SUGGESTED METHOD FOR EVALUATING COTTONSEED FOR CRUSHING PURPOSES

By G. S. MELOY

It was with mingled feelings that I accepted the invitation of your president to appear before you. Needless to say, I felt greatly honored, but at the same time, the subject I have makes me feel as a layman well might who had the temerity to appear before a medical clinic and expound a new theory for correcting a physical deformity.

I am not a chemist and so I come simply as one who has been looking over the figures and tabulating the quantitative analyses of cottonseed that you chemists have been making. In making up my tables and graphs, I have attempted to correlate the data you have supplied with some of the physical circumstances surrounding the purchasing, handling, conditioning and crushing of cottonseed.

Let us consider for a moment the relative value of the four products of the cottonseed crushing industry. First in value is the oil, which during the past five years has averaged 52.5 per cent of the total value of all the products. Second, meal with an average value of 34.5 per cent of all products. Third, hulls which have represented an average of 6.1 per cent. Lastly, linters which in the same period have represented an average value of 5.9 per cent. From this we see that the oil and meal have a combined average value of 87 per cent of the gross receipts of the oil mills—the range during the five year period being from 81 per cent to 93.3 per cent, while the hulls and linters had a combined average value of only 13 per cent. The hulls and linters are not only of small relative value, but can be set down as of fairly constant relative value; but the oil and the meal not only constitute nearly 90 per cent of the value, but they are variables in quantity, in quality and in units of value. So much so, that the value of the supplies of raw seed bear a direct relation to them.

If we leave out of our consideration for a moment the question of free acid and damage, and consider prime oil only, the question of quantity of oil is paramount and of almost equal weight is the amount, character, and local value of the meal. Two methods for estimating the quantity of oil have been used. The old method most generally used is to determine the percentage of oil in the meats and the percentage of meats in the ton and from these to calculate the oil yield. The newer method, which some of you chemists have been practicing during the past season or two, is to make a direct determination of the percentage of oil in the gross ton. This appears to me to be a step in the right direction; but it still leaves out many factors which should be considered in evaluating seed to be purchased. For instance, it leaves out that very serious factor, the effect of foreign

matter, both dirt and moisture, on the keeping and handling qualities of the seed.

Some ten or fifteen years ago the Department of Agriculture conducted a series of tests to determine whether the variations in the oil content of cottonseed was a varietal characteristic or due to some other cause. For this purpose a series of twenty or more varieties were planted in a number of places in each of the cotton growing states and the seed produced under all of the different conditions of rainfall, temperature and soil represented in the plantings, were assembled and carefully analyzed and the results of the analyses over a period of several years compared. At the same time records were kept of the growing conditions under which each set of seed were matured. After the tests were completed almost all that could be said, safely, was that the percentage of oil in the meats seemed to be correlated with growing conditions; soil, rainfall and temperature, and not to the variety of cotton. But it was always found that the amount of oil in any quantity of seed depended greatly upon the proportion of matter other than kernel contained in those seed. So that while considerable variations in the oil-in-meats character are found because of the very nature of the causal factors referred to, nevertheless, within sections where similar growing conditions obtain, we can generally assume that the oil in the meats is fairly constant regardless of the variety of seed. However, in the plan for evaluating cottonseed for crushing purposes which I am about to suggest, it is not proposed to act wholly on this assumption, but through frequent and regular analyses to check the percentage of oil, and on large shipments to make specific determinations. In fact, specific determinations, in my opinion, should be the rule rather than the exception. In the analyses that I have reviewed during the past year the percentage of oil in the meats varied from 33 to 39. But, rarely did I find the percentage in any single district varying more than one per cent as a 33-34 or a 35-36, and then only where there was a marked difference in the soil in the section, as hill lands and river bottoms.

So much for the oil-in-meats factor. Next we come to the percentage of meats per ton of seed. The situation here is more complicated. Percentage of meats might be said to be the residuum after deducting foreign matter such as sand and dirt, sticks and boll shucks, thick and heavy or thin and light hulls, aborted and immature seeds which increase the hull content without contributing to the meats, and, finally, moisture.

Let us consider first the question of dirt. In the past it has been the custom to pay the freight on the gross tonnage, then to clean the seed and to pay for a net tonnage. But what of the effect of the dirt? The seeds themselves have been contaminated. They have been impregnated with fungus spores, which are only awaiting proper germination conditions to start fermentation and rot. Not only does dirt act as a carrier of rot

causing fungi, but when allowed to remain in the seed provides one, and sometimes two conditions which hasten the growth of those fungi. Dirt in seed always prevents ventilation. It fills up the interstices between the seeds so that no air can circulate through them to cool and dry them out. In addition the dirt which is found in cottonseed is nearly always moist and this moisture added to that already in the seed and combined with a stoppage of ventilation has but one inevitable result—rot. Therefore, dirty seeds have not the same value after cleaning as seed that have been kept clean.

The next item is the extent and thickness of the seed hulls. This item is influenced very materially by the size of the seed. Suppose, for example, that cottonseed were cubes ¼ inch square. A cubic foot of such seed would contain something like 41,422 square inches of hull; but if they were cubes ⅛ inch square they would have just twice as much or 82,844 square inches of hull and this increase in hull would be accompanied by a marked decrease in the amount of kernel contained within those hulls. We have assumed cubes for convenience, but the variations in the diameters of cottonseeds are not far from these proportions. A very interesting phase of the question of small and large seed is to be seen from the breeder's viewpoint. Small seed are correlated with poor degenerate varieties of cotton and conversely nearly all of the varieties that have been bred along scientific lines have large seed. In my own studies of cottonseed I have found varieties in which the seed weighed only 6 grams to the hundred and other varieties the seed of which weighed over 20 grams to the hundred; but 20 grams to the hundred is the exception. Modern, well-bred varieties have seed ranging from 12 to 15 grams per 100 seed, or from 3,020 to 3,775 seeds to the pound. Small, seeded, degenerate varieties run nearer to 7,550 to the pound.

Another item that influences the percentage of kernel per ton is aborted and immature seed. Such seed are seldom composed of anything other than the testa. Rarely do we find more than the rudiments of either the germ or the cotyledons. An effort has been made in the past to penalize immature seed along with damaged seed, but since their true basis is merely a decrease in the percentage of kernel per ton, the attempt to place them in the same category with damaged seed has never been justified. I know that it has been alleged that immature seed increases the fiber content of meal, but that is no justification for classing them with damaged seed. Moreover, I have yet to be shown that immature or aborted seed play any part in the fiber content of meal. My experience has been that they are the first to felt and separate out during sifting.

At present we have no basis for computing proper reductions on account of excess moisture. Excess moisture is foreign matter as far as percentage of kernels is concerned. In addition it furnishes one of the

PROPOSED GRADES AND TABLES FOR EVALUATING COTTON SEED FOR CRUSHING PURPOSES.

TABLES FOR EVALUATION (pounds of oil)

Names and kernel content in percentages per ton		Oil-in-Meats-Factor 33%	34%	35%	36%	37%	38%	39%
Grade No. 1	60	396.0	408.0	420.0	432.0	444.0	456.0	468.0
or	59	389.4	401.2	413.0	424.8	436.6	448.4	460.2
"Fancy"	58	382.8	394.4	406.0	417.6	429.2	440.8	452.4
Grade No. 2	57	376.2	387.6	399.0	410.4	421.8	433.2	444.6
or	56	369.6	380.8	392.0	403.2	414.4	425.6	436.8
"Extra"	55	363.0	374.0	385.0	396.0	407.0	418.0	429.0
Grade No. 3	54	356.4	367.2	378.0	388.8	399.6	410.4	421.2
or	53	349.8	360.4	371.0	381.6	392.2	402.8	413.4
"Good"	52	343.2	353.6	364.0	374.4	384.8	395.2	405.6
Grade No. 4	51	336.6	346.8	357.0	367.2	377.4	387.6	397.8
or Basis								
"Middling"		330.0	340.0	350.0	360.0	370.0	380.0	390.0
Grade No. 5	49	323.4	333.2	343.0	352.8	362.6	372.4	382.2
or	48	316.8	326.4	336.0	345.6	355.2	364.8	374.4
"Fair"	47	310.2	319.6	329.0	338.4	347.8	357.2	366.6
Grade No. 6	46	303.6	312.8	322.0	331.2	340.4	349.6	358.8
or	45	297.0	306.0	315.0	324.0	333.0	342.0	351.0
"Ordinary"	44	290.4	299.2	308.0	316.8	325.6	334.4	343.2
Grade No. 7	43	283.8	292.4	301.0	309.6	318.2	326.8	335.4
or	42	277.2	285.6	294.0	302.4	310.8	319.2	327.6
"Poor"	41	270.6	278.8	287.0	295.2	303.4	311.6	319.8

two chief physical conditions conducive to fermentation and rotting, the other condition being atmospheric heat. Excessive moisture may stimulate fermentation, but it is not a necessary factor. It is a demonstrated fact that seed well within the accepted safe moisture content, will rot when confined and subjected to high atmospheric temperature, if fungus spores are present. This is not only true of cottonseed, but is also true with other seed such as wheat, corn, grass, etc.

It is to meet these conditions that it is now suggested that purchases of cottonseed be made not upon the net weight of cleaned seed, but upon the gross weight of the seed after grading them on the basis of the amount of dirt and excess hull and moisture they contain.

In the first column in the chart the proposed grades are given. In the other columns are tables from which the value of any ton of seed may be computed on the current price of oil and the local market for meal, when the oil-in-meats factor of the place of origin of the seed are known. Under this system differentials are shown to be warranted and justifiable in the basis price in each section in which seed originate, on account of the oil-in-meats factor. Other and greater differentials for each grade above and below Grade No. 4 or middling seed are not only justified, but are essential if purchases of cottonseed are to be made on a sound basis. For the purpose of illustration: If the current quotation for oil is 10 cents, a differential of $1.00 per ton within Grade No. 4 is apparent on the basis of the oil-in-meats factor as shown in the columns under the various percentages of oil in the meats. And a differential of $2.00 for each grade, above and below the basis Grade No. 4. Thus penalties for excess dirt, hulls and moisture are provided and at the same time similar premiums are offered for clean, large, well developed seed and freedom from excessive dirt and moisture.

To my mind, the first and most important question to decide is upon some plan for grading or evaluating seed. I have suggested a plan. The second question is how to put the scheme into practice. The first consideration is, of course, the character of the sample. How large a sample would be truly representative of a car? Certainly, we should have not less than 100 pounds to begin with. A 100 pound sample has two distinct advantages. Such a sample is large enough to be truly representative of a car. Each unit of a 100 pound lot is equivalent to one per cent of the sample. In this way calculations which are always avenues of error are avoided. Having secured the proper sample, let us proceed to determine the grade of the car. First, the sample should be thoroughly cleaned and then reweighed and the net weight noted. With clean seed the size of our sample may safely be reduced through quartering. Again, for the convenience of calculating, the sample should be reduced to 100 grams, less the original loss, or simply stated to the same number of grams as is the

net weight in pounds of the original sample. Remove the meats from this sample and weigh them and note their weight. Next determine the moisture content of the meats and correct the weight by the departure from a normal moisture tolerance of 10 per cent. The corrected weight in grams will then be the percentage of meats per gross ton of seed.

For example, if we start with a 100 pound sample and the cleaned seed weighs 88 pounds, reduce the cleaned seed to a sample of 100 grams minus 12 or to 88 grams and from this extract the kernels. If the extracted meats are found to weigh 55 grams and if the meats are of normal moisture, that is to say 10 per cent, the percentage of meats would be 55 and the grade a number two; but if on the other hand, the meats are found to contain 16 per cent of moisture, an excess of 6 per cent above normal, then 3.3 grams of water are to be subtracted and the corrected weight of the meats would be 51.7 grams. The percentage of kernels then would be 51.7 or a very good type of a grade number 4.

One hundred fair seed may next be cut and the damaged seed content determined in the usual manner and proper premiums or penalties computed on the departure from a standard of damaged tolerance.

W. E. Anderson, Fellow of the Institute of American Meat Packers, is studying the influence of diet upon the quality of fat produced in the animal body. The work is being done in the Laboratory of Physiological Chemistry, Yale University.