A Rapid Visual Method For Estimating the Amount of Lint on Cottonseed*

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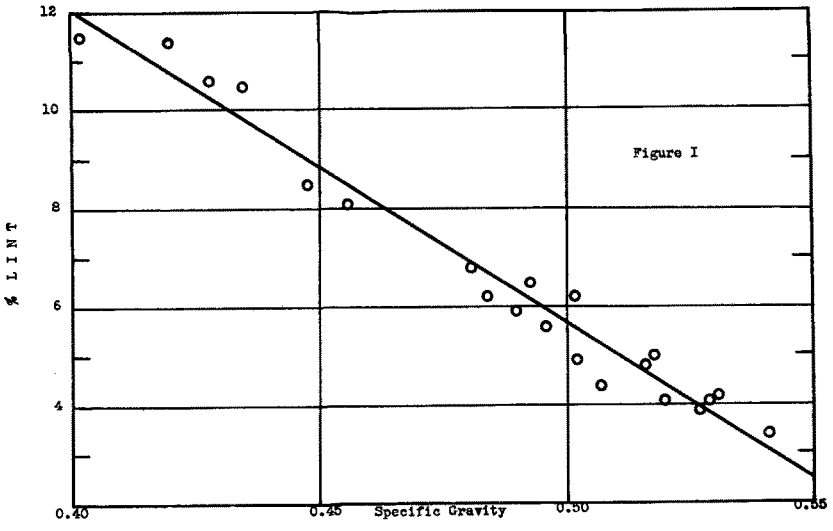
RELATION OF ITS LINT AND MOISTURE CONTENT TO SOME OF THE PROPERTIES OF COTTONSEED

IN another paper the writer has described a fairly rapid and easy procedure for determining the amount of lint on cottonseed, the accuracy of which leaves nothing to be desired, considering the nature of the material. By this method results are obtained in a minimum time of three and a quarter hours; whereas the handling of six or eight samples requires at least four and a half hours. When much larger numbers are to be treated one analyst's time is consumed the better part of a day. In order to test three mill delinted samples daily for each of eight or ten oil mills, it became desirable to have a very rapid method of estimating the lint, even at some sacrifice of accuracy. It was considered that any such method yielding results to within 0.5 per cent of the actual amount of lint present would be acceptable. This figure represents roughly a precision of 10 per cent. Although in this laboratory interest has centered chiefly around mill delinted seed, with a view towards holding its lint to a low figure, it is obvious that a quick method applicable also to whole or undelinted seed would permit a routine accounting of the lint cut as well as a more representative evaluation of seed received. We have not considered it worth while to apply the sulphuric acid method of lint determination to all seed samples analyzed.

In considering this problem the writer hoped that some physical property of cottonseed might be found to depend upon the amount of lint on it to such an extent that a method of lint estimation might be developed that would yield results in a few minutes' time. The properties which it seemed might offer some possibilities in this connection are listed in the following paragraph, and each is discussed to the extent that it was studied. Although from the standpoint of the object in view, the results were for the most part negative, some of the properties showed a certain correlation with the amount of lint, and are mentioned in the hope that further investigation might be stimulated. The properties are:

1. Bulk specific gravity.
2. Bulk compressibility.
3. Angle of repose.
4. Water retention after wetting and centrifuging.
5. Light reflecting power.

After the method of visual comparison of the unknown with graded standard samples had been developed to the point of satisfaction in the case of mill delinted seed, efforts were continued towards finding a means of testing whole seed with equal facility and precision. The range of lint percentages that has come within the writer's experience has been roughly 3.5-7.0 per cent for mill delinted seed and 8.5-12.0 per cent in the case of whole seed; thus, 100 per cent increase in the former and 40 per cent in the latter case; so that the problem is far easier for delinted seed; for, although the interval, 3.5 per cent, is the same, a difference of, say, 0.5 per cent lint is 10 per cent of the average value for delinted seed, but only 5 per cent of the average for whole seed.



Relation of the Amount of Lint on Cottonseed to Bulk Specific Gravity

Specific Gravity, and the Relation of Lint and Moisture Content

This appeared to offer some promise for grading mill delinted seed for lint as the curve in Figure I shows, but the deviations are greater than those occurring in the method of visual comparison, so that further studies were applied to whole seed. In all cases the true percentage of lint has been considered to be that determined by treatment with concentrated sulphuric acid.

For measuring the specific gravity accurately the galvanized con-

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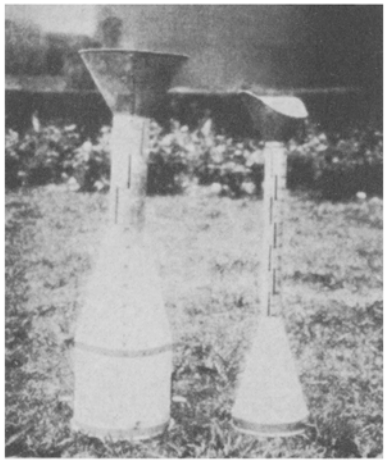


Galvanized Containers Used for Measuring Specific Gravity Accurately

tainers shown in the photograph were designed. A definite weight of seed was taken and some was poured into the pycnometer until full; then the seed was shaken down or packed by dropping the apparatus a definite number of times on a pad from a definite height, after which the remaining seed was added and the whole again packed under standard conditions. The specific gravity was read from a scale on the neck of the vessel, being determined, of course, by the level of the surface of the seed, which was viewed through the slots running the length of the neck. Duplicate determinations often agreed to within one part in a thousand.

It was suspected that the moisture content might be associated with the specific gravity, but we found that the moisture content varied only slightly from day to day in the case of the delinted seed from a particular mill, the seed apparently coming almost into hygroscopic equilibrium with the atmosphere during their travel through the conveyors and linters, and during handling and shipment of the samples in non-moisture-tight containers. (Paper bags are used as containers for delinted seed samples.)

However, in the case of samples representing seed shipments the wide variation of moisture content very definitely prevents the use of specific gravity as a means of estimating lint. Moreover, the data indicate that other properties, notably oil content, also affect the specific gravity.

While this work was in progress it was desired to obtain certain information about the amount of lint on seed received at various mills in southeast Texas, in particular the range of variation from one locality to the next, the range of variation in a particular locality, and the variation occurring at different times in the season of seed movement. Four series of samples were tested: (1) Samples composited from three to five regular analyzed samples from each of several mills; (2) the same repeated several weeks later; (3) a number of regular samples from different gins in one area; (4) samples from scattered origins but composited to yield a graded series of varying moisture contents.

The data are given in Tables I, II, and III. It will suffice to state here that the specific gravity depends more largely on oil and moisture content than on the amount of lint, and that the percentage of lint is roughly inversely proportional to the moisture content in one series, even when calculated to a dry basis; whereas in the other series it shows little dependence on moisture content expressed on a dry basis, but does so, as would be expected (other things being equal) when expressed on the basis of the original moisture content.

Studies of Other Properties to Find One Depending Largely Upon the Amount of Lint

Compressibiilty

When it was found that specific gravity measurements offered no possibility of estimating lint, the writer hoped that the compressibility; that is, the difference in the specific gravities under different packing or pressure conditions, might be used. This should be independent of the composition of the seed if the distortion of the individual seed under pressure is small compared to the variation of degrees of packing that would reasonably be expected to result from varying amounts of lint. Two methods were used: (1) Taking the volume of a given weight of seed packed only moderately; then applying definite weight and reading the contraction. (2) Affecting the diminution of volume by additional packing, using the method mentioned above of repeatedly dropping the containing vessel under definite conditions. No relation of amount of lint to compressibility could be detected, probably because the kernels and hulls themselves were compressed. Wet seeds are softer than dry ones, and as it has been shown that the amount of lint follows inversely the moisture content, this assumed distortion of the seed would balance the effect of the compression of the mass as a whole due to the lint.

TABLE I

Variation of Amount of Lint on Seed from Different Areas and on Different Dates Analysis

Origin	Latitude	Oil*	Moisture	Lint	8-10-34 Lint Dry Basis	9-27-34 Lint Dry Bas.	Sp. Gr.
Valley Mills	31° 40′	17.9%	7.7%	11.2%	12.1	12.6	0.340
Waco	31 32	17.6	8.3	11.1	12.1	12.1	.348
Taylor	30 36	17.7	8.7	11.1	12.2	12.3	.354
Average	31° 16′	17.7%	8.2%	11.1%	12.1	12.3	.347
Austin	30° 14′	19.1%	8.7%	10.5%	11.5	11.6	.366
Hearne	30 52	19.7	9.4	10.4	11.5	11.7	.372
Houston	29 46	20.2	10.7	10.1	11.3	11.5	.390
Average	30° 16′	19.7%	9.6%	10.3%	11.5	11.6	.376
Victoria	28° 49′	19.0%	11.4%	9.9%	11.2	11.7	.384
Corpus Christi	27 46	20.6	10.3	9.5	10.6	...	.384
Corpus Christi	27 46	20.0	11.3	9.3	10.5	...	.398
Robstown	27 46	19.9	10.9	8.7	9.8	...	.393
Average	28° 2′	19.9%	11.0%	9.3%	10.5	...	.390

*Basis equal moisture contents.

TABLE II

Amount of Lint on Seed from Different Gins Within Radius of 80 Miles of Houston, Texas

Origin	Moisture	Lint	Lint Dry Basis
Columbus	8.4%	11.3%	12.2%
Ellinger	9.1	10.4	11.4
Simonton	10.2	10.6	11.8
Clodine	11.7	9.9	11.2
Barbers Hill	12.6	9.9	11.3
Shepherd	13.2	9.8	11.3
Sweeney	14.2	9.8	11.4

TABLE III

Lint on Seed from Various Origins Composited With Respect to Moisture Content

Average Reported Moisture	Oil Dry Basis	Lint	Lint Dry Basis	Specific Gravity
7.4%	17.8%	10.3%	11.1	0.355
8.5	18.6	10.0	10.9	0.369
10.6	18.3	9.7	10.9	0.388
11.7	19.3	10.0	11.3	0.382
12.7	20.1	9.5	10.9	0.396

Angle of Repose

When material like sand, cottonseed, etc., is poured into a pile the slope of the cone thus formed is called the angle of repose, and its value depends upon various factors. It was thought that due to the frictional resistance of the lint this angle would be greater in the case of seed containing more lint. This proved to be the case, but due to the comparatively large size of the sample required to yield a definite

angle, and to the greater accuracy of the method finally adopted, the measurements were discontinued.

Retention of Water After Wetting

One might expect that if a given weight of seed were thoroughly wetted, then quickly centrifuged, and again weighed, the weight of water retained would be proportional to the amount of lint on the seed. For a very wide range of lint percentages this was found to be the case, as the following table shows. It was found difficult to wet cottonseed quickly with pure water, but the result was readily attained by adding to the water a small quantity of liquid soap. However, because the liquid retained by the lint was small in proportion to that absorbed by the hull or held on its surface, the extent of the variation with amount of lint was too slight to be of any value in grading seed. Moreover, the effect of the difference in size of the seed in different samples was quite appreciable.

Water Retained by Cottonseed of Varying Lint Content

% Lint	0	4.0	6.0	9.5	10.4	11.3
% Water	3.8	4.5	5.9	6.8	6.3	6.6

Light Reflecting Power

It is apparent to anyone that of two samples of seed bearing different amounts of lint the one with the most lint appears lighter. To determine if this fact might be made the basis of a method of estimation, a photometer was built in which the light reflected from the level surfaces of two samples of seed, one a known standard of reference, was compared by viewing the comparative brightness of two halves of a milky, translucent glass disc, each half being illuminated by the light reflected from one of the seed sample surfaces. Means were provided for causing a shadow of varying extent to fall over the area of seed representing the standard until the two halves of the split field were matched in brightness. Then the percentage of lint on the unknown sample was read from a previously calibrated scale attached to the mechanism used to vary the shadow. Sources of error are due to:

(1) Variations of the relative whiteness of the lint on different samples.

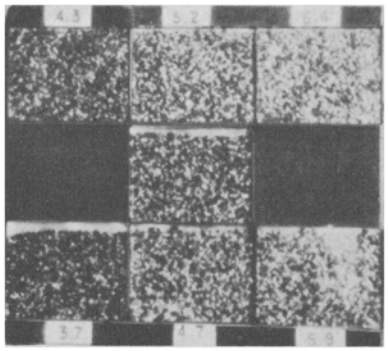
(2) Variations of the relative blackness of the hulls of different samples.

The following table shows values of lint percentages obtained by this method as compared with the values obtained by weighing the acid-delinted seed, and by the method of visual comparison. Duplicate figures represent visual estimations made by different observers:

Photometric	Visual	Acid
5.6%	5.8%	5.7%
6.3	6.3	6.5
5.9	6.0	..
4.5	4.5	..
6.1	5.9—5.9	..
6.1	5.9—5.7	..
4.5	4.5—4.7	..
3.9	4.0—4.2	..
3.9	3.9—4.2	..

The Method of Visual Comparison

It finally became apparent in the course of this work that a difference could easily be detected visually in the case of two samples differing in the amount of lint by no more than 0.5 per cent. Accordingly a graded series of mill delinted seed samples was prepared covering the range 3.7 to 6.5 per cent lint, as illustrated in the photograph. The lint



Graded Series of Mill Delinted Seed Samples

values were established by repeated determinations, using the acid method. The seed were spread out in flat cigarette tins, covered with glass, and mounted on a masonite board as shown. The standards were placed in two horizontal rows in order that the unknown sample might always be either directly adjacent to the standard which it matched, or between the two which it most nearly matched, in case of an intermediate value. A number of the flat tins with glass covers for each were provided for the samples to be graded daily; these should be well mixed before spreading out in the tins. Only a few minutes are required to estimate the lint on ten or twelve samples. The reliability of this method is indicated in the figures in Table V.

TABLE V
Comparison of Results of Lint Estimation by Two Methods

Visual Comparison	Delinting by H_2SO_4	Difference
6.2%	6.5%	—0.3%
5.8	6.0	—0.2
5.2	5.3	—0.1
4.6	4.4	+0.2
5.8	5.7	+0.1
6.2	6.2	0.0
6.3	6.5	—0.2
4.3	4.2	+0.1
5.8	6.2	—0.4
6.2	5.9, 6.5	+0.3, —0.3
6.1	6.5	—0.4
5.2	4.8	+0.4
5.2	5.0	+0.2
4.8	5.0	—0.2
5.2	5.1	+0.1
5.2	5.0	+0.2
4.4	4.6	—0.2
5.0	4.9	+0.1
4.4	4.0	+0.4
5.2	4.7	+0.5
4.5	4.3	+0.2
	Mean	+0.01
	Greatest	+0.5

It must be mentioned that one mill sending samples has a flue system in which apparently the air acts so violently on the residual lint as to cause it to have an appearance somewhat different from that of ordinary delinted seed bearing the same amount. The lint appears to be pulled away from the seed, making it look as though there were about 1 per cent more present than analysis shows to be the case. The seed from this mill is either tested by the sulphuric acid method, or a correction based on a number of comparative tests is applied.

In estimating lint by this method the comparison may be made under two conditions: (1) At close range, under a strong light, studying the relative proportions of nearly bald seed to those more nearly covered, and noting the relative density of the lint. Occasionally, samples are found in which there are relatively few bald seed, but it is apparent from the low density of the lint that its percentage is low. Thus, considerable judgment is sometimes required. (2) Under the other condition the light is subdued and the observer stands at a distance of about fifteen feet, from which the seed are not seen as individuals, and the comparison is made by judging the relative grayness of the surfaces and the relative distribution of light and dark patches. Matching is easier this way, but the same errors enter that were mentioned in the discussion of the photometric method. For example, seed with much dirtier lint than the average would appear to bear less of it.

Some experience, though not a great deal, is necessary for the observer. Table VI, page 262, shows the agreement between the estimates

of three observers, graded according to their experience with the method at the time.

TABLE VI
Experience Required for Visual Estimation

Observer	Freyer	Thoede	Haddon
Experience with method	Much	Very little	None
No. 771	4.3	4.8	4.0
772	5.9	5.9	5.5
773	5.9	5.7	5.9
780	4.5	4.7	3.9
781	4.2	4.0	3.0
782	4.2	3.9	2.8

To see to what extent the lint on original or whole seed might be estimated by this method ten samples were arranged in the order of their lint percentages as judged by the writer. Then the amounts of lint was determined gravimetrically. These were the samples shown in Table I, each from a different oil mill. The series is given below in the actual order of lint percentages

Actual Order		Adjudged Order
11.2% Lint	Valley Mills	Valley Mills
11.1	Waco	Austin
11.1	Taylor	Waco
10.5	Austin	Taylor
10.4	Hearne	Hearne
10.1	Houston	Houston
9.9	Victoria	Corpus C/O
9.5	Corpus C/O	Corpus Christi
9.3	Corpus Christi	Victoria
8.7	Robstown	Robstown

and in the order arranged as in the Table VI.

Only two samples were placed out of their proper order, and the error represented is 0.6 per cent lint. Since the average interval between adjacent samples is 0.3 per cent lint in the above series, it would seem that if a carefully prepared graded series of standard samples were arranged as in the case of mill delinted seed, visual estimates of an accuracy of about 0.6 per cent lint might be made. It should be recalled, however, that this about represents the entire range of variation for a given locality under ordinary conditions.

REPORT OF THE SEED ANALYSIS COMMITTEE

J. L. MAYFIELD, Chairman

IT is with a great deal of regret that the Seed Analysis Committee this season finds itself unable to offer any constructive suggestions for improving the present methods of seed analysis. Primarily, this is due to the fact that present conditions have caused reduction in the personnel of the various committee laboratories, such that they were unable to make the considerable number of tests that would have been necessary to justify any changes. Also, due to the controversial nature of the questions studied, the Chairman felt that no recommendations should be made on any point, through the study of a single laboratory, regardless of its thoroughness. However, three definite subjects were studied by the Committee and in order that the Society may have this information for discussion and thought they will be briefly reported on.

The subject most unanimously agreed upon by the committee was the advisability of attempting to find a mill more suitable for grinding fumed seed than the present Bauer Mill. This phase the chairman undertook. Samples of fumed seed were sent to several manufacturers, together with rough specifications as to what was wanted. One company, Eimer and Amend, undertook to adapt one of their mills to our requirements. The result was highly satisfactory as far as the type of sample was concerned, but after the alterations in the mill had been made its price of one hundred and seventy-five dollars was considered prohibitive. By the time these negotiations were finished it was too late to contact any other manufacturer, though we strongly recommend continuing these efforts.

The question of an adequate mill was but one approach to the main problem of the lack of uniformity of results, especially in oil determinations, and to some extent those of ammonia. Of course, fineness of sample is essential, but evidence indicates that both the time element and the temperature of the preheating and fuming ovens exert a marked influence on the oil determination. Strong differences of opinion were brought out in the study, some workers holding that the seed should be treated in such a way that a yellowish, slightly darkened sample results, and others that such a sample is obviously charred and will give high results. It has been definitely shown that excessive heating, so that the lint appears blackened, will give high results, due probably to the fact that some non-oil materials in the hulls, and lint, and perhaps some of the lipase of the seed are rendered ether soluble. It is probable that the present temperature and time limits are satisfactory where operators use large well ventilated preheating ovens and oil bath fuming ovens. However, where smaller preheating ovens are used, subject to large heat variations and spot heating, it is equally probable that some seed are too excessively heated to give accurate results. It is, at least, incontrovertible that this study should be continued and that the lowest possible efficient temperatures should be stipulated and rigidly followed. It has been shown that the type of pot used for fuming is important since the rapidity with which the acid is released to the seed is governed by the thickness and glaze of the pot. In this regard the relatively thick, heavy, unglazed pots give a noticeably superior sample with far less chance of the lint charring.

The chairman also asked the committee to compare the present method of mixing the ground sample to one in which the material is mixed with an iron mortar and pestle, using the small end of the pestle so as to get a mixing rather than a crushing action. For the past two seasons this method has been followed in the writer's laboratory with, we believe, a 10 to 20 per cent finer sample. Certainly a smoother, less linty material is achieved with no greater expenditure of time or energy. However,