Methods of Determining Extent of Stinkbug Damage in Soybeans. II. Flotation Method

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ABSTRACT

Decrease in soybean density resulting from stinkbug punctures causes a greater number of soybeans in a stinkbug-damaged sample to float on a saturated NaCl solution. The percent of soybeans in a sample containing stinkbug damage that will float on a saturated salt solution is determined. The percent of undamaged beans, picked by hand from a separate portion of the same sample, that will float is also determined. The differences between these two percentages for different samples have been found to be proportional to the extent of stinkbug damage present. On the basis of these measurements, a linear scale of values representing relative amounts of damage can be prepared.

The great increase in stinkbug damage encountered by soybean growers has emphasized the need for a rapid method for determining the extent of such damage in soybeans (1,2). Such a method, recently developed in this laboratory (3) is based on the fact that the density of soybeans is decreased by stinkbug damage. Measurements were made which depended for their value on the densities of the individual seeds in a sample. The instrumentation required was expensive and not readily available commercially. The method proposed here employs the same principle but is simpler and requires no expensive equipment.

The method now being used for determining damage gives the number (or weight) of beans having stinkbug punctures. The amount of damaged tissue in individual punctured beans varies greatly; the total amount of damaged tissue in a sample is not known. However, in a well-blended sample containing stinkbug damage, it may be assumed that the pattern of distribution and the ratio of damaged to undamaged tissue are fairly uniform throughout. Standardized subsamples can be made from such a sample by picking from it by hand all the damaged beans and adding them back to the undamaged in such proportions as to produce desired percentages by count. These percentages would be proportional to the amounts of damaged tissue in the subsamples. Within these samples the percentage of soybeans that will float in a saturated solution of NaCl bears a linear relation to the percentage of damaged soybeans and, consequently, to the amount of damaged tissue.

The method described here gives only relative amounts of stinkbug damage. It makes possible the preparation of a linear scale of values ranging from a value corresponding to zero damage to a value corresponding to the amount of damage contained in an arbitrarily chosen sample having great damage. This scale would be of great practical value. Stinkbug damage is determined because of the effect the damage has on quality. The user of the scale could determine by other means the quality deterioration in the sample arbitrarily chosen and then assign consistent quality values to other samples on the basis of their position on the scale.

The relation between percentage of damaged beans and percentage floating on a saturated NaCl solution does not hold true when applied to beans from different samples, owing to appreciable variation in density found in different samples of undamaged soybeans. Therefore, the percent of floating soybeans cannot be used

directly to determine the relative amount of stinkbug damage. In making a determination, the percentage of floating beans in a sample must be subtracted from the percentage of floating beans in undamaged beans picked from a separate portion of the same sample. This *increase* in percent floating, resulting from the presence of stinkbug-damaged beans, may be used to develop a regression equation for calculating the relative extent of stinkbug damage from percent of floating soybeans.

MATERIALS AND METHODS

Samples were obtained from elevators, grain inspection stations, and agricultural experiment stations in the South. They had been sieved to remove trash and blended with a Boerner divider. Splits were also removed, since splits without seed coats, or with disproportionate amounts of seed coat, differ in density from whole beans.

Under the present visual examination method, in which percent damage is determined by the percent by weight of damaged beans in the sample, two samples found to have the same percentage of damaged beans may contain vastly different actual amounts of stinkbug-damaged tissue. Increase in number of punctures causes decrease in weight. Because of this inherent inaccuracy, visual examination is unsatisfactory as a standard for evaluating the accuracy of the proposed new method which estimates relative amounts of damaged tissue. Each sample must be made to serve as its own standard. This procedure is also necessary to establish the correlation between percent of floating beans and amount of damage. The procedure determines the difference between the percent of seeds floating for the sample as a whole and the percent floating in undamaged seed picked from the sample. The assumption can be made, with the introduction of only minor errors, that the same change in percent floating for different samples represents the same amount of stinkbug-damaged tissue.

Each of 20 samples used was made into subsamples containing known percentages of damage. (Percent by count of beans containing damage was taken as percent of damage.) A total of 110 subsamples was prepared in this manner.

In determining the data presented here, the following procedure was used: Two hundred undamaged seeds picked from a sample were added to a saturated solution of NaCl in a 2-liter beaker and stirred vigorously to detach air bubbles from the beans. The percent by number of floating beans was determined. Determinations were then made in the same manner on successive 50-bean portions consisting entirely of damaged beans picked from the same sample. By combining the data from the 200 undamaged beans with the data from 50 damaged beans, a result was obtained which corresponded to a determination on a 250-bean sample containing 20% damage. Combining the 200 undamaged beans with two 50-bean portions of damaged beans gave results for a 300-bean sample containing 33% damaged beans. The same plan gave results for samples containing 43, 50, 55, 60, or 64% damage. Combining all portions containing 50 damaged beans gave results for 100% damaged beans. This plan was necessary because of the excessive amount of labor involved in picking the damaged beans from samples.

After each determination, the percent of floating beans in the 200 undamaged beans was subtracted from the percent of floating beans in the combination to give

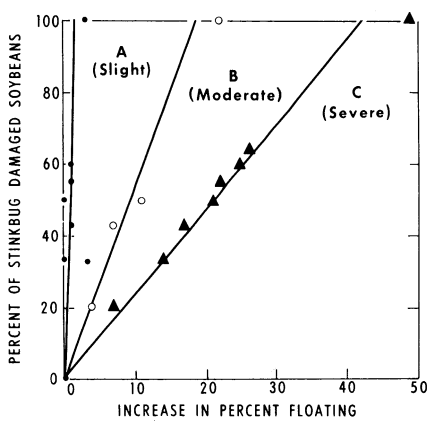

Fig. 1 (left). A, B, and C show the relation between the increase in percent floating and the percent of stinkbug-damaged soybeans for samples containing slight, moderate, and severe damage. Each point represents a subsample.

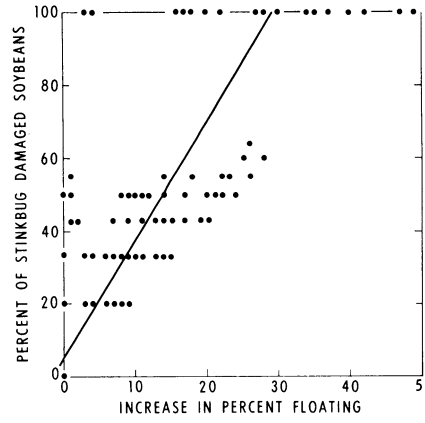

Fig. 2 (right). Increase in percent floating vs. percent of damaged soybeans for the 20 samples (110 subsamples) tested. Regression equation Y = 4.49 + 3.24 X.

differences, hereafter referred to as "increase in percent floating," which were related to the amount of stinkbug-damaged tissue present.

In using the method for making routine determinations, it is proposed that the percent of floating seeds found in 50 undamaged beans, picked from a separate portion of the sample, be subtracted from the percent of floating seeds found in 200 seeds (or a larger number if desired) taken from the sample as a whole; however, this procedure could not be followed in producing the test data presented because the samples contained relatively small percentages of damaged beans. All the values obtained would have been near zero.

RESULTS

Figure 1 shows graphs A, B, and C of three of the samples used. In each graph, increase in percent floating is plotted against percent of damaged beans by count for each of the three subsamples. Sample A shows the greatest slope and C the least of any of the 20 samples. Sample B shows the lowest correlation found. Visual examination indicated that the individual damaged bean in C contained, on the average, a much greater amount of damaged tissue than the individual damaged bean in A.

Every subsample of the 20 samples is represented by a point in Fig. 2 where increases in percent floating are plotted against percent of damage by count as determined by visual examination. If a sample showed an increase in percent floating of 49 (corresponding to 100% damaged beans in C of Fig. 1), the percent of damage calculated from the regression equation would be approximately 150%. The ordinate values on the regression line do not represent percentages of damaged tissue; they are, however, a scale of values giving relative amounts of damaged tissue. To reduce this scale to a range of 0 to 100, all the ordinate values may be

reduced by two-thirds. The ordinate scale provides a means of ascertaining the relative amount of damaged tissue from the measured increase in percent floating.

DISCUSSION

The percent of floating beans was determined for a separate portion of 50 undamaged beans for each of the 20 samples and the result compared with the percent floating in the 200 undamaged beans used in each sample. For two samples the difference between the two measurements was greater than 1. One showed a difference of 2 and the other 3.

Other conditions besides stinkbug punctures undoubtedly contribute to increases in percent floating, since these conditions are less likely to be found in the undamaged beans picked out than in the sample as a whole. When samples have only a small amount of stinkbug damage, accuracy can be increased if moldy and shriveled beans not containing punctures are picked out before sampling.

The slope of graph A, Fig. 1, is so great as to render it useless, of itself, in determining the extent of damage. However, when the points on A are referred to the regression line of Fig. 2, very low values for relative damage will be obtained. Visual examination of this sample confirmed that the damage was very slight. Punctures were superficial and damaged areas so small as to make the real damage to the sample negligibly small.

Accuracy might also be increased by rejecting from the undamaged portion only those beans having stinkbug punctures.

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