted on the feed end of the disc shaft, with progressively larger pockets toward the tail end. Since the pocket shapes, in addition to their dimension, can be selected to meet varying separation conditions, the operator frequently finds that one particular group of discs can remove a specific sized or shaped particle more effectively than another. By using the grain level control blades he can hold the material longer at that group of discs, increasing the lifting capacity at that point only, without changing the grain level at any point in the machine. Changing the grain level does not materially change the input capacity but only increases or decreases the liftings percentage of the retarded flow area. Usually if the separation to

be made is an easy one, or if the pockets tend to lift the desired size readily, the retarders would be moved out of the disc eye area so as to keep the grain level low. As the disc pockets wear down losing some of their lifting ability, raising the grain level in the machine permits them to work at peak efficiency for a longer time before disc replacement is made necessary.

At the tailings discharge outlet, in the end frame of the machine, an adjustable gate or retarder is provided to control the rate of discharge and the grain level for the last few discs.

Using these adjustments in combination provides the disc separator with broad flexibility of selectivity and can produce more than one length size at a time.

Disc Separation Limitations

The disc separators have broad applications in most types and textures of products, efficiently handling such separations as crumbled leaf pieces from leaf stems in dry spices, to length sizing of shelled peanuts (without damage or nut breakage), and are not affected by weight or surface moisture. Most dry materials which are normally not free flowing can be remarkably easily conveyed through the machine. However, some materials may wedge in the pockets causing plugging and lost efficiency. For example, compressed powdered pellets, corn and soybeans cannot be separated or handled by disc separation. In this case, we recommend consideration of indented cylinder length separators as an alternate. Laboratory tests can best determine which principle of length separation should be used.

THE ROLL MILL

Charles E. Vaughan[1/]

No manufacturer has yet claimed to have developed an all-purpose machine that will remove all objectionable weed seeds and foreign material from all lots of legume seeds. The application of the principles of seed cleaning in which components of a mixture differing in dimensional characteristics may be separated by screens, indented cylinders or discs and those differing in weight and specific gravity by aspirators or gravity tables, are well known through the trade.

The roll mill is useful in separating mixtures where crop seed and contaminants differ in the texture of the seed coat. In some instances seeds of different shapes can also be separated on this machine.

The roll mill is always used after the basic cleaning machines in the processing line. It is often used to finish lots that contain dodder, dock, flat or immature seed and inert matter that passed the previous machines.

The rough seed are separated from the smooth seed by the action of the rolls. A pair of rolls covered with a velvet-like material are placed side by side close enough to touch lightly. The rolls are mounted in an inclined position and turn in opposite directions, outwardly when viewed from the top.

The seed mixture is fed onto the rolls at the high end of the machine. As the seed travel downhill between the revolving, inclined rolls, the rough seed are caught by the velvet-like rolls and thrown against the baffles, deflected back against the rolls, etc. until they have been thrown out. The smooth seed continue bouncing downhill between the rolls and discharge off the end. The seeds thrown over the sides are caught in graduated grade hoppers underneath the machine. The grades of seed from these hoppers vary from a high percentage of rough seed from one nearest the feed end of the machine, to a very low percentage of rough seed from one nearest the discharge end. The intermediate grades can be re-run to recover the smooth seed that were thrown out with the rough seed.

The feed hopper of many machines consists of a vertical shaft from which individual feed spouts lead directly to each pair of rolls. This vertical shaft is equipped with a fast, complete clean-out pull slide. The rate of feed is adjusted by opening or closing the feed slide in the vertical shaft underneath the feed hopper. This increases or decreases the size of the opening in the shaft through which the seeds flow into the individual feed spouts.

The rate of feed is adjusted and controlled for two reasons. First, the effectiveness of the separation may be controlled somewhat by the rate of feed.

1/ Mr. Vaughan is Assistant Agronomist, Seed Technology Laboratory, Mississippi Agricultural Experiment Station, State College, Mississippi

If the space between the rolls and the baffles becomes crowded the agitation necessary to make an effective separation is reduced or prevented. Second, the capacity may be increased by opening the feed slides.

The rolls are the separating parts of the machine. They are covered with a velvet-like material and placed side by side close enough to touch lightly. The rolls are always used in pairs and each pair of rolls is a separate cleaning unit.

The length of rolls may vary with different machines, as a certain length is not absolutely necessary for maximum cleaning. The number of rolls may also vary from machine to machine. An increase in the number of rolls does not increase efficiency but merely increases capacity.

The speed of the rolls is the most important adjustment on this machine. In general, the faster the rolls revolve, the cleaner the seed. However, too fast a speed is not recommended because it results in unnecessary throw-over of good seed. The recommended way of making the adjustment is to start with a minimum speed and the desired rate of feed, then increase the speed of the rolls until the product is clean.

The tilt mechanism is located at the bottom of the feed end of the machine. On some machines it is a large hand wheel screw; whereas on other machines it is a combination lever-screw device. This variable tilt mechanism permits quick, easy adjustment of the machines pitch for various types of seeds. A continuous incline range from 7^{o} to 13^{o} may be obtained. This adjustment is used less by most operators once a desirable tilt has been established. Increasing the tilt has the effect of shortening the rolls and also reduces the amount of throw-over.

The baffles are shields that conform fairly close to the shape of the rolls as viewed from the top and are positioned directly over each pair of rolls. Rough-coated seed lifted by the turning rolls are deflected by the baffles back on the rolls with the result that these seed are removed rapidly from the smooth-coated seed which are not lifted. The baffles are independently adjustable at either end of the machine. The range of separation possibly may be increased by changing the distance between the rolls and the baffles. For most cleaning problems, a 1/4 inch spacing seems to be best.

Below are listed a few rough-coated seeds and objects which are thrown out by a roll mill.

Dodder	Catchfly	Wild Winter Peas
Mustard	Cockle	Wild Carrot
Foxtail	Timothy	Pieces of Clay or Stones

These rough-coated seeds or objects may be removed from clovers, alfalfa, hulled lespedeza, hairy vetch and other smooth coated seeds. Because of its triangular shape and sharp corners, dock is commonly and easily removed from the clovers.

The removal of buckhorn can be accomplished with this machine if prior treatment has been given the seed lot containing buckhorn. This prior treatment involves adding a foreign material such as wood dust to the buckhorn which creates a rough surface. Separation is then an easy matter.

The roll mill is a very economical machine becuase the cost of operation and maintenance is extremely low. The minimum attention needed to operate the roll mill, once it is adjusted, is also a point to remember when considering this machine.

MAGNETIC SEPARATORS

T. Wayne Still[1/]

Magnetic separators are not a new principle of seed separation, but only in recent years have they received much attention. Industry has used the magnetic separator for many years. Industrial applications range from removing tramp iron from coal to the purification of pharmaceuticals. The most common use is the separation of ores and in the removal of tramp iron from non-ferrous materials.

It has been said that the first application of the magnetic process to the separation of seed was made in England some 30 to 40 years ago. In the English method, iron oxide was mixed with red clover containing dodder, after which the mixture was passed through a magnetic field. The English were not too happy with the results as the red clover was badly discolored and removal of the dodder was incomplete.

The magnetic cleaner is not a complex piece of machinery. In fact, its operation is quite simple as there are fewer adjustments to make on the magnetic separator than on most other seed cleaners. It is by no means the answer to all seedsmen's unsolved problems, as, like conventional cleaners, it has certain limitations. However, the magnetic cleaning process has proven to be effective in making some seed separation which are difficult, if not impossible, on other types of cleaners. An increasing number of seedsmen in the clover and alfalfa producing areas are installing magnetic cleaners in their plants and are finding the performance to be quite satisfactory. A few have found their way into the Southeastern States.

The most common use of the magnetic separator is the separation of ores and the removal of tramp iron from non-ferrous materials. As seeds contain no free iron and are not attracted to a magnet, how can the method be applied to seed separation? The answer is that seeds must be pretreated with a magnetic material such as finely ground iron powder. If the iron powder can be made to stick on the weed seeds, inert material, and other undesirable components in the seed lot, then these materials will respond to a magnetic field while the uncoated crop seed remains non-magnetic. This can be accomplished only if the materials to be separated differ in seed coat characteristics. Generally, the seed to be cleaned must have a smooth seed coat such as that found in legumes, while the seed to be removed will have a rough, gelatinous, or granular surface which will retain a fine iron powder when pretreated with water or a combination of oil and water. The degree of successful cleaning depends largely upon the magnitude of the seed coat differences and the thoroughness of the mixing operation.

1/ Mr. Still is Assistant Agronomist in the Mississippi Agricultural Experiment Station and Assistant Director of the State Seed Testing Laboratory, State College, Mississippi.

Several different makes of magnetic separators are used in the seed industry today, representing United States, German, and English developments.

Many of the magnetic separators used by the seed industry were developed for other purposes. However, several machines currently on the market were specifically designed for seed cleaning. Several types of cleaners are available such as the drum, induced roll, and the crossbelt types. The induced roll and crossbelt cleaners were designed as industrial machines and have been adapted to seed separation. A revolving cylinder or drum is the most common type of separating device used. Regardless of the make or type, all utilize the same principle of operation.

A magnetic cleaning system, regardless of the type or make, consists of a mixing unit and a cleaning unit.

The mixer distributes a specific amount of water, oil, and iron powder throughout the seed lot. The amount of each varies with the kinds of seed being separated and other factors.

A magnetic separator utilizes one of two general types of mixers. One is the batch type in which measured amounts of dosage materials are added to a given quantity of seed and mixed for a certain length of time. The material is then transferred to the separating or cleaning unit. The second type of mixer is the continuous flow type in which the seed is passed through a series of auger-type mixing chambers. At different points in the system the dosage materials (iron powder, water and oil) are metered into the stream of seed where they are thoroughly mixed together in the course of being transferred to the separating unit. Both types of mixers require careful attention. It must be emphasized that the key to the success of magnetic cleaning lies in the mixing operation. If the dosage materials are not applied to the seed thoroughly, uniformly, and in the correct proportions some of the undesirable seed will not be coated with the iron powder and will pass over the cleaning unit with the clean seed.

The most common type of cleaning or separating unit used by the seed industry is the revolving cylinder or drum. The drum may be an electro-magnet, with the amount of magnetism easily controlled, it may contain permanent magnets with constant magnetism, or the magnetism may be introduced into the drum by stationary electric poles. The laboratory model separator in the adjoining room utilizes an electro-magnetic drum, while the commercial model downstairs utilizes permanent magnets. Both offer advantages and limitations. A more precise separation can be made with the electro-magnet as the intensity of the magnetism can usually be varied by use of a variable transformer to suit the particular lot of seed being cleaned. You can expect to pay more for machines equipped with the electro-magnet as the drum is more expensive and a rectifier is required for converting alternating current to the direct current necessary to magnetize the surface of the drum.

Regardless of the type of separator used, or whether or not the drums are magnetized with permanent or electro-magnets, the general principles of seed separation are the same for all magnetic cleaners. The iron powder is introduced onto the seed that have been slightly moistened, after which the mass is agitated in the mixing apparatus. The rough or gelatinous coated seed retain the iron powder whereas the smooth coated seed do not. With some separations, such as Johnson grass, it may be necessary to apply oil before the iron powder is applied. After the application of the iron powder, the seed are then passed over the magnetized rolls. Those seed which have magnetic powder sticking on them are retained on the surface of the drum by magnetic force and those to which no powder adheres pass over the drum without their trajectory being affected. The seed clinging to the rolls either fall off due to gravity or are brushed off the back into containers provided for the waste material. There is no rerun of rejected material.

There is some question as to whether the iron powder may be salvaged and re-used in future cleaning operation. It is generally believed, however, that enough properties of the powder may have been changed or altered to render the powder ineffective for use a second time. I am of the opinion that the iron powder should not be used a second time, and I base this observation on past experience. The iron powder is relatively inexpensive. Enough to treat 100 lbs. costs in the neighborhood of 30 cents.

There are a number of factors that affect magnetic cleaning of seed. Some of these factors are as follows:

The Condition of the Crop Seed Coat

High crop seed losses sometime accompany magnetic cleaning. These high losses can usually be attributed to the treatment the seed received during harvesting and processing operations prior to cleaning on the magnetic separator. Crop seed which have received careful treatment during harvesting and subsequent handling operations are likely to have less broken and damaged seeds than those which are roughly handled. Cleaning losses are higher with scarified and badly broken seed because the roughened seed coats collect more iron powder than the unscarified seed.

Seed to be cleaned on the magnetic separator should be thoroughly cleaned with other machines, especially seed high in inert material. A good screening and aspirating job will result in a better job and less worry.

Inert Materials

The presence of dirt, sticks, straw, leaves, and other contaminating debris in a seed mixture results in a higher dosage requirement for effective cleaning. The inert material competes with the weed seed for the available dosage materials and enough dosage must be applied to coat both the weed seed and inert matter.

The Kind of Crop Seed

Not all crop seeds which can be cleaned with the magnetic separator respond equally to similar dosage applications. Seeds with extremely hard and slick seed coats, such as sericea lespedeza, take up less iron powder than seeds with slightly roughened or irregular seed coats such as alfalfa and red clover. Sweet clover will take up even more iron powder than alfalfa and red clover as a result of having a still rougher seed coat. Generally speaking, the crop seed which have the slicker coats will require smaller dosages, have a lower cleaning loss, and will result in a more effective separation.

The Kind and Concentration of Weeds

An ideal mixture is one in which the two species to be separated differ in physical characteristics to such an extent that a separation can be made on basic cleaning machinery. Unfortunately, the weed seeds of many species cannot be satisfactorily removed by the magnetic method because of the similarities in physical properties of the seed coat of the weed and the crop in which it is mixed. In mixtures that can be separated some considerations relative to the amount of water, oil, and iron powder should receive attention. A seed lot containing a high weed seed concentration requires a higher dosage for effective cleaning than a lot with a lower concentration. Since the gelatinous seed coat of buckhorn absorbs water quite readily, the water requirements of a mixture containing this weed seed is higher than lots of the same crop seed contaminated with a similar amount of dodder.

Kind of Magnetic Powder

Even though the iron powders available for use with the magnetic separator are similar in that each contains a high percentage of iron, they differ in other important respects such as particle size, shape, apparent density, and to some extent color. The better performing powders are effective on most seed lots that may be magnetically cleaned but in some instances certain powders seem to be somewhat specific. That is, one material or powder adheres to a particular species of weed seed better than to another.

The magnetic separator is a relatively simple machine to operate as there are few adjustments to be made once the correct proportions of dosage material has been ascertained. However, these few are extremely important if satisfactory results are to be obtained.

One adjustment is the dosage material. Getting the right proportion of iron powder and liquids mixed with the seed lot is the real problem in magnetic seed cleaning, and the problem differs with each seed lot. Too little liquid results in inadequate coverage by the iron powder and consequently poor cleaning results. Excessive amounts of liquid and powder results in discoloration of the seed and excessive cleaning loss.

A second adjustment is the mixing time. This particular adjustment is all important. An incorrect mixing time for any lot of seed will result in

ineffective separation. Too long a mixing time will allow the water to evaporate and the iron powder to be rubbed from the seeds. Too short a mixing time will not permit thorough coverage of the weed seed with the iron powder.

A third adjustment is the rate of feed. For accurate and economical cleaning the rate of feed must be controlled and adjusted properly. An incorrect feed adjustment will result in either a loss of capacity or ineffective cleaning depending upon whether the rate is too slow or too fast. For efficient cleaning the feed should not be more than one seed thick when fed onto the magnetized drums. This enables every seed to contact the drum.

A fourth adjustment is the intensity of magnetism. The strength of magnetism can be adjusted on separators equipped with electro-magnets and a rectifier with a variable transformer. Such an adjustment is advantageous since over or under dosage with water, oil and iron powder can be partially compensated with varying intensities of magnetism.

TRIANGULAR DECK GRAVITIES VS RECTANGULAR DECK GRAVITIES VS STONERS WHICH SHOULD THE SEEDSMAN USE?

Oliver W. Steele[1/]

Not too many years ago the seedsman had a choice of only two or three models of Gravity Separators made by several manufacturers. All of these models were similar in shape, and similar in capacity and efficiency. There was little choice on the part of the seedsman as to which make of Gravity to buy. The capacity of these Gravities was in proportion to the deck area; the larger the deck area, the greater the capacity. The practice among manufacturers was to produce a small, a middle size, and a large machine. These three models were about all any manufacturer had to offer. Several decks of different covers were offered, and if a seedsman had about three decks, he was able to clean all seed stocks ranging in size and weight from the grass seeds up to the size and weight of beans, seed corn, and similar stocks. A processor who specialized only in the cleaning of beans was offerend a Gravity which could almost instantly be changed to a machine for cleaning grass seed and other light seeds. Likewise a seedsman who specialized in the cleaning of alfalfa was offered a machine having a builtin blower and powered with a motor large enough to clean beans. Many Gravities are still being used which are powered with 15 and 20 h.p. motors and these machines are of rather limited capacity and efficiency as compared with present day Gravities. I always have to smile when I see a seedsman driving a late model car and know that his cleaning plant has machinery dating back 30 or 40 years. But we still have seedsmen doing the job the way their grandpappy did it. I question though whether their bank balance is as sound as was grandpappy's. Grandpappy had the latest in processing machinery at the time of his purchase.

The trend today in seed processing machinery is toward machines of higher efficiency and higher capacity. We have reached the age of "Specialized" machinery which is fast replacing the "universal" machines of yesterday. This trend is being hastened by wide-awake seedsmen who are demanding faster and better machines. Increases in labor costs, high taxes, (and a hundred and one other fixed costs) have put an additional squeeze on already narrowing profits. Of course the answer to the narrowing profit problem is, larger volume, quicker turnover, and extended trade territory. In order to attain this objective, the seedsman must have the machinery to quickly clean his seed stocks between the harvest and the spring planting.

The seedsman today must convert into cash the last trace of saleable seed flowing through his cleaning plant. He must therefore make a study of all types of seed processing machinery. He must know which type of machine will

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1/ Mr. Steele is the owner of the Oliver Manufacturing Company, Rocky Ford, Colorado, Manufacturers of seed and grain cleaning equipment.

do his job more efficiently on a given seed mixture. He must know the limitations of each machine. He must know his costs to a fraction of a penny. He must be willing to retire his old "pets" and he must invest in new and better equipment in order to keep on the right side of his ledger. In short, he must pattern after the meat packer who utilizes the last squeal of the pig.

I mentioned a moment ago of the trend toward specialized machines, that is, machines designed to do a specific job. As an example, I mentioned that the bean processor is not particularly interested in a Gravity which can instantly be changed to a Gravity for alfalfa. Likewise the processor of small seeds is not interested in a Gravity capable of being converted into a bean machine on short notice. Therefore the "universal" Gravity is becoming a machine of the past, but there will always be a few made until a better process is discovered. For that matter, horse collars, and curling irons, are still being made.

Not too many years ago from five to eight Gravities were needed to keep abreast of one Cleaner. Today we have many installations with one Cleaner followed by one Gravity. And we do not as yet see the stopping point. As new and better Cleaners are developed, Gravity manufacturers must do likewise. I might insert the thought here that we have always recommended that a Cleaner be used ahead of the Gravity. A Gravity performs at its highest efficiency when processing seeds which have previously been closely sized.

The sale of a specialized Gravity is sometimes a little difficult to put across. Should we question the prospective customer too closely as to the intended use of the machine, he generally becomes suspicious that we are trying to learn too much about his business, or his trade secrets, if any. In the case of the alfalfa processor, we have developed a Gravity having a capacity of 2000-2500 lbs/hr and only requires a 1 h.p. motor. Compare this machine with the Gravity of yesterday having a capacity of 500-600 lbs/hr and uses a 5-7 1/2 h.p. motor.

Pioneering a new idea is expensive and we do not make too much of an effort to talk our customer into a specialized machine. If he wants the old orthodox Gravity with the large motor, and if he wishes to continue paying a high connected load rate, and if he wished to process his alfalfa with the air controls barely cracked, we give him exactly the machine he wants even though he could have a better machine at less initial cost. This leads me up to my subject, "Gravity Separators," and "which type of Gravity Separator is best for a given job?".

Gravity Separators may be divided into three general types: (1) Triangular Deck Gravities, (2) Rectangular Deck Gravities and (3) Stoners. There are also variations of these three types. There are installations using one type in conjunction with another type, for example, Stoners recleaning the sand and rock product from Gravities. We make all three types and for nearly 25 years we made only the Triangular Deck type.

Some six, or seven years ago we made a rather extensive survey of the use of Gravities. We found that over 80% of Gravity work consisted of the separation of a small fraction of light seed from a large fraction of heavier seed. We then began the development of a special machine to reduce the volume of the middling product and the more efficient separation of the lighter seed. The middling product of the Triangular Deck has always been a difficult product to reclean. We knew the answer to our problem before hand, which was, a deck having extremely long travel of the lighter seed. These experiments led to the development of the Rectangular Deck, and also to the development of the multiple fan system which reduced the power consumption over 60%. Patents were granted in August of 1956 on the multiple fan system.

Figure 1 illustrates the several areas formed on the Triangular Deck Gravity.

The most important area is the Stratifying Area. Without thorough stratification of the particles composing the mixture, there can be no efficient separation. This stratifying area depends on the difference in the specific gravities existing between the particles, and the rate of feed. Excessive feeding will cause a corresponding increased area, in fact, it is possible to overfeed a Gravity Deck to the extent that the entire deck area is covered by the stratifying zone. In this case, no separations can be expected.

On the other hand the failure of many a Gravity is caused by under feeding. There must be a thickness of particles in order to stratify. A thin depth of seed cannot be formed into zones of differing weights. There must be a depth of sufficient thickness that the lighter seeds will be lifted to the top by the air jets coming through the deck cover while the heavier seeds will form a zone on the deck surface.

It may be seen by the above brief discussion that the rate of feed is most important. Again, the rate of feed depends upon the difference in specific gravities existing between the particles in the mixture. A mixture composed of particles differing greatly in specific gravity, may be fed faster than a mixture composed of particles differing only slightly in specific gravity.

The above remarks will apply to any Gravity Separator Deck regardless of shape or size. Once this line of thought is understood, the operator should experience no difficulty in getting the highest efficiency from his machine.

Figure 2 represents the Oliver No. 16 Triangular Deck Gravity 48" x 96" and the Oliver No. 160 Hi-Cap 42" x 90" Rectangular Deck. Both Decks have approximately the same area.

Each of these Decks have been given the same amount of feed which will form equal stratifying areas.

Notice that the Middling Product becomes progressively smaller in volume as it travels the full 90"length of the Rectangular Deck. The net result is that more tailings are made; likewise more of the heavier seed product; with corresponding less Middling product. On an average seed separation approximately

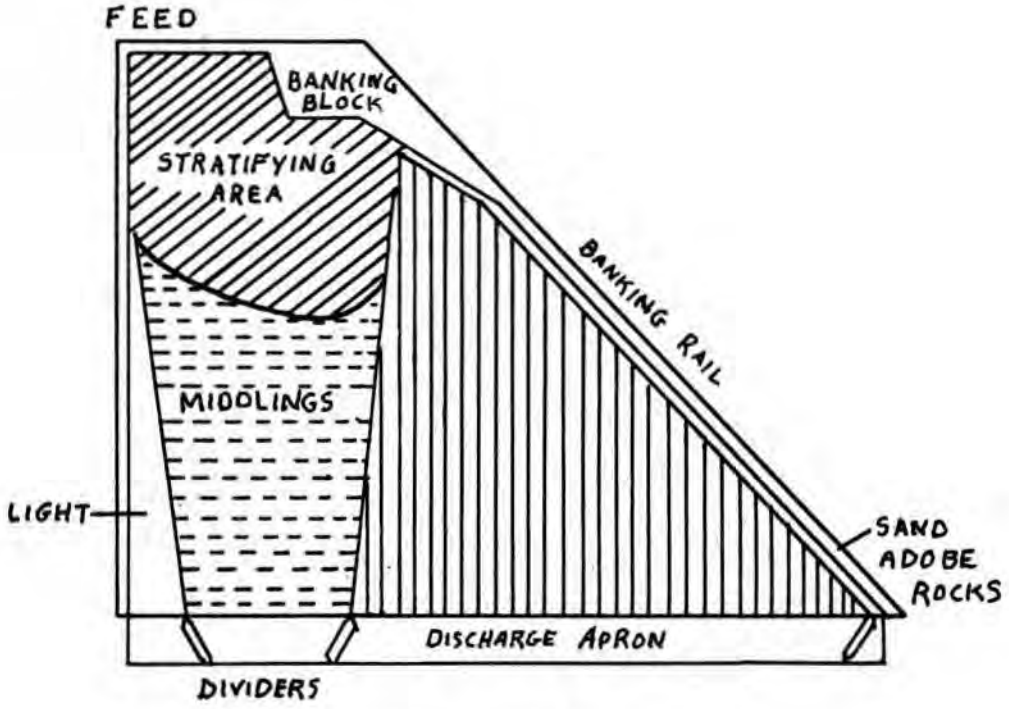

Figure 1

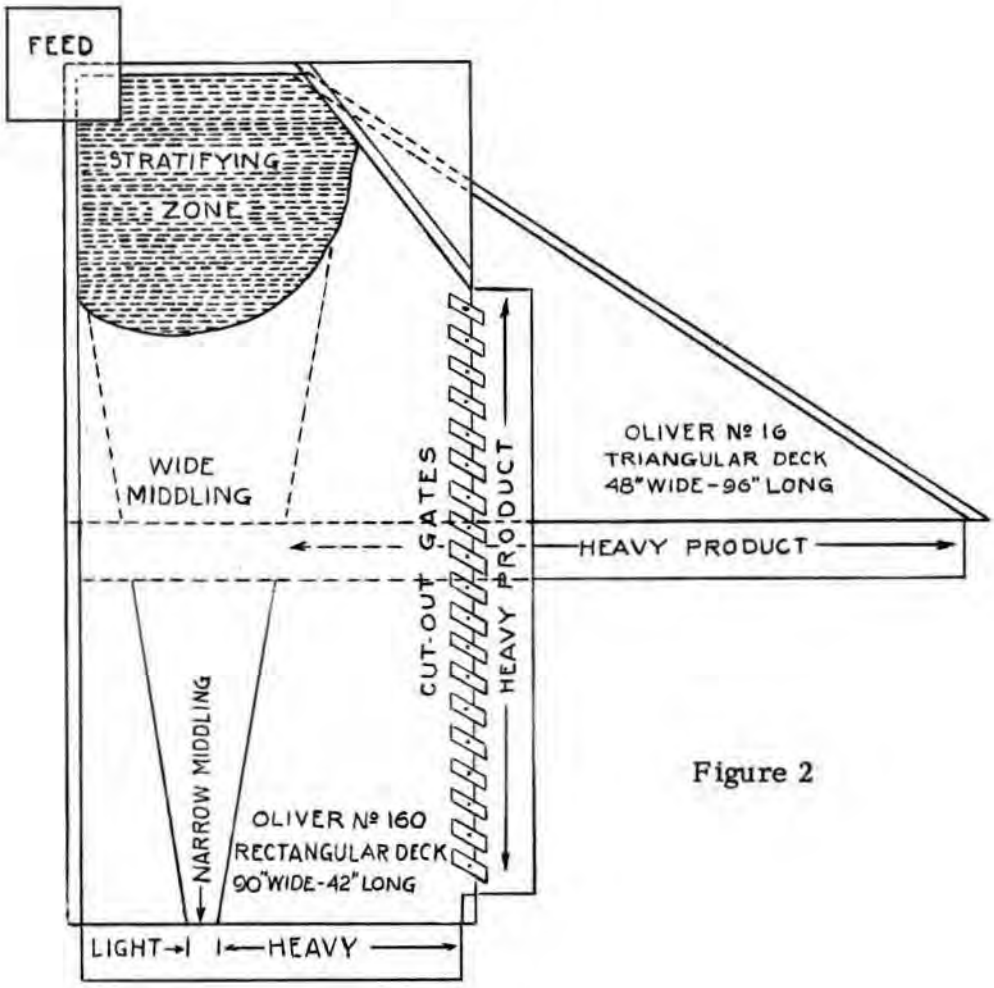

Figure 2

2/3 less Middling Product is made on the Rectangular Deck which is roughly the same results as re-running the Middling Product over the Triangular Deck three times.

The Triangular Deck is a good Deck for separating a small fraction of heavy particles from a large fraction of lighter. This is because of the long travel of the heavier particles. Triangular Decks are especially efficient for cleaning grass seeds containing a small fraction of heavier weed seeds, sand, etc. A small amount of chaff is removed from the tailing side.

The Middling Product

No general discussion of Gravity Separators can be complete without a few remarks on the "Middling Product". This has always been a problem in the past and will likely remain with us so long as Gravities are used. It is yet to be completely solved and a full discussion of the problem will require much more time than is allowed on this program, but I might pass the following brief remarks.

The Middling Product is a partially separated mixture lying between the heavier and lighter zones reporting at the discharge apron of the Gravity Deck. It is usually a mixture containing too many good seeds to be discarded as waste and too many saleable seeds permit being classified as a finished product.

There is always a Middling Product between the number of grades being cut from a Gravity. If two grades are being made, a light and a heavy, a Middling Product will occur between. If three grades are being made, there will be two Middling Products, and so on.

Various methods are being employed to reduce the Middling Product. The following methods are the ones most commonly being used:

1. Returning the Middling Product to the feed of the Gravity through a small elevator.
2. Accumulating the Middling Product to be re-run over the Gravity at a later period.
3. Returning the Middling Product to the head of the cleaning system.
4. The Middling Product from several primary Gravities is fed to a secondary Gravity which has been carefully adjusted to separate particles of very slight difference in specific gravity. This method is used in extremely large operations.
5. Using Gravities in series. The Middling Product from a large Gravity is sent to a smaller size Gravity and the Middling Product in turn is sent to a still smaller size Gravity.

There are other methods in minor use. Of the five general methods listed above, we recommend No. 3. Here the Middling Product is passed over the cleaner again and becomes thoroughly mixed with the original commodity being cleaned. It becomes a more homogeneous mixture for the Gravity. A uniform

mixture is the ideal feed to a Gravity. Uneven mixtures to a Gravity will cause "surging," or irregular flow on the Deck and necessitates frequent changing of the dividing fingers. Careless operation of the Cleaner will cause an increase of the Middling Product.

The Middling Product should be frequently examined. In many cases a close examination will reveal large reject seed reporting with smaller saleable seed. Merely passing such a mixture over a small screen having the proper openings will help solve this problem.

Common Installation Mistakes

1. Gravity Installed on a Weak Foundation
2. Blowers Running Backwards
3. Protector Over Air-Filter Not Removed
4. Air Not Clean
5. Machine Running With Loose Clamps
6. Using Wrong Deck
7. Trying to Obtain Capacity Before Getting Efficiency
8. Attempting to Separate Commodities Not Suitable for Gravity Separation
9. Using Insufficient Air
10. Using Excess Air
11. Belts Slipping

Try These Simple Steps to Start a New Gravity:

1. While the machine is not in operation make the following adjustments by means of the jack screws at the high end of the machine. Loosen the clamps, make the adjustments, tighten the clamps.

Deck Adjustments	Machine No.	50	80	160
Difference in Short-Side Elevation		1 1/2"	1 3/4"	2"
Difference in Long-Side Elevation		2 1/2"	2 1/2"	5"

2. After being sure the BLOWERS ARE NOT TURNING BACKWARDS, close tight all the air gates. Directional arrow on end of machine.

3. Open the feeder to flow a small amount of seed approximately 4" - 6" wide. Without air, the seed will flow directly across the deck surface and "bank" against the cut-out gates along the upper side of the deck. Wait until this flow reaches the discharge at the end of the deck.

4. Adjust the eccentric speed to force the seed up-hill in a smooth travel. Too much speed will cause the seed to "jump" up-hill.

5. Gradually open the air-gates (two) on the Blower nearest the feeder. It will be noticed the seed will begin to slightly "boil" and the lighter elements will begin to separate and flow backwards.

6. Gradually open the air gates of the remaining Blowers until the lighter

elements will begin to separate and flow backwards. Be careful of using excess air, otherwise all seed will flow backwards.

7. Continue making feed, and air adjustments, until the lighter elements are caused to flow along the "banking rail" along the lower edge of the long side of the deck. The deck surface should now be fully covered with an even bed of seed.

8. Beginning at the lower cut-out gate, gradually open these gates to allow the escape of clean seed over the upper long side of the deck. As the clean seeds escape through the cut-out gates, open the feeder to replace the same amount as the escaping seed.

9. Should the lighter elements commence to travel away from the banking rail, adjust by closing cut-out gates, or by increasing air, or by decreasing speed, or by increasing feed.

A short discussion of the common installation mistakes follows:

1. Gravity Installed on a Weak Foundation

A weak foundation is the cause of many Gravity failures. A slight vibration at the base of the machine is multiplied many times on the deck. The Gravity is a reciprocating machine, and like all reciprocating machines, the Gravity must be secured to a solid foundation.

Weak foundations cause false vibrations which react adversely to the flow of the seed across the deck. False vibrations counteract the mechanical force of the eccentrics. Often the seed bed will surge, or flow in waves across the deck, when false vibrations become synchronized with the eccentric force. In other words, when the seed bed starts flowing in waves at regular intervals look for false vibrations. A good solid foundation pays big dividends.

2. Blowers Running Backwards

Blowers running backwards is one of the common mistakes in new installations. The function of the Blowers is to build a static pressure in the air-chest to insure an even air flow through the deck cover. The degree of this static pressure depends on the size of the seeds being cleaned, and the openings in the deck cover.

Notice the directional arrow on the feed end of the Gravity. The direction of rotation may be checked by removing the cover of the variable speed change pulley which is found near the directional arrow. The speed change pulley runs in the same direction as the Blowers.

Another method to determine correct Blower rotation is to remove the deck and start the machine. The fan wheels should be turning toward the fan opening. By opening one of the airgates the blower will deliver a strong air blast.

If a three phase motor is being used, simply change any two connections and the motor will run in the reverse direction.

3. Protector Over Air Filter Not Removed

The Gravity is shipped with a protection over the air filter. This is done

to protect the filter during shipment and installation. The protector should be carefully removed so as to not damage the filter screen underneath.

4. Clean Air

The importance of clean air cannot be stressed too strongly as the success of the Gravity depends on a source of clean air. Dust laden air will soon close the meshes, or openings in the deck cover. Under such a condition the deck soon becomes inoperative, or "blinded". Blinded decks can easily be noticed by the seed bed appearing to be dead.

All Oliver Gravity Separators provide two means of introducing clean air into the machine. The built-in air filter is for use in locations having a limited amount of floating dust and chaff. If this filter requires cleaning too frequently, the air must then be taken from a more remote location.

A "nipple-panel" is shipped with each machine which fits any of the filter openings. Should outside air be necessary, the operator may use any convenient filter opening, however the diameter of the lead-in pipe should not be reduced otherwise the machine will starve for air.

Never attempt to clean an air filter while the Gravity is in operation. There is a strong suction against the filter screen and any attempt to brush, or remove the accumulation of dust particles adhering to the filter surface merely forces the smaller particles through the filter and quickly blinds the deck cover.

Even under favorable operating conditions it is necessary to frequently clean Gravity Decks. Some operators purchase an extra deck which can be quickly installed. The extra Deck insures continued operation with very little delay in cleaning Decks.

5. Loose Clamps

The operator will find two tie-rods running through each side of the air chest. The purpose of these rods is to rigidly clamp two plates which fix the air chest to the base of the Gravity. The clamps should be loosened before attempting to adjust either the side-raise, or the end-raise, and should be quickly tightened again. Loose clamps induce false vibrations.

6. Using Wrong Decks

The general rule for deck covers is: the smaller the seed, the smaller the opening in the deck cover. Conversely, the larger the seed, the larger the opening in the deck cover.

The above rule simple means that alfalfa, clover, and similar seeds cannot be efficiently cleaned on decks having large openings designed for cleaning beans, peanuts, peas, and like stocks. Use the right deck for a given size seed.

7. Trying to Obtain Capacity before Getting Efficiency

New operators often have a tendency to try for high capacities before taking the time to adjust their machine properly for efficiency. Efficiency should come first and increased capacity will naturally follow with experience. Once a Gravity is adjusted to function properly the matter of increasing its

capacity becomes a simple matter.

8. Attempting to Separate Commodities Not Suitable for Gravity Separation

The Gravity is a "specialized" machine designed to separate two, or more, commodities of the same size but differing in specific gravities. Unless the commodity comes under this general rule, the Gravity becomes an inefficient machine.

9. Insufficient Air

The deck surface of the Gravity Separator is divided into two zones, a "STRATIFYING ZONE," and a "SEPARATING ZONE."

The stratifying zone lies in the deck area near the feed. Here the air jects stratify the seed according to their relative weights. The light weight seeds are forced to the surface of the seed bed while the heavier layer of seeds seek a location on the deck surface.

The separating zone is the remaining area of the deck surface after the seeds become stratified. The eccentric motion causes the heavier layers of seed to move up-hill. The lighter layers of seed not having contact with the deck surface are caused to flow downhill.

INSUFFICIENT AIR causes all seeds to flow up-hill similar to a deck surface badly blinded with dust particles.

10. Excess Air

The most common fault to be found with new operators is their tendency to use excess air. Excess air serves to lift the heavier seeds off the deck surface and to "blow" the heavier seeds through the stratum of lighter seeds. Excess air causes the heavier seeds to flow down-hill and report with the tailings. It is impossible to stratify the seed into relative weight zones and without stratification there can be no separation. The new operator who takes the time to adjust the air will find his time well spent.

11. Belts Slipping

Belt slippage is frequently another source of trouble, especially when starting the Gravity on a cold morning. "V" belts should not be rigidly tight which will cause excessive wear on bearings. Slipping belts cause an irregular flow of the seeds across the deck.

And while we are on the subject of cold mornings, at the start of the winter season it is good practice to tighten the bearing races on the shaft. Cold weather causes the grease in the bearings to thicken and the shafts to become slightly smaller. Shaft scoring is caused by the bearings sticking and the shaft revolving in the inner race of the bearing. A good inspection of the set screws fixing the bearing to the shaft might eliminate the trouble of replacing a scored shaft later.

New Operators

New operators often experience some difficulty in starting a Gravity. They have likely seen Gravities in operation with a full bed of seeds on the

deck. They seem to get the impression that they can immediately duplicate the work by simply turning on the power and opening the feeder. Such is not the case as a Gravity Separator must be adjusted according to each variety of seeds being cleaned.

MAKE ALL ADJUSTMENTS GRADUALLY. All gravities have the following adjustments:

1. Feed
2. Eccentric Speed
3. Air Control
4. Lateral Inclination of the Deck
5. Longitudinal Inclination of the Deck

The reason for making all adjustments gradually is because the Gravity does not respond quickly to any adjustment. A short time must be allowed before the effect of an adjustment can be noticed. After making the adjustment wait a few minutes to see what effect the adjustment made on the flow of seeds across the deck. Then continue with another adjustment until a satisfactory product is obtained.

Never make two or more adjustments at the same time, otherwise, the operator will not know which adjustment benefitted the separation.

Remember to first adjust for efficiency. Once the Gravity is adjusted to give the desired separations, the matter of increased capacity will follow.

Like every machine found in the Seed Cleaning Plant, the Gravity depends on the skill of the operator

Gravity Operators Should Keep a Log Book

Most gravities are used to clean several varieties of seed during a season and each variety will require different settings of the various adjustments, Deck, Feed, Air, Eccentric Speed. For example, assume an operator is cleaning alfalfa seed this week. Next week he might be cleaning some other variety, say beans, or grass seed. The Deck will require a slightly different setting for each different variety. After he has adjusted his Gravity to give him the best results, the operator should note the settings in a small note book for future reference, in this case under the heading "alfalfa seed." Suppose a month from now, or even next year, the operator is given another lot of alfalfa seed to clean. How handy it will be if he had a little note book which will give him the setting he previously used? Only a few minutes are required to make these notes and much time can be saved. His notes should give him the following information:

End-raise Difference_____" Deck Used_____

Side-raise Difference_____"

Feeder Opening _____"

Air Gate Opening _____"

RPM of Eccentrics _____"

The difference in end-raise, and side raise, may be taken from any convenient fixed point. The base of the machine may be used, or the distance from the floor to the high and low points of the Deck. The difference between these measurements will give him the difference in the Deck elevations.

The difference in eccentric speeds is not too important as an operator can instantly tell whether his Gravity is reciprocating too fast, or too slow, from the movement of the seed across the Deck.

The Stoner

The Stoner (Figure 3) is a Gravity because its operation depends first upon stratification of the particles in a mixture according to differences in their specific gravities. The upward flowing jets of air through the deck cover lift the lighter particles to the top of the mixture while the heavier particles sink through the mixture and come to rest on the Deck surface. The particles therefore quickly form "zones," or layers, according to differences in their relative weights.

The heavier particles, being in contact with the Deck surface, are caused to move uphill by the eccentric force. The lighter particles, floating on a film of air, flow backwards and are discharged along the wide edge of the Deck.

It can be seen from the above statements that the air adjustment is most important. Excess air will cause all particles to flow downhill. Insufficient air will cause all particles to flow uphill by reason of being in contact with the deck surface and being acted upon by the eccentric force.

The area of the Stratifying Zone depends on the difference in the specific gravities between the particles being separated. A mixture having a wide difference in specific gravity, for example stones from wheat, the Stratifying Zone is relatively small. The Stratifying Zone increases in area as the feed is increased, however, the Stratifying Zone should never exceed more than one-third of the total area of the Deck. Otherwise, the smaller bits of the heavier elements will not have sufficient time to contact the Deck surface and will tail over with the lighter elements.

The pattern in Figure 4 illustrates an operating condition which frequently occurs. A heavy area forms slightly short of the throat and only the larger of the heavier particles travel upward. The smaller heavy particles tail over with the lighter. This condition may be caused by the following:

EXCESS AIR. This is the most common cause. Only the largest of the heavy particles will accumulate along the fringe edge of the lighter particles. This condition is corrected by reducing the air pressure.

DECK TILTED TOO HIGH. The heavier particles are only pushed upward by the mass behind them.

SLOW ECCENTRIC SPEED. Increasing the eccentric speed will cause the heavy particles to travel upward, providing the tilt, and the air adjustment, has

first been properly made.

The illustration in Figure 5 is also one frequently seen among Stoner operators. Here the operator is allowing the lighter particles to travel too close to the discharge of the heavier particles. The lighter particles become entrapped in the heavier and are discharged with the heavier. The result is a mixture being discharged from the Deck. A more careful adjustment of the machine will produce cleaner products of each.

The sketch shown in Figure 6 is an ideal pattern. Notice the Throat of the Deck is entirely covered with the heavier particles. The gate across the discharge is kept closed until a sufficient amount of the heavier particles accumulate to cover an area 8" - 10" from the discharge edge. The gate is then opened, or adjusted, to allow an equal amount of the heavier particles to escape as are being fed to the Deck.

MAKE ALL ADJUSTMENTS GRADUALLY AND WAIT A FEW MINUTES TO NOTICE THE EFFECT OF THE CHANGE.

Figure 7 is a sectional diagram of what occurs on a Stoner Deck. Compressed air forced through the meshes of the Deck cover lift the lighter particles upward while the heavier particles sink against the air currents and come to rest on the Deck surface, providing the air is properly adjusted. The heavier particles are forced to travel forward, by mechanical action, while the lighter particles float backward on a film of air.

We have often heard operators of Stoners argue as to the proper location of the Feed. Many different theories are advanced.

The proper location of the Feed depends on the mixture being separated. Here again the Stratifying Area is the important factor. If the Feed is too far down the Deck, the particles are discharged before having an opportunity to become thoroughly separated into zones. If the Feed is too far forward, the lighter particles become trapped in the heavier particles and a "ragged" heavy product is made.

While Stoners have greater capacities than Gravities, based on square feet of relative Deck area, there is a limit as to the amount of Feed flowing to the Deck. As the Feed is increased, the Stratifying Area is also increased. The Stratifying Area should occupy not more than one-third of the entire Deck area.

Samples should often be taken of the two products and closely examined. If small heavy particles are being discharged with the light, the Feed should be moved slightly forward, or the amount of the Feed reduced.

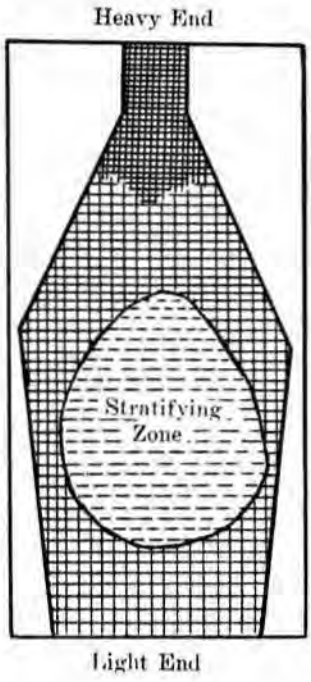

Figure 3

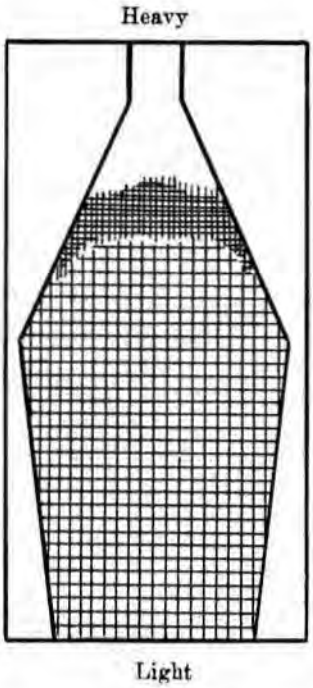

Figure 4

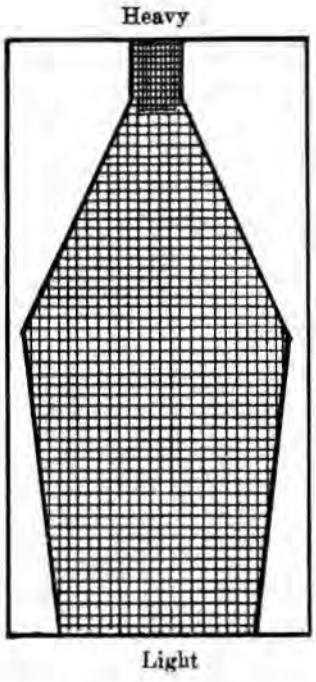

Figure 5

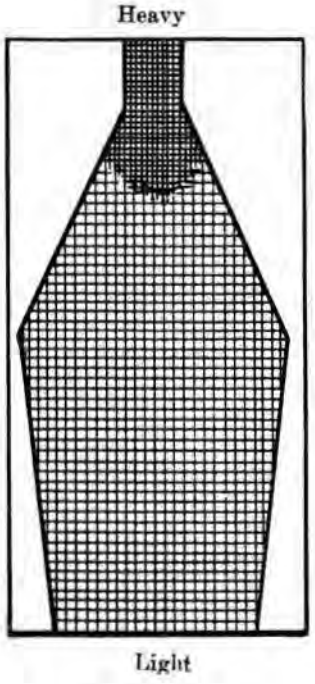

Figure 6

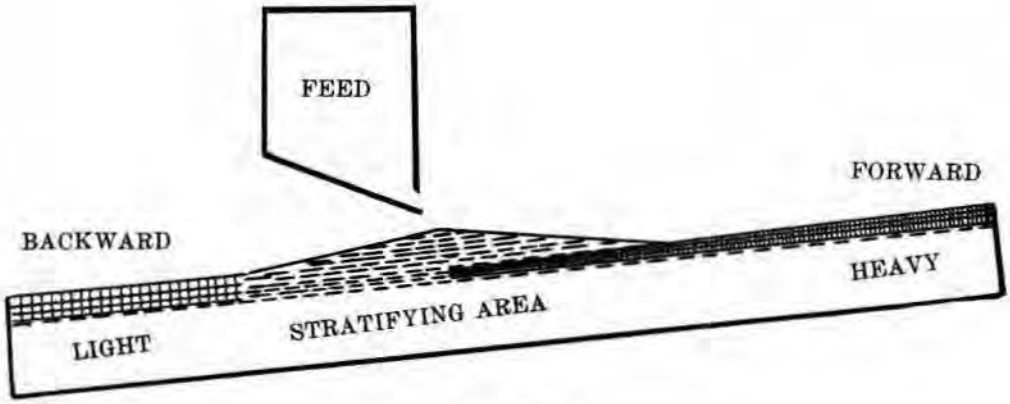

Figure 7

REGISTRATION LIST

Acheson, W. S. "Bill"
Gustafson Mfg. Company, Inc.
6501 Cambridge Street
Minneapolis 26, Minnesota

Adams, Mr. & Mrs. C. L.
Adams Seed Company
Purcellville, Virginia

Ahlrich, V. E.
Soil Conservation Service
P. O. Box 25
Coffeeville, Mississippi

Allen, W. W.
Seed Marketing Sepcialist
Grain Section - NCDA
Raleigh, North Carolina

Almond, Mr. & Mrs. Sherrill
Morton Chemical Company
Route # 1
New London, North Carolina

Amor, Mr. & Mrs. Glen
LaPaz Grain Company
LaPaz, Indiana

Atkinson, Roy M.
N. J. Dept. of Agriculture
1 West State Street
Trenton, New Jersey

Baker, Doyle
Adkins-Phelps Seed Company
West Memphis, Arkansas

Barnett, Jerel D.
Sharp Brothers
Healy, Kansas

Bastien, Mr. & Mrs. Jack
Bastien Seed Company
Vergennes, Illinois

Belew, Mr. & Mrs. D. S.
Route # 1
Rogersville, Alabama

Bennett, C. W.
FCX Sumter Wholesale Service
Sumter, South Carolina

Berentsen, Antonio, Jr.
Antonio Berentsen S.R.L.
Dr. Velasco # 18
Mexico 7, D. F.

Berry, Charles T.
Harty Seed Company
Stuttgart, Arkansas

Bickel, R. J.
West Virginia Pulp & Paper Co.
4501 Gustine Avenue
St. Louis, Missouri

Black, Charles J.
Missouri Farmers Association
West Haynie Street
Marshall, Missouri

Bogard, Jerry
Bogard Grain & Seed Co., Inc.
Box 498
Stuttgart, Arkansas

Bolen, Carrol D.
Indiana Crop Imp., Association
Lafayette, Indiana

Bradshaw, I. R.
Riemers Company
Ellisville, Mississippi

Bravo, (Franco) Abraham
Departamento De Fomento Agr.
Industrial Y Minero
Caja De Credito Agrario
Bogota, D. E., Colombis, S.A.

Bruton, Harry
Hollandale Seed & Delinting Co.
Hollandale, Mississippi

Bruveleit, Mrs. Albert
245 North Cedar
Ainsworth, Nebraska

Burch, Thomas A.
L.S.U. Extension Service
Louisiana State University
Baton Rouge, Louisiana

Callahan, Noel
Agricultural Alumni Seed
Improvement Association, Inc.
West Lafayette, Indiana

Callaway, Thorp
N. Hunt Moore & Assoc.
3373 Poplar Avenue
Memphis, Tennessee

Cayce, D. D., III
Cayce Yost Seed Company
Hopkinsville, Kentucky

Cecka, M. C.
Simon-Carter Company
655 19th Avenue, N. E.
Minneapolis 18, Minnesota

Chapman, A. V.
Chapman Seed Farms
Belton, South Carolina

Chapman, Mr. & Mrs. C. M.
Chapman Seed Cleaner
Pelzer, South Carolina

Cheshire, Ted
Louisiana Seed Co. of Miss., Inc.
Jackson, Mississippi

Civretta, Marty
Crown Zellerbach Corporation
New Orleans 12, Louisiana

Copley, T. L.
USOM/Vietnam - P. O. Box 32
APO 143
San Francisco, California

Corniels, Russell
Bristol Grain & Seed Company
Bristol, Illinois

Cox, John A.
Mississippi Federated Coop.
Canton, Mississippi

Crouch, Ross
McGregor Milling & Grain Co.
P. O. Box 477
McGregor, Texas

Crum, Roger C.
University of Arkansas
Rice Branch Experiment Station
P. O. Box 315
Stuttgart, Arkansas

Dailey, David T.
E. I. Du Pont de Nemours
1173 East Irvin Drive
Memphis 17, Tennessee

Danielson, C. B.
West Virginia Pulp & Paper Co.
1400 Annunciation Street
New Orleans 13, Louisiana

Davis, John D., Jr.
Producers Gin, Incorporated
Decatur, Alabama

De Moss, Carl
Cayce Yost Seed Company
Hopkinsville, Kentucky

Dennis, Robert E.
University of Arizona
Agricultural Extension Service
Tucson 25, Arizona

Dobbins, B. H.
FCX Lumberton, Wholesale
Lumberton, North Carolina

Dole, G. L.
Peppard Seeds, Incorporated
1117 West 8th Street
Kansas City, Missouri

Douglas, Johnson E.
Indiana Crop Improvement Assoc.
Seed Certification Service
Life Science Building
West Lafayette, Indiana

Dunlap, G. F.
Dixie Farms
Box 44
Satartia, Mississippi

Durkot, George
Simon-Carter Company
655 19th Avenue, N. E.
Minneapolis 18, Minnesota

Eckhoff, Mr. & Mrs. Donald E.
Pfister Associated Growers, Inc.
Box 470 - Galena Road
Aurora, Illinois

Edwards, Clyde R.
U. S. Dept. of Agriculture
Seed Branch, Grain Division
AMS, USDA
Washington 25, D. C.

Elkins, Joe
Lee Wilson & Company
Wilson, Arkansas

Ellis, James
Ellis Brothers
Route #1
Centre, Alabama

Estes, Robert
McGregor Milling & Grain Co.
P. O. Box 477
McGregor, Texas

Ewing, Thomas
Hoblit Seed Company
202 N. E. Second Street
Atlanta, Illinois

Farris, Mr. & Mrs. J. D.
Seaberg Rice Company
Box 98
Dayton, Texas

Freeman, Ed
Riverside Chemical Company
Macks, Mississippi

Freeman, Wayne H.
Seed Development Company
Thomasville, Georgia

Frevert, Mr. & Mrs. Vergil D.
Crippen Mfg. Company, Inc.
515 Iowa Street
Alma, Michigan

Frisbie, George
Crown Zellerbach Corporation
Birmingham, Alabama

Frizzell, Bob
Adkins-Phelps Seed Plant
13th & Cedar Street
North Little Rock, Arkansas

Garrison, Robert H.
Dept. of Seed Certification
Clemson College
Clemson, South Carolina

Gilbert, W. T.
Sawan, Incorporated
Columbus, Mississippi

Goddard, Mr. & Mrs. Clyde
Goddard Seed & Produce
Anna, Illinois

Godfrey, M. R.
N. C. Crop Imp. Assoc., Inc.
State College Station
Raleigh, North Carolina

Gould, H. C. "Clint"
Stegall-Sylvest Seed Company
Montgomery, Alabama

Graham, Mr. & Mrs. Ralph
DeKalb Agricultural Assoc.
Box 281
Bogart, Georgia

Grandfield, Mr. & Mrs. C. O.
1016 McCollum
Manhattan, Kansas

Granstaff, Ed
Oklahoma Crop Imp. Assoc.
Stillwater, Oklahoma

Graves, Richard A.
Alice-Sidney Dryer & Seed Co.
Box 156
Jerome, Arkansas

Gremillion, Mr. & Mrs. Hubert
Louisiana Seed Company
P. O. Box 1112
Alexandria, Louisiana

Guthrie, J. Dennett
Foreign Agricultural Service
USDA, FAS
Washington 25, D. C.

Hackleman, Mr. & Mrs. J. C.
Illinois Crop Imp. Association
110 West Green Street
Urbana, Illinois

Hanna, Mr. & Mrs. Robert E.
The Jack C. Phillips Ranch
Star Route - Box 66
Earlimart, California

Hansen, Mr. & Mrs. Charles C.
Hansen Seed Incorporated
Winner, South Dakota

Harris, Fred
McNair Seed Company
Laurinburg, North Carolina

Hefner, Mr. & Mrs. Eugene
W. A. Rice Company
Jerseyville, Illinois

Henderson, Mr. & Mrs. Jim
A. T. Ferrell & Company
Saginaw, Michigan

Herndon, Max
Greenwood Farms
Thomasville, Georgia

Herring, Woodrow W.
Quitman Co. Farmers Assoc.
Box 176
Marks, Mississippi

Hoff, John J.
John J. Hoff Farm
616 Valley Drive
Booneville, Missouri

Holland, Charles Wm.
Superior Division Daffin Crop.
311 Shepherd Street
Raleigh, North Carolina

Hollsman, Clint
Green-Jackson
Byron, Georgia

Holman, Mr. & Mrs. Bill
Holman Seed Farms
Box 42
Collinsville, Oklahoma

Hoppes, Mr. & Mrs. Clyde
Mitchell Farms
Peru, Indiana

Horton, Mr. & Mrs. Jack B.
Horton Milling Company
Box 21
Greenville, Texas

Hoskins, Mr. & Mrs. Harold
Syler, Incorporated
P. O. Box 511
Plymouth, Indiana

Hudson, Dewey
Morton Chemical Company
110 North Wacker Drive
Chicago, Illinois

Hudson, Harold D.
Bemis Brothers Bag Company
601 South 4th Street
Minneapolis, Minnesota

Hulsey, Mr. & Mrs. Jake
Hulsey Seed Laboratory
Box 132
Decatur, Georgia

Hunter, Dave
Adkins-Phelps Seed Co.
North Little Rock, Arkansas

Huntzinger, Homer G.
2200 Poplar Street
Denver 7, Colorado

Jackson, Charles E.
Green-Jackson
Byron, Georgia

Johnson, J. M.
Dakin Rice Dryer
Cleveland, Mississippi

Kern, B. W.
Mississippi Federated Coop.
Canton, Mississippi

King, L. A.
Delta & Pine Land Company
Scott, Mississippi

Koepplin, Mr. & Mrs. W. A.
Pfister Hybrid Company
Fremont, Nebraska

Lake, Stanley
N. J. Crop Imp. Assoc.
Allentown, New Jersey

Lambert, Freddie
Valley Feed & Seed Company
1918 West Van Burer
Phoenix, Arizona

Launer, John E.
DeKalb Agric. Assoc., Inc.
310 North 5th Street
DeKalb, Illinois

Lee, Bill
Lee's Seed Store
Dancy, Alabama

Lee, John E.
Lee's Seed Store
Aliceville, Alabama

Leleux, L. M.
Delta & Pine Land Co.
Scott, Mississippi

McClain, Kenneth S.
Delta & Pine Land Co.
Scott, Mississippi

McDonough, Charles Robert
Missouri Farmers Association
West Haynie Street
Marshall, Missouri

McGee, H. Joe
Harpool Seed House
Drawer "B"
Denton, Texas

McKillipp, Jim, Jr.
Universal Hoist Company
1326 Waterloo Road
Cedar Falls, Iowa

McKnight, Dennis
Rex Seed, Incorporated
Parkin, Arkansas

Mantey, Carl
Mantey Pedigreed Seed Co.
Fairgrove, Michigan

Marks, Denny
Agricultural Alumni Seed
Improvement Association, Inc.
2336 Northwestern Avenue
West Lafayette, Indiana

Matlock, James W.
Harpool Seed House
Drawer "B"
Denton, Texas

Menges, Arthur W.
Illinois Crop Imp. Association
110 West Green Street
Urbana, Illinois

Mesamore, John L., Jr.
Kaufman Seeds
P. O. Box 398
Ashdown, Arkansas

Midyette, James W., Jr.
1114 State Office Building
Richmond, Virginia

Moffett, Ralph V.
Greenwood Seed Company
Drawer 890
Thomasville, Georgia

Morgan, J. K., Jr.
Mississippi Federated Coop.
P. O. Box 449
Jackson, Mississippi

Morris, J. D.
Holleman Seed Service Co.
Wynne, Arkansas

Munroe, William D.
Munroe Engineering Company
Box 860
Quincy, Florida

Murphy, Harry M.
Daffin Corporation
Hopkins, Minnesota

Murray, Billy
Bogard Grain & Seed Co., Inc.
Box 498
Stuttgart, Arkansas

Norwood, DeWitt
Southern Seedsmen's Assoc.
Box 371
Barnwell, South Carolina

Paris, (Navarro) Rafael
Departamento De Fomento Agr.
Industrial Y Minero
Caja De Credito Agrario
Bogota, D. E., Colombis, S.A.

Parkman, Sammie B.
Foundation Seeds, Inc.
Hoke Smith Annex
Athens, Georgia

Palau, Mr. & Mrs. Vincent J.
Mercator Corporation
P. O. Box 142
Reading, Pennsylvania

Peck, Robert S.
N. J. Crop Imp. Association
Allentown, New Jersey

Phillips, J. C., Jr.
The Jack C. Phillips Ranch
Star Route, Box 66
Earlimart, California

Pierce, D. C.
Foundation Seeds, Incorporated
Hoke Smith Annex
Athens, Georgia

Primm, W. Roe
Bobshaw Pedigreed Seed Co.
Indianola, Mississippi

Pugh, Charles O.
Titan Chemical Sales
107 South Court Street
Memphis, Tennessee

Radford, M. H.
Caladino Farm Seeds, Inc.
Willows, California

Reeves, Stephen
Florida Seed & Feed Company
Osceola and Taylor Street
Ocala, Florida

Reding, Lowe
Montgomery Farmers Coop.
Clarksville, Tennessee

Riggs, Wilson
Carl P. Harrison
Cooper, Texas

Rodgers, Mr. & Mrs. Harry P.
Farm Seed Company
West Point, Mississippi

Rodriguez, Jose
Direccion General de Agricultura
Balderas # 94
Mexico, D. F., Mexico

Rose, Emory
Stoneville Pedigreed Seed Co.
Stoneville, Mississippi

Roush, Robert D.
Soil Conservation Service
Plant Materials Center
Route # 2, Box 576
Arcadia, Florida

Ruffin, Mr. & Mrs. Leonard
Leonard Ruffin Company
2584 Chamblee-Tucker Road
Chamblee, Georgia

Ryker, T. C.
E. I. Du Pont De Nemours Co.
Biochemicals Department
Wilmington, Delaware

Sandage, Omer
Witte Milling Company
Bristow, Indiana

Satterlee, G. C.
Sutton, Steele and Steele
Dallas, Texas

Savage, Sam
Dixie Seeds, Incorporated
Gilliam, Louisiana

Sawyer, A. N.
FCX Wholesale Service
Washington, North Carolina

Sharp, Gerald W.
Sharp Brothers Seed Company
Healy, Kansas

Smith, James C.
James C. Smith Company
P. O. Box 336
Bryan, Texas

Smith, Perry
Mississippi Federated Coop.
Canton, Mississippi

Southwell, O. F.
Georgia Crop Imp. Assoc.
Route # 2
Leesburg, Georgia

Spicknall, Donald K.
M. F. A. Seed Division
LaBelle, Missouri

Steele, Mr. & Mrs. Oliver
Oliver Manufacturing Company
Rocky Ford, Colorado

Stoker, James B.
Pfister Assoc. Growers, Inc.
3251 Woodview Drive
Jackson, Mississippi

Stoltenberg, Mr. & Mrs. Dale E.
Foundation Seed Division
University of Nebraska
Lincoln, Nebraska

Strickland, John C.
West Virginia Pulp & Paper
Multiwall Bag Division
P. O. Box 312
Wellsburg, West Virginia

Stutzman, Roy
Morton Chemical Company
110 North Wacker Drive
Chicago, Illinois

Swallow, Clarence
Kansas State University
Manhattan, Kansas

Sweatt, Houston
Cap-Tex Distributing Company
Lubbock, Texas

Taylor, A. D.
Crookham Company
Box 651
Caldwell, Idaho

Turner, Bernie B.
Bernie B. Turner Proc. Equip.
305 Fairfax Avenue
Nashville, Tennessee

Turner, John "Jerry"
Bernie B. Turner Proc. Equip.
305 Fairfax Avenue
Nashville, Tennessee

Tuzun, Nail
Ministry of Agriculture
Ankara, Turkey

VanPutte, Richard
L. P. Gunson & Company, Inc.
29 Ambrose Street
Rochester, New York

Vaughn, G. F.
Mississippi Dept. of Agr.
Jackson, Mississippi

Wallace, Mr. & Mrs. Bill
Wallace Processing Equipment
Cleveland, Mississippi

Warren, Joe Lee
Warren & Coody Grain Company
Eudora, Arkansas

Warren, William
Morton Chemical Company
110 N. Wacker Drive
Chicago, Illinois

Washburn, Mr. & Mrs. H.G., Jr.
H. G. Washburn & Sons
Atlanta, Georgia

Watling, Mr. & Mrs. Donald K.
Soil Conservation Service
Bath, Michigan

Weber, Mr. & Mrs. Robert
Russell Company
58 Franklin Street
Hilliards, Ohio

Wilkins, Howard
Kansas State University
Manhattan, Kansas

Willey, T. C., Jr.
Mississippi Federated Coop.
P. O. Box 449
Jackson, Mississippi

Wilson, Jack
Hollandale Seed & Delinting Co.
Hollandale, Mississippi

Wilson, Dr. & Mrs. Lane
Southern Seedsmen's Assoc.
2036 Line Avenue
Shreveport, Louisiana

Windish, Mr. & Mrs. Leo G.
The Windish Seed & Feed Mills
301 Market Street
Galva, Illinois

Winstead, Elmo
Georgia Dept. of Agriculture
19 Hunter Street
Atlanta, Georgia

Witte, R. G.
Witte, Milling Company
Dale, Indiana

Wolfe, Buddy
Cap-Tex Distributing Company
Lubbock, Texas

Wood, Robert H.
Asgrow Seed Co. of Texas
P. O. Drawer "A"
San Antonio 11, Texas

Woodruff, Waldo E.
Indiana Crop Imp. Assoc.
Seed Certification Service
Life Science Building
West Lafayette, Indiana

Wright, W. F.
Montgomery Farmers Coop.
Clarksville, Tennessee

Wurst, Foster
Donalsonville Warehouse, Inc.
Donalsonville, Georgia

LIST OF PROCESSING EQUIPMENT

IN THE SEED TECHNOLOGY LABORATORY

EQUIPMENT	MANUFACTURER
Air and Screen Cleaners	
Clipper, Model Super X-29D	A. T. Ferrell and Company West Michigan & Wheeler Street Saginaw, Michigan
Crippen, Model H-534-A	Crippen Manufacturing Company Alma, Michigan
Crippen, Model 334-A	" "
Vac-A-Way, Farm Model	J. W. Hance Manufacturing Co. Westerville, Ohio
Aspirator	
Pneumatic Separator	Electric Sorting Machine Co. 5134 Glenmont Drive Houston, Texas
Belt Separator	
Ross Beet Seed Draper (Inclined Belt)	J. J. Ross Mill Furnishing Co. Portland, Oregon
Buckhorn Separator	
Sutton, Steele and Steele	Sutton, Steele and Steele, Inc. 1031 South Haskell Dallas 23, Texas
Corn Graders	
Morecorn Grader, Model 2 SA	Universal Hoist and Mfg. Co. 1326 Waterloo Road Cedar Falls, Iowa
Rock-It Corn Grader, Model S-4	Superior Separator Company 121 Washington Avenue South Hopkins, Minnesota
Corn Sheller	
Western Corn Sheller	Union Iron Works Decatur, Illinois

EQUIPMENT	MANUFACTURER
Conveyors	
Burrows Belt Conveyor, Model R-13-3/4 HE	Burrows Equipment Company* 1316 Sherman Avenue Evanston, Illinois
Clipper Vibrating Conveyor	A. T. Ferrell and Company West Michigan & Wheeler St. Saginaw, Michigan
Elton Belt Conveyor, Model B.	R. R. Howell Company* Minneapolis, Minnesota
Universal Belt Conveyor, Model H-2	Universal Hoist and Mfg. Co. 1326 Waterloo Road Cedar Falls, Iowa
Debearder	
Clipper	A. T. Ferrell and Company West Michigan & Wheeler St. Saginaw, Michigan
Elevators	
Burrows Cup Type, Model 100	Burrows Equipment Company* 1316 Sherman Avenue Evanston, Illinois
Burrows Cup Type, Model 200	" "
Gordonbilt Airlift, 1-H.P.	Gordon Machinery Corporation P. O. Box 1452 Marysville, California
John F. Grisez	John F. Grisez Company Crows Landing, California
Lift-Master Airlift, 2-H.P.	Holzinger Brothers 10140 South Shoemaker Ave. Sante Fe Springs, California
Seedburo Cup Type, Model 200 B.	Seedburo Equipment Company* 618 West Jackson Boulevard Chicago 6, Illinois
Universal Cup Type, Model B.	Universal Hoist and Mfg. Co. 1326 Waterloo Road Cedar Falls, Iowa

*Supplier

EQUIPMENT	MANUFACTURER
Gravity Tables	
Oliver, Model 50-A	Oliver Manufacturing Company Rocky Ford, Colorado
Sutton, Steele & Steele, Model AX-100	Sutton, Steele & Steele, Inc. 1031 South Haskell Dallas 23, Texas
Hullers and Scarifiers	
Clipper, Eddy-Giant	A. T. Ferrell and Company West Michigan & Wheeler Street Saginaw, Michigan
Clipper, Model HSC-2	" "
Crippen, Model S	Crippen Manufacturing Company Alma, Michigan
Length Graders	
Carter Disc Separator, Model 1522	Simon-Carter Company 655 Nineteenth Avenue, N.E. Minneapolis, Minnesota
Carter Disc Separator, Model 1827	" "
Hart Uni-Flow Cylinder Separator Model 3	" "
Superior Length Grader (Cylinder) Model C-56	Superior Separator Company 121 Washington Avenue South Hopkins, Minnesota
Magnetic Separators	
John F. Grisez	John F. Grisez Company Crows Landing, California
Mixers	
Kelly Duplex Vertical Mixer Model 1	Burrows Equipment Company* 1316 Sherman Avenue Evanston, Illinois
Mac Lellan Batch Mixer Model 1	" "
Roll Mills (Dodder)	
Clipper, 10 rolls	A. T. Ferrell and Company West Michigan & Wheeler Street Saginaw, Michigan

*Supplier

EQUIPMENT	MANUFACTURER
Roll Mills (Dodder)	
Warsco, 8 rolls	W. A. Rice Seed Company Jerseyville, Illinois
Scales	
Apex Bagging Machine, Model D-100	Burrows Equipment Company* 1316 Sherman Avenue Evanston, Illinois
Fairbanks-Morse, 1000# Platform Scales	" "
Fairbanks-Morse, 2500# Warehouse Scales	" "
Scalpers	
Clipper, Model 1297-1	A. T. Ferrell and Company West Michigan & Wheeler St. Saginaw, Michigan
Seed Treaters	
Calkins Slurry, Model S-30	Calkins Manufacturing Co. Spokane, Washington
Gustafson Mist-O-Matic, Model MC	Ben Gustafson & Sons Mfg. Co 1031 Center Avenue Moorehead, Minnesota
Gustafson Mist-O-Matic, Model M100	" "
Gustafson Mist-O-Matic, Model M400	" "
Panogen Automatic, Model US 60-C	Panogen, Incorporated 110 North Wacker Drive Chicago 6, Illinois
Panogen Automatic, Model LC	" "
Spiral Separator	
Krussow Double Spiral	Cleland Manufacturing Co. 2800 Washington Avenue North Minneapolis 10, Minnesota
Width and Thickness Grader	
Carter Precision Grader	Simon-Carter Company 655 Nineteenth Avenue, N.E. Minneapolis 18, Minnesota

*Supplier

LIST OF LABORATORY MODEL

SEED PROCESSING EQUIPMENT

EQUIPMENT	MANUFACTURERS
Air and Screen Cleaners	
Miniature Clipper, Model 29-D	A. T. Ferrell and Company West Michigan & Wheeler Street Saginaw, Michigan
Clipper, Office Model	" "
Aspirator	
Superior Fractionating	Superior Separator Company 121 Washington Avenue Hopkins, Minnesota
Debearder	
Clipper	A. T. Ferrell and Company West Michigan & Wheeler Street Saginaw, Michigan
Dockage Tester	
Carter, Model XT 1	Simon-Carter Company 655 Nineteenth Street, N.E. Minneapolis, Minnesota
Electrostatic Separators	
Carpco, Model HP-16	Carpco Research & Eng. Co. P. O. Box 3272 Jacksonville 6, Florida
Coronatron	Ding's Magnetic Separator Co. 4740 West Electric Avenue Milwaukee 46, Wisconsin
Gravity Tables	
Forsberg	Fred Forsberg & Sons, Inc. Thief River Falls, Minnesota
Oliver Stoner	Oliver Manufacturing Company Rocky Ford, Colorado
Whippet	Sutton, Steele & Steele, Inc. 1031 South Haskell Dallas 23, Texas

EQUIPMENT	MANUFACTURERS
Kvarnmaskiner Laboratory Cleaning Plant Type KM	A/B Kvarnmaskiner Malmo, Sweden

This plant consists of the following equipment:

Scourer (Huller)
Air Separator (Aspirator)
Shaking Sieve Sifter (2 Screen Cleaner)
Table Separator (Gravity Separator)
Trieur (Cylinder Separator)

Length Graders

Carter, Test Cylinders	Simon-Carter Company 655 Nineteenth Street, N.E. Minneapolis, Minnesota
Carter, Test Disc	" "
Superior, Test Cylinder	Superior Separator Company 121 Washington Avenue South Hopkins, Minnesota

Magnetic Separators

Gompper-Maschinen Gesellshaft m.b.H. - "Lilliput"	Buderich bei Dusseldorf Grunstr 32, Postfach, Germany U. S. Distributor: Ulbeco, Incorporated 484 State Highway 17 Paramus, New Jersey

Roll Mill (Dodder)

W. A. Rice	W. A. Rice Seed Company Jerseyville, Illinois

Roll Mill built by the Seed Technology Lab.

Scalper

Clipper, Model 1297-1	A. T. Ferrell and Company West Michigan & Wheeler St. Saginaw, Michigan

Scarifier

Forsberg	Fred Forsberg & Sons, Inc. Thief River Falls, Minnesota

Screens

Complete set of Clipper 9" x 9" Hand Screens	A. T. Ferrell and Company West Michigan & Wheeler St. Saginaw, Michigan

EQUIPMENT	MANUFACTURERS
Seed Treater	
Calkins	Calkins Manufacturing Company Spokane, Washington
Spiral Separator	
Krussow Spiral	Cleland Manufacturing Company 2800 Washington Avenue North Minneapolis 10, Minnesota
Thresher	
Vogel Head Thresher	Bill's Machine Shop Pullman, Washington
Width and Thickness Grader	
Carter Precision Grader	Simon-Carter Company 655 Nineteenth Avenue N.E. Minneapolis, Minnesota

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Additional equipment includes: bag holders, sewing machines, seed probes, moisture testers, germinators, ovens, purity boards, seed dividers, seed counters, balances, microscopes, seed sample cabinets, the Vitascope and other laboratory equipment.

Some of this equipment was contributed by:

Ben Gustafson & Son Manufacturing Company
Burrows Equipment Company
E. L. Erickson Products
Paul Hattaway Company
Redhead Bagholder Corporation
Seedburo Equipment Company