Methods for Determining the Extent of Stinkbug Damage in Soybeans. III. Relation of Stinkbug Damage to Quality in Soybeans

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ABSTRACT

Changes in oil content, percent of free fatty acids, and protein content, resulting from stinkbug damage, were determined for 27 samples of soybeans. Determinations were first made on undamaged soybeans picked by hand from a sample, and the results were compared with the same determinations made on an unpicked portion of the sample. Results indicate that stinkbug damage causes lower oil content, higher percent of free fatty acids, and in most samples, higher protein content. Longer storage time appeared to produce no further quality deterioration in stinkbug-damaged beans.

The price the farmer receives for his soybeans is discounted at times because of stinkbug damage. The method now used to estimate extent of stinkbug damage is not accurate (1) and, consequently, the true relation between extent of damage and degree of quality deterioration is not known. Other workers (2,3) have shown, on the basis of determination of damage by visual examination, that decrease in oil content and increase in percentages of free fatty acids (FFA) and proteins are associated with stinkbug damage. In this investigation, these quality changes are correlated with stinkbug damage.

MATERIALS AND METHODS

Samples were obtained from grain inspection stations and elevators in the South: 21 samples from the 1968 crop, three each from the 1967 and 1966 crops, two from the 1965 crop, and one from the 1964 crop. These last nine samples, which had been stored at room temperature, were used to investigate the effect of storage on increase in deterioration due to stinkbug damage. The moisture level for the samples ranged from 7.0 to 15.3%, calculated on a dry basis. High-moisture samples (20%) were prepared from two additional 1968 crop samples. The calculated weights of liquid water were added to the samples contained in Mason jars, which were then shaken to distribute the water and allowed to stand for 10 days.

To extend the range of relative damage values as greatly as possible, three samples from the 1968 crop were made into subsamples by the method previously employed (4). Stinkbug-damaged beans were picked by hand from the sample and were then added to different portions of undamaged beans from the same sample to produce subsamples having different amounts of relative damage. Thus it was possible to produce in the nine subsamples higher relative damage values than those found in unpicked samples. The subsamples were treated in the same manner as unpicked samples. It has been shown (4) that in a well-blended sample, the pattern of distribution and the ratio of damaged to undamaged tissue are uniform.

Oil content, percent FFA in extracted oil, and protein content were determined according to AOCS official methods (5)[1]. The oil extracted in determining oil content was used for FFA determination. Relative amounts of stinkbug damage in the samples were determined by the method proposed by Hart (4). On the scale used, a sample showing an increase in floating beans of 45% was given a relative damage value of 100.

Changes in quality associated with stinkbug damage were determined as follows: Through visual examination, soybeans containing no stinkbug damage were picked from a portion of the sample; oil content, protein content, and percent FFA in the extracted oil were determined on these undamaged beans. The same determinations were made on another portion of the sample. The differences in oil content, protein content, and percent FFA between the undamaged beans and the sample as a whole were then calculated. An assumption is made that if the soybeans had not been damaged, they would have been of the same quality as the sound beans.

RESULTS

Figures 1, 2, and 3 give the relation between relative damage values and, respectively, decrease in oil content, increase in percent of FFA in the extracted oil, and increase in protein content. Circles on the graphs represent samples held in storage for 1 year or longer. The two triangles represent the high-moisture samples, not included in calculating regression equations. All results were calculated on a dry basis.

DISCUSSION

In soybeans damaged by stinkbugs, decrease in oil content appears to be the principal factor of quality deterioration (Fig. 1). Results obtained with the two prepared high-moisture (Fig. 1) samples give presumptive evidence that moisture contents as high as 20% caused increased deterioration from stinkbug damage.

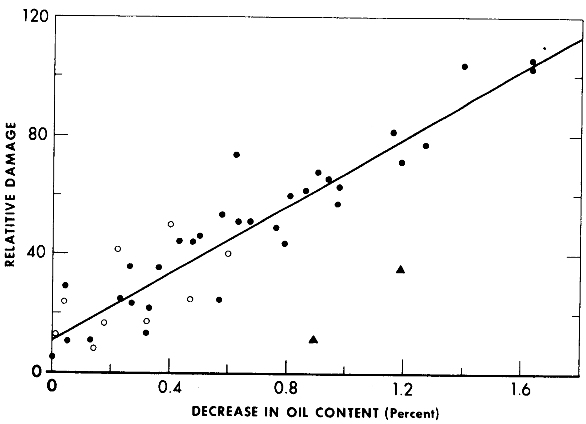

Fig. 1. Relative amounts of stinkbug damage vs. decreases in oil content that resulted from the damage. Regression equation: y = 11.68 + 56.33 X.

[1]Protein determinations were made by the Grain Division, C&MS, USDA, Beltsville, Maryland.

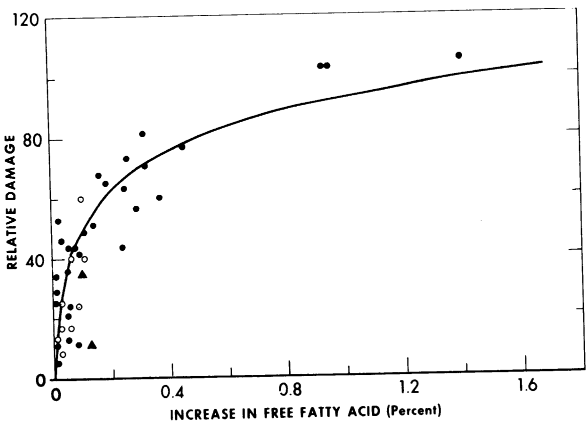

Fig. 2. Relative amounts of stinkbug damage vs. increases in percent of free fatty acids in extracted oils. Regression equation: $y = 92.825 + 43.786 \log X$.

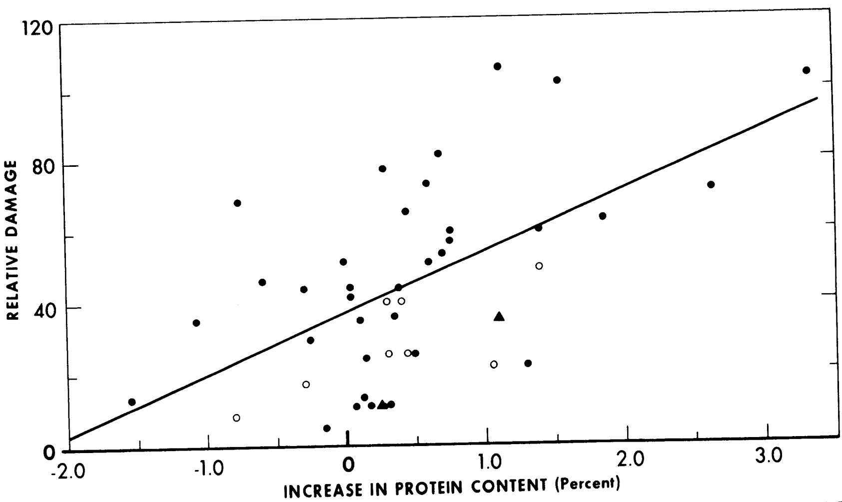

Fig. 3. Relative amounts of stinkbug damage vs. increases in protein content that resulted from the damage. Regression equation: $y = 37.01 + 17.03 X$; $r = 0.58$.

Samples having 14 and 15% moisture showed no more increase in deterioration than low-moisture samples.

Because of the exponential character of the regression curve of Fig. 2, the oil extracted from samples having relative damage of less than 60 show negligible increases in percent of FFA. Apart from the subsamples made by mixing stinkbug-damaged beans with undamaged from the same sample, only two of the samples tested had relative damage values of 60 or higher. In samples with relative damage higher than 60, increase in FFA becomes a very important cause of quality deterioration.

In these tests, where correlation between relative damage and protein content is very poor (correlation coefficient: 0.58), relative damage was not a reliable indicator of increase in protein content. Other workers (2,3) have reported that stinkbug damage caused increases in protein content. They compared the protein contents of samples taken from the same lot of soybeans but having progressively greater numbers of stinkbug punctures. Present results indicate a general tendency for protein content to increase as damage increases; however, many samples, particularly those with small amounts of damage, actually decreased in protein content.

The number of stored samples tested was too small to give conclusive evidence on the effect of prolonged storage on increases in quality deterioration due to stinkbug damage. Relative damage from stinkbugs appears to be fixed before the beans are harvested; it depends upon the amount of damaged tissue. Decrease in quality for stored and freshly harvested samples was the same at a given relative damage. Unless relative damage and quality factors change during storage at rates which maintain the relationships existing in Figs. 1, 2, and 3, it must be assumed from the data that relative damage does not change during storage and quality deterioration does not increase.

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