Economic Impact of Uncontrolled White-Fringed Beetle Damage to Peanut Farmers in Alabama, Florida, and Georgia

BULLETIN 491
AUGUST 1977

AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY
AUBURN, ALABAMA
R. DENNIS ROUSE, Director

SUMMARY

White-fringed beetle (WFB) larvae have been recognized as a destructive pest of peanuts in the southeastern United States for more than 25 years. After their discovery in the Florida Panhandle in 1936, the insect spread rapidly throughout the Southeast despite quarantine efforts. Various insecticides and other control methods were tried since 1936, but the most effective controls were those that killed WFB larvae in the soil. The most effective, commonly used insecticides were DDT, aldrin, dieldrin, and chlordane. All these substances had relatively long residual toxicity when incorporated into the soil and could provide WFB control for several years.

In 1976 chlordane was the only one of the above mentioned insecticides available for use. Production of the other substances has been banned due to environmental hazards. A cancellation hearing on chlordane in 1976 by the U.S. Environmental Protection Agency prompted research on the WFB problem in peanuts in Alabama, Florida, and Georgia. Data were needed on the destructive capability of white-fringed beetles in peanuts and on the economic damage due to a loss of the only effective control of WFB larvae.

A mid-1976 survey of 31 counties in the tri-state peanut producing area yielded much of the needed data of WFB damage and infestation levels. White-fringed beetles were found to be a widespread and destructive pest of peanuts. In Alabama, Florida, and Georgia white-fringed beetles were estimated to infest 28 percent of total peanut acreage. When left untreated, this infested acreage could be expected to produce only 85 percent of normal yields. Effective treatment of infested acreages would greatly reduce yield loss, and infested-treated areas were expected to produce 97 percent of normal yield.

Under infestation and production situations existing in 1975, estimated value of yield losses on infested-untreated acres was $84 per acre in Alabama, $66 per acre in Florida, and $107 per acre in Georgia. Losses on infested-treated fields were estimated to be $21 per acre in Alabama, $27 per acre in Georgia, and damage was expected to be completely eliminated in Florida. Further information gained in the survey showed that approximately 50 percent of infested acres in 1975 were under treatment. Using these infestation and loss figures, a 3-state annual yield loss of $13 million was attributable to white-fringed beetles. Value of 1975 WFB related peanut damage in Alabama amounted to approximately $3.5 million, in Florida over $1 million, and in Georgia about $8.5 million.

Even assuming static infestation levels and no increase in damage levels, a cancellation of the remaining effective control of WFB larvae would mean much greater losses. Without controls, white-fringed beetles could mean additional tri-state losses of over $7.5 million annually.

Of those counties reporting a type of control for WFB larvae in 1975, all reported the use of chlordane. The cost of treatment with chlordane was approximately $7.50 to $10.50 per acre depending on formulation used. Because of the residual properties of chlordane, this cost could be prorated over several years making the annual cost of treatment around $3.00 per acre. Also as a result of its residual nature, the full impact of a cancellation of chlordane would not be felt immediately. It would take approximately 3 years for most of the insecticide's control effectiveness to diminish. After the control of WFB larvae began to lessen, existing infestations could spread and strengthen, and damage levels could increase. Because of lack of data on the magnitude of these increases, estimates were made only for the "first-round direct losses" from uncontrolled WFB damage. These were annual losses expected immediately after residual WFB control was gone. Second-round losses in subsequent years could be expected to be larger than those of the first-round.

A large number (7 to 10,000) of peanut farmers were already being affected by WFB infestations in 1975. The majority of peanut acreage on farms is relatively small. In the Alabama sample, farmers averaged 25 acres of peanuts per farm. The average number of acres was nearly 50 in Georgia; but in the Florida sample it was only 19 acres per farmer. Because of the sporadic nature of WFB damage, small acreage peanut farmers with a WFB infestation would more likely have heavier relative losses on their peanut crops than farmers with large acreages.

Peanuts represent an opportunity for profit, but they also represent a large risk when all costs of production are considered. Total costs (including land and allotment rent) for growing one acre of peanuts may run from $410 to $485. High costs involved make high yields (2,100 to 2,400 lb./a) necessary in order for the farmer to break even.

Peanuts are an important cash crop to farmers, but they are perhaps just as important to the economy of communities and counties in which they are grown. Peanuts represent the largest single contributor to cash farm income in many areas of concentrated peanut production. Needless to say, the peanut industry employs many people other than farmers. The incomes of all these persons have a direct and indirect impact on the economy of the surrounding area. Once peanut income is withdrawn from the economy, the reduction's impact is amplified through the interrelationships among different sectors of the economy.

White-fringed beetles will feed actively on most alternative crops that can be grown in the Peanut Belt. If a field is so highly infested with WFB that it will not profitably produce peanuts, it is doubtful that any other crop can be grown profitably on the field without prior WFB treatment and control.

Under possible future peanut legislation, there is an opportunity for U.S. farmers to sell export peanuts on the world market, if they can maintain break-even yields at the lower world market price. An uncontrolled WFB infestation in many instances would lower yields below the break-even level and prohibit entry into world markets.

Any change that will have a detrimental effect on peanut yields will have a similar effect on the incomes of peanut growers and the economy of the peanut producing areas. Based on the findings of this study, a cancellation of the remaining control for WFB larvae would have such an effect on peanut yield and the consequences should be expected. Careful consideration should be given to the alternatives and their corresponding consequences.

CONTENTS

First Printing 3M, August 1977

ECONOMIC IMPACT OF UNCONTROLLED WHITE-FRINGED BEETLE DAMAGE TO PEANUT FARMERS IN ALABAMA, GEORGIA AND FLORIDA*

John L. Boutwell**

INTRODUCTION

History

White-fringed beetles (WFB) have been described as "potentially one of the worst pests of peanuts in the southeastern United States" (2). This insect's destructive capability was quickly recognized after its discovery in September 1936 at Svea, Florida, and measures to limit its spread were soon begun. In July of 1937, the Bureau of Entomology and Plant Quarantine, with the cooperation of the State Plant Board of Florida and the Alabama Department of Agriculture and Industries, established the White-Fringed Beetle Control Project in the Division of Domestic Plant Quarantines. The purpose of this project was to reduce known populations of white-fringed beetles with the use of suitable control measures and to prevent further spreading by effective quarantine action (4). Shortly afterward in January 1939, a Federal domestic plant quarantine to restrict interstate movement of WFB-infested materials was initiated (4).

In spite of work done during the early years of these quarantines, by 1948 the white-fringed beetle was established in 115 counties in seven southeastern states – Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina (1). The apparent ineffectiveness of early quarantine

*This study was conducted under research funding provided by Velsicol Chemical Corporation, Chicago, Illinois.

**Former Research Associate, Department of Agricultural Economics and Rural Sociology, currently Economist–Pest Management, Alabama Cooperative Extension Service.

efforts and rapid spread of WFB populations was primarily due to two factors: (A) a lack of basic knowledge of the biology and habits of this insect, and (B) the lack of an effective larvacide (4). The bulk of WFB damage is done by the larva. Thus, control of this stage of the insect is critical.

DDT, a product of World War II technology, became the first available insecticide shown to be effective against both adult and larval WFB (4). A few years later chlordane and toxaphene were tested as soil-mixed larvacides (5). From June 1949 until June 1961, the USDA conducted outdoor tests on chlordane at different rates for killing young WFB larvae. In these tests, a rate of 5 pounds or greater per acre of technical chlordane was shown to give effective soil control of young WFB larvae for several years. Later aldrin, dieldrin, and heptachlor were also shown to be effective soil larvacides.

Control methods used during the quarantine varied over time. In addition to disseminating control information and giving advice to growers, the USDA provided other control services. During certain time periods they made complete field treatments in infested areas, supplied insecticides for farmers to apply, cleaned and treated farm machinery used in infested fields, treated transportation distribution points and actual peanuts being shipped to non-infested areas, and supervised implementation of other quarantine measures (9). Even with these concentrated efforts, new infestations of white-fringed beetles continued to arise.

In the 1950's and 1960's, however, the quarantine measures were more effective than in earlier years. During this time increased biological knowledge of the white-fringed beetle and effective insecticides were available to quarantine workers. The rapid spread of infestation seen from 1936 to 1948 was somewhat repressed. By 1971, white-fringed beetles had spread from the seven southeastern states reported in 1948 to only six other adjoining states – Texas, Arkansas, Missouri, Tennessee, Kentucky, and Virginia (2). This group of 13 states by no means encompassed the projected geographical boundaries of the insect's possible infestation. (2). The heaviest infestations remained in Georgia, Florida, and Alabama.

At the end of June 1975, the WFB quarantine was withdrawn by the USDA. Responsibility for control was placed in the hands of individual growers and transporters of peanuts (9). At that time aldrin, dieldrin, DDT, and heptachlor could no longer be used to control WFB larvae. No other effective larvacides had been developed or discovered, so chlordane was the only remaining effective control for WFB larvae.

In 1976 cancellation hearings on the use of chlordane were begun by the United States Environmental Protection Agency. Since the loss of chlordane would leave the farmer with no available means of control, studies were begun to determine the negative economic implications or costs that could arise from cancellation.

WFB Damage

This report focuses mainly on peanut damage, but peanuts are certainly not the only crop susceptible to WFB attack. This insect feeds on several hundred species of cultivated, ornamental, or wild plants. An abridged listing of those crops with high economic importance includes cotton, soybeans, corn, peanuts, lima beans, potatoes, okra, tomatoes, and clovers (4). Much can be said about damage caused to these crops, but the general nature of WFB damage to field crops was well summarized in the following excerpt from a USDA report:

"White-fringed beetles cause serious damage to many field crops of economic importance in the southern states where the beetles are established. Damage is due mostly to the larvae, which feed on the roots of practically any plant with which they come in contact. This is especially true in the spring when the larvae are congregated in the upper few inches of the soil and where they vigorously attack the roots of spring-planted vegetation. . . .

". . . White-fringed beetles do not usually cause uniform crop damage over large continuous areas as do some other insect pests. Crop injury in fields of appreciable size may vary from a trace in one portion of the fields to complete destruction in another. However, the aggregate damage may be so great as to render the total crop unprofitable.

"The adult beetle will feed upon most plants having leaves that can be cut successfully with its mandibles. Adults are not voracious feeders and usually do little economic damage. While known to feed upon the foliage of more than 170 plant species, the adults appear to exercise definite food preferences. Among the cultivated plants preferred are peanuts, velvetbeans, cotton, lespedeza, and alfalfa. . .

"The white-fringed beetle had demonstrated an ability to build up damaging populations in 1 or 2 years in areas not previously known to be infested. This high reproductive capacity renders the insect potentially dangerous (4)."

The above description of WFB crop damage is quite applicable to infested peanut fields in the southeast. Unless infestations are relatively new or infested fields are large, the fields are likely to have some degree of infestation over much of the entire area. However, visible damage would appear only where the heavy concentrations of white-fringed beetles occur. Damage is caused primarily by the larvae in late spring and sometimes continues into summer. Potentially the worst time for damage is the early seedling stage of the peanut plant. Often when WFB larval feeding occurs at this stage, the seedling is killed (2). After the plant passes the seedling stage, heavy WFB feeding may still kill it; but stunting and lack of plant vigor are more likely results. Thus, white-fringed beetle can cause yield reductions in infested fields by reducing stand counts and reducing plant vigor.

WFB Control

As mentioned earlier, several insecticides—namely DDT, chlordane, heptachlor, aldrin, and dieldrin—were found to be effective WFB larvacides when mixed with the soil. The only one of the above listed that is labeled and available for use on peanuts to control white-fringed beetle larvae in 1976 was chlordane. Other possible soil insecticides have been tested (3), but differences between yields on the plots treated with these insecticides and the untreated check plots were not statistically significant.

Chlordane was available in both granular (G) and emulsifiable concentrate (EC) formulations. The application method most often used was to broadcast 5 pounds actual chlordane per acre before planting. The 5-pound broadcast rate would usually provide protection from WFB for 3 years and sometimes up to 5 years. The granular form was commonly spread with a fertilizer mix, and the emulsifiable concentrate could be applied along with preplant herbicides (8). Chlordane was then incorporated into the soil at the same time as the fertilizer or herbicide. Thus, little or no additional cost was incurred for application or incorporation. At the 1976 cost of chlordane to farmers ($12.00/gal. for 8 lb./gal. chlordane EC) (7), the total cost of materials per acre to broadcast 5 pounds of chlordane was $7.50; and this could be prorated over 3-5 years making the yearly cost $2.50 or less per acre. In addition to controlling white-fringed beetles, this one treatment also provided control of wireworms, southern corn rootworm, and fire ants if any were present in the field (6).

An alternative method of application is to band 2 pounds actual chlordane over the row or place it in the drill at planting. This method has a smaller initial cost, but protection lasts for 1 year only, making the yearly costs higher. Farmers who make a last minute decision to treat WFB or farmers renting peanut land for only 1 year often treat in this manner. (8).

The Alabama Cooperative Extension Service has written recommendations in the *Alabama Insect Control Guide* which advises chlordane at either the 2- or 5-pound rate for WFB control. Georgia extension workers made the same recommendations. Florida extension personnel stressed the 5-pound broadcast rate but both rates were included in their written recommendations. In all three states, recommendations only applied to fields or portions of fields that were found to be infested.

ALABAMA-FLORIDA-GEORGIA STUDY

Need for Further Study

It was hypothesized that: (A) because white-fringed beetles were a pest of peanuts and were known to be present in the southeast, they must represent some actual and potential dollar loss to peanut farmers; and (B) because in 1976 chlordane was the only uncancelled insecticide effective in controlling WFB larvae, the loss of this material for farm use would leave the peanut farmer with no effective defense and mean a more certain dollar loss from white-fringed beetles.

An examination of available research findings and publications revealed very little data that would credit or discredit the above hypotheses. A study for the specific purpose of ascertaining the extent of WFB infestation and damage to peanuts was needed.

Scope and Methodology

Sizable acreages of peanuts are grown in seven states in the U.S. However, white-fringed beetles present the most acute problem to peanuts in Georgia, Florida, and Alabama. Hence, this study was directed toward the WFB damage in these three states. The basic research tool used in this study was a short questionnaire mailed to all the county extension offices in each state in counties meeting a specified level of peanut cultivation. Because most insect problems eventually come to the attention of county extension workers, it was felt that this group should know as much or more about the WFB problem in their particular county than anyone else.

To obtain a representative sample of peanut producing counties, those counties to be included in the study were selected strictly on 1974 peanut acreage harvested. For Alabama and Georgia, all counties with 7,500 or more acres were included. Florida counties with 2,500 or more acres received a questionnaire. The minimum acreage for Florida was lowered because only one county in that state had at least 7,500 acres. No preference was given to a county's location or previous occurrences of WFB infestations.

Using the specified minimum acreage criteria, the sample encompassed 25 counties in Georgia, nine in Alabama, and six in Florida (Fig. 1). Even though the sample by no means included all peanut producing counties, a high percentage of the total peanut acreage of each state was represented in the sample. A breakdown of the 1974 acreages is shown on page 11.

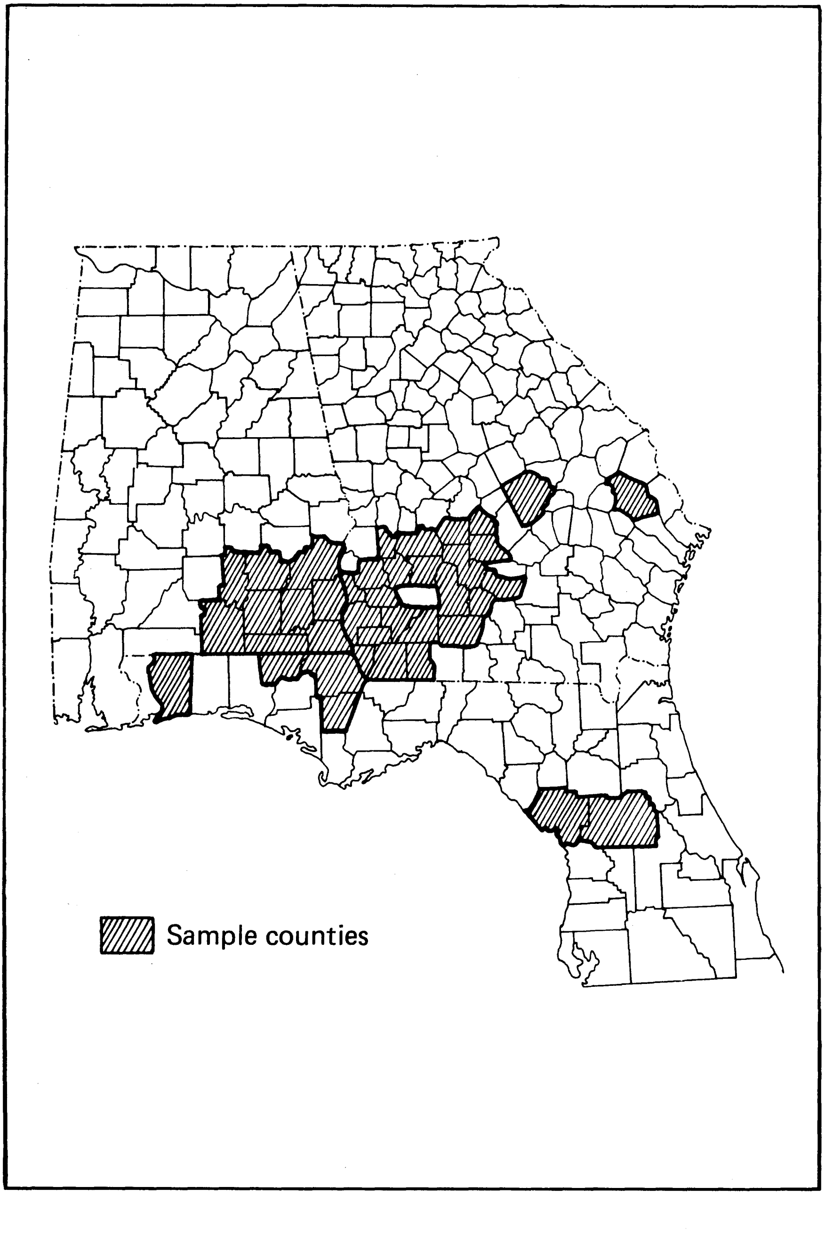

Figure 1. Map of Sample Counties

	Alabama	Florida	Georgia	Three state total
Total acres	201,000	55,000	516,000	772,000
Acres in sample	190,370	44,150	402,064	636,584
Percent of total acres	95%	80%	78%	82%
Acres in sample responding	157,160	36,140	325,113	518,413
Percent of total acres	78%	66%	63%	67%

The questionnaire was mailed out the week of June 30, 1976. Approximately 4 weeks later, those county offices that had not yet responded were recontacted by mail and another questionnaire was enclosed. Final response rate was as follows: Alabama 7 out of 9 counties responding (78%); Florida, 4 out of 6 counties responding (67%); and Georgia, 20 out of 25 counties responding (80%).

Questionnaire Description

Before any statement on economic impact could be made, two essential elements were necessary – (A) an estimate of the number of acres infested with WFB, and (B) an estimate of yield damage done to peanut fields by WFB when left untreated. The primary objective of the questionnaire used in this study was to obtain county estimates for these two unknown elements.

Because of the sporadic nature of WFB damage, respondents were asked to give answers for the growing seasons of 1974 and 1975. On items such as yield reduction, an averaging of the 2 years was expected to give an estimate that would be more representative than a single year. Two yield damage estimates were requested for each year: first the percentage of normal yield expected from infested fields that were treated, and second, the percentage of normal yields expected from infested fields that were left untreated.

Three acreage figures were requested: (A) the number of infested acres, (B) the number of infested acres treated, and (C) the number of infested acres left untreated.

Research and extension entomologists from Alabama, Florida, and Georgia were consulted about their views on WFB infestations. Their general consensus was that even though an infested field was treated, the farmer could expect WFB damage again in that field as soon as the treatment effectiveness was dissipated. Therefore, infested acres were classified as either treated or untreated. A field was considered treated for as long as the insecticide remained effective. For chlordane, one application should remain effective for approximately 3 years. Hence, the infestation levels derived from questionnaire responses are not an average infestation for 1974 and 1975; but they represent the number of acres infested at the end of the 1975 growing season.

Respondents also were asked to record treatment methods and insecticides used for WFB control. Finally a listing was made of the number of farmers reporting WFB losses, the estimated number of farmers having losses but not reporting them, and the total number of peanut farmers in the county.

STUDY FINDINGS

WFB Infestation and Treatment Levels

Infestations of WFB were reported over a large portion of the peanut producing areas of Alabama and Georgia. The degree of infestation varied from county to county with some counties showing the majority of peanut acres infested, some having none or a few acres infested, and others reporting some intermediate degree of infestation.

Only one county in the Alabama sample (Pike County) reported no WFB infestation for 1974 and 1975. The Pike County extension chairman indicated that there previously had been white-fringed beetles in that county, but the infestations had been treated and were under control during 1974 and 1975. Because no infestations were reported during those two years, the extension chairman did not attempt to estimate his county's latent WFB infestation. Pulaski and Webster counties in Georgia also responded that no WFB damage of peanuts was noted during either 1974 or 1975.

Florida had a somewhat different situation in that its WFB problems were concentrated in the Florida Panhandle area. The two counties in the Florida sample that were located outside the Panhandle (Levy and Marion) reported that they had no WFB infestation or damage. Unfortunately, only about 15 percent of Florida's peanut acreage lies outside the Panhandle; so the majority of Florida peanut acres are highly susceptible to WFB infestation.

The proportion of total peanut acreage infested and infested acreage treated are shown below for each state.

State	Percent of total peanut acres infested	Percent of infested peanut acres treated
Alabama	31	45
Florida	50	40
Georgia	24	50
3-state total	28	47

By applying the proportions found in the samples of each state to the corresponding total statewide peanut acreage, an estimated 63,860 acres were infested in Alabama; 27,500 acres in Florida; and 125,760 acres in Georgia. Using the average number of peanut acres per farmer as reported in the sample (25 acres – Ala.; 19 acres – Fla.; and 49 acres – Ga.), at least 2,550 farmers in Alabama, 1,450 in Florida, and 2,550 in Georgia had WFB infestations. Since all farms with a WFB problem are not completely infested, the above estimates represent a minimum number of farmers affected by WFB infestations.

Of course infestations are not so evenly distributed among farms as an average infestation might indicate. Some infested farms would have very little damage, while the peanut crop on another farm might suffer heavy losses to WFB if no control measures were taken. The same type differences would be present between counties.

White-fringed beetle damage is generally sporadic and spotty with infested fields rarely having over 5 acres that suffer heavy yield reductions. Because of this spotty damage pattern, a farm with two or three five-acre peanut fields would more likely become highly infested (if infested at all) than a farm with 50-100 acres of peanuts in larger fields or a greater number of fields.

These small allotment farms represented a substantial majority in terms of numbers of farms in Alabama and Florida. Figures provided by the state ASCS offices of Florida and Alabama showed that in Florida 73 percent and in Alabama 63 percent of total effective farm peanut allotments were 20 acres or less in size during 1976. Hence, if effective WFB control measures were not available, a portion of the small scale peanut farmers could expect to experience relatively heavy losses on their peanut crop yields.

Yield Damage Due to WFB

Respondents from all three states estimated that white-fringed beetles did substantial damage to peanut yields when left untreated. Average percentages of normal yields that could be expected from WFB infested acreages are shown below for each state.

State	Percentage of normal yield on infested-treated acres	Percentage of normal yield on infested-untreated acres
Alabama	96	84
Florida	100	90
Georgia	96	84

Some respondents in Alabama and Georgia felt that even infested fields that were treated would experience some yield reduction. County extension workers who felt that untreated acres would still show a yield reduction, reported the following reasons for their answers: (A) reinfestation of fields from untreated field borders; (B) feeling that drill treatment at lower insecticide rate was not a completely effective control; and (C) yield reduction figure was an average of 5-year treatment duration, and control may break down the last 2-3 years of the period. The average of all counties included in the study area indicated that 97 percent of the normal yield could be expected from infested-treated acres.

On the percent of normal yield from infested-untreated acres, respondents from Alabama and Georgia again agreed and estimated that an untreated field would average 84 percent of normal yields.

Normal yields are those that could be expected from non-infested peanut acres. State average yields did not represent normal yields since the state encompassed both infested and uninfested peanut acres. However, from the information gathered in this study on acres of infestation and their corresponding yield reductions, normal yields could be calculated, Appendix A. Yields for 1975 were normalized, and 1975 normal yields were used in all calculations.

Value of Lost Production, 1975

An earlier statement was made that infestation estimates and yield reduction estimates were needed before any total losses could be calculated for WFB damage. Both of these estimates were obtained from survey results. When combined with a price for peanuts, WFB damage could be given an economic value.

The first estimate of economic damage was calculated from white-fringed beetle damage as it existed in 1975 – some acres treated and some left untreated. The purpose of these estimates was not to imply that chlordane could eliminate all of these losses. Rather, the purpose was to establish the white-fringed beetle as a serious economic pest of peanuts and show that effective WFB control could substantially reduce losses.

Present losses from WFB damage were calculated using 1975 price averages for each state. Since losses on both untreated and treated acreages were involved, separate dollar figures were found for each category, and they were summed to reach a total damage amount. Calculations for each state are shown on page 15.

Alabama

.16 (yield reduction factor on infested-untreated acres)	X	2,688 lb/a (normal yield)	X	$.196/lb[a] (average) price)	=	$84 a loss when left untreated
.04 (yield reduction factor on infested-treated acres)	X	2,688 lb/a	X	$.196/lb	=	$21/a loss when treated

$84/a loss X 35,020 a untreated	=	$2,941,680	loss on untreated acres
$21/a loss X 28,840 a treated	=	605,640	loss on treated acres
Total state loss	=	$3,547,320	

Florida

.10	X	3,330 lb/a	X	$.199/lb[a]	=	$66/a loss when left untreated
0	X	3,330 lb/a	X	$.199/lb	=	$0/a loss when treated

$66/a loss X 16,500 a untreated	=	$1,089,000	loss on untreated acres
$0/a loss X 11,000 a treated	=	0	loss on treated acres
Total state loss	=	$1,089,000	

Georgia

.16	X	3,376 lb/a	X	$.198/lb[a]	=	$107/a loss when left untreated
.04	X	3,402 lb/a	X	$.198/lb	=	$27/a loss when treated

$107/a loss X 62,800 a untreated	=	$6,728,160	loss on untreated acres
$27/a loss X 62,880 a treated	=	$1,697,760	loss on treated acres
Total state loss	=	$8,425,960	

[a] Source: Field Crops–Production, Disposition, and Value, May 1976, SRS, USDA

The above figures illustrate several important points that should be noted. First, white-fringed beetles cause a sizable amount of economic damage in each of the three states. Second, treatment of a WFB infestation could be expected to substantially lower the amount lost per acre. Third, even though the economic incentive is present, only about half of the infested acres in 1975 had been treated.

For the treatment cost of $2.50 per infested acre an Alabama farmer can expect an additional $63 return per acre, a Florida farmer $66 extra, and a Georgia farmer $80 per acre more than when not treating. Chlordane treatment is definitely economically feasible from the farmer's perspective.

All farmers do not treat their infested fields. Since pertinent information on reasons for not treating was not gathered in this study, the reasons can only be inferred. For quite a long time, USDA Plant Quarantine workers did much in the area of identifying and treating WFB infestations. Perhaps some farmers relied entirely on USDA advice and have not yet accepted responsibility for WFB control. Some may not have recognized that their problem is due to WFB damage, and others may not have realized the severity of their problem.

Much effort on the part of the Cooperative Extension Services was being directed toward educating the farmer on WFB identification and control. Several county extension personnel indicated that use of WFB control measures was on the increase in their counties, so the proportion of treated acres likely was greater in 1976 than in the previous year.

Value of Additional Damage Due to Loss of Effective Controls, 1975

Assuming the same level of treatment for 1976 that existed in 1975, the direct first-round additional damage attributable to cancellation of effective controls can be calculated. The full impact of these losses would be felt approximately 3 years after the last application of insecticide because of effective residual WFB control. Damages due to loss of control for each state are calculated below.

Alabama

$63/a (Value of average yield difference in treated and untreated infestations	X	28,840 a (acres treated in 1975)	=	$1,816,920 additional yield damage

Florida

$66/a	X	11,000 a	=	$ 726,000

Georgia

$80/a	X	62,880 a	=	$5,030,400

Three State Total Additional Yield Damage
Attributable to the Loss of Effective WFB Control = $7,573,320

Notice that the above figures were termed "direct first-round additional damage" attributable to the loss of effective WFB control. These were the full extra losses expected immediately after all residual control from the currently used insecticide was gone – approximately 3 years after control measures are ceased. If all treated acreage was not treated the very last year of insecticide use, there would also be losses to a lesser degree during the 2 years prior to the third year.

No attempt is made in this publication to predict the rate at which WFB infestations would spread and increase in intensity if the insect remains uncontrolled. However, both these changes might be expected to occur: present infestations could spread to other areas previously uninfested, and infestation levels could become worse in fields already infested, causing the yield reduction on such acres to increase. The increases in yield reduction and number of acres infested could cause second round losses to be greater than the first round effects.

Economic Impact

So far WFB damage estimates have been presented on a per acre and statewide basis; but these damages would have little macroeconomic consequences if peanuts were a crop of minor importance. In Alabama, Florida, and Georgia, however, such was not the case. Peanuts were extremely important to the local economies in areas of concentrated production, Appendix B.

In Georgia the peanut crop was very important to the state's economy in 1975 since it brought in more cash receipts than any other crop. Peanuts were even more important to the economies of the 36 Georgia counties which annually grew more than 5,000 acres of peanuts each. The economies of Alabama's southeast counties were heavily dependent upon cash receipts from peanuts. In Florida during 1975, peanuts represented only 1.5 percent of total cash farm receipts; but in Jackson County, Florida, peanuts made up 45 percent of its highly diversified agricultural income.

A loss of WFB control could have a substantial first-round impact on the economies of certain peanut producing counties. In Jackson County, Florida, for example, 6,000 of the 15,000 WFB-infested acres of peanuts were treated with chlordane in 1975. If chlordane were unavailable in this county, peanut farmers on the 6,000 acres could expect first-round losses of almost $400,000 because of WFB damage. This $400,000 reduction should not be considered as a stagnant loss, however. The farmers do not put the money they earn in a Mason jar and bury it in the back yard; they either spend or save it. If they spend the money, it in turn becomes profits or salaries for other people. If they save it in a bank, the bank loans it out to a borrower, the borrower invests or spends the money and the cycle begins over. The phenomenon is caused by the interrelationship of different sectors of the ecomony and it is called the "multiplier effect." Without going further into the theory of multipliers, it is sufficient to say that the total impact to a county's economy of a $400,000 loss in receipts would be substantially larger than the initial $400,000.

An absence of effective WFB controls could have more serious and permanent implications for the peanut industry than what has been presented to this point. So far losses from WFB have been shown as reductions in receipts. It was perhaps implied that these reductions meant a farmer made net profits of $125 rather than $200 per acre. He would then have less spendable income to reinvest in his farm operation or purchase consumer goods for his family. Reduced spendable income could possibly be the case; but what if WFB yield reductions caused his net profits to drop from $65 per acre profit to a $10 loss per acre? This possibility of WFB damage resulting in net losses per acre should not be ruled out.

Even though peanuts present an excellent opportunity for profits, they also require a substantial investment in production costs. In addition to fixed and variable production expenses, total cost estimates should include a charge for land and allotment rent. This cost may range from $75 to $175/a but a conservative average of $120 was used for calculation purposes. These high production costs caused "break-even" yields to approach high levels. In Alabama for example, total costs per acre for producing peanuts were approximately $410. At the price of $.196 per pound, a yield of 2,100 pounds per acre was required just to break even and cover all costs. Assuming the average yield reduction on untreated WFB infestations for Alabama (16%) and the normalized yield for the state (2,688 lb/a), the average yield on infested-untreated acres would be 2,250 lb/a. Therefore, in the case of the average farmer, he would still cover costs but make only a slight profit per acre.

It should be remembered that these estimates of yield damage were made during a time that control measures were available for white-fringed beetles. After 5 years of no controls, how widespread would white-fringed beetles be and what level of yield reduction would exist? Estimates would indicate the situation becoming worse rather than better. In the average farmer's case, percent of normal yields would only have to drop from 84 to 78 percent and the farmer would make no net profit at all. At this point he would be forced to cease peanut production in the long run.

White-fringed beetles can also do substantial damage to corn, cotton, soybeans, or vegetables if they are planted on infested land. At 1975 price levels, if peanuts were unprofitable because of WFB damage, there is serious doubt that any other field crop could have been grown profitably on the land without prior control of this insect pest.

Effects of Changes in Government Programs

All the previous calculations were based on 1975 prices and yields, and on the most current production cost estimates. Only speculation can be made about future changes in yields or in the costs of peanut production. Because of proposed revisions in the present national peanut program, probable areas of change would be support prices and number of allotted acres.

The 1977 peanut legislation that was proposed but not acted upon by Congress would have made such changes. The bill apparently was an effort to gradually move peanuts out from under the old price support program into a target price program with less governmental controls and payments. The proposed program contained two major revisions: (A) a slightly lower support price paid for production on a lower number (about ¼ lower) of allotted acres; and (B) U.S. peanut farmers growing unallotted peanuts and selling them at world market prices. A similar type program might reasonably be expected in the future.

If enacted, a program such as the one described above would have several pertinent implications. First, if the number of acres on which farmers receive full price support decreased, farmers will want as much profit per acre as possible on the reduced allotments. This is not possible in some areas unless white-fringed beetles are controlled. Furthermore, indications are that farmers should not expect increases in the level of support prices in the near future. Neither should they expect production costs to be reduced or even remain constant. With no increase in price for the product and a rise in production costs, the break-even yield in peanut production rises.

The second major implication of such a program deals with U.S. peanut farmers selling on the world market. A farmer could produce some amount (perhaps an unrestricted acreage) of nonallotted peanuts to be sold on the world market at world market prices. In mid-1976, the world market price was about \$250/ton (\$.125/lb). At \$.125/lb and under current production costs, break-even yield for Alabama would be 2,565 lb/a, 3,160 lb/a for Georgia, and 2,765 lb/a for Florida. Uncontrolled WFB infestations could easily put some farmers in all three states out of the world market.

When peanuts are sold as exports, they become a plus factor in our national balance of payments. Any acreages that cannot be grown for the world market because of uncontrolled WFB damage, would then be potential reductions in our national exports.

CONCLUSIONS

Are insecticides good or bad? Should all insecticides that pose possible danger to man and the environment be cancelled? Obviously these questions have no clear-cut, simple answers. There are pros and cons for the use of any pesticide.

All insecticides influence the environment to some degree. As the suffix indicates, the purpose of insecticides is to kill designated insects. Hopefully selected pests are the only things killed by an insecticide application. However, no insecticide is available that will have absolutely no ecological side effects. Insects do not live in an isolated environment, and the mere elimination of certain pests will affect other organisms of the environment. Hence, even under the best conditions, pesticide usage can be expected to have some repercussions–regardless of how small they may be.

More times than not, an insecticide is not so selective that it is only lethal to the target insects. Other pests or similar beneficial insects may be killed; or in the worst cases, the insectivide may harm livestock or humans. Both government and industry laboratories have expended much effort into investigating the potential dangers associated with specific insecticides. When an insecticide is determined to be potentially dangerous, serious consideration must be given to discontinuing its use. Often an insecticide has multiple uses, however. In these instances a decision must be made on whether to stop all uses or only specific uses on certain crops. The value of each use should be decided individually. As with pesticide usage, a discontinuance of pesticide use can also be expected to have repercussions or costs.

The above mentioned consideration should include an attempt to fairly weigh the health benefits to man and the environment against the costs resulting from a cancellation of the insecticide. These costs can take on many varied forms, some of which do not have easily determined dollar values. Initial increased costs can spread throughout economic system and influence a large number of people. Following the discontinuance of an insecticide, increased costs could arise from any of three possible production changes – (A) decreased productivity, (B) increased costs for maintaining productivity, and/or (C) lower production quality and value. Farmers, product consumers, and others would feel the effects of such changes.

This study attempted to look at some of the repercussions associated with cancelling the use of one insecticide on one crop. It provided only a small portion of the total information needed before a cancellation decision could be made. Similar information on other insecticides will be soon needed. If an effort is made to obtain such information before actual cancellation proceedings begin, there should be time to develop more useful data than if data gathering begins with cancellation action. Complete and accurate cost data promise to be a primary tool for determining wise usage of pesticides.

REFERENCES

(1) ARANT, FRANK SELMAN. 1951. "Insect Pests," *The Peanut, the Unpredictable Legume.* The William Byrd Press, Inc. pp. 235-240.

(2) BASS, MAX H. and F. S. ARANT. 1972. "Insect Pests," *Peanuts—Culture and Uses.* American Peanut Research and Education Association, Inc. pp. 408-410.

(3) HARLAN, D. P. and H. R. GROSS, JR. 1976. "Yield of Peanuts in Soil Treated with Insecticides for Control of White-Fringed Beetle Larvae," *Journal of the Georgia Entomological Society.* Vol. II, no. 2. pp. 126-30.

(4) HENDERSON, C. F. and L. J. PADGETT. 1949. *White-Fringed Beetles, Distribution, Survey and Control.* U.S. Department of Agriculture, Bureau of Entomology and Plant Quarantine. Report No. 779. pp. 2-13.

(5) HOLLINGSWORTH, H. S. and H. C. YOUNG. 1961. *Tests With Soil Insecticides Against White-Fringed Beetles in Outdoor Chambers at Florala, Alabama 1960-61 Results.* U.S. Department of Agriculture Entomology Research Division. Special Report Z-129. pp. 1-7.

(6) INGLETT, W. A. 13 August, 1976. Miller County Extension Chairman, Georgia Cooperative Extension Service. Personal telephone interview.

(7) PARRISH, WM. 19 July, 1976. Fertilizer and farm chemical dealer, Flower's Guano Company, Dothan, Alabama. Personal telephone interview.

(8) RONEY, M. H. 19 July, 1976. Houston County Extension Farm Agent, Alabama Cooperative Extension Service. Personal telephone interview.

(9) STEPHENSON, W. N. 12 August, 1976. Plant Quarantine Inspector, USDA, Dothan, Alabama. Personal telephone interview.

APPENDIX A

Normalized Yields

The concept of "normal yields" for the purposes of this study meant yields that could be expected under the absence of white-fringed beetle infestation and damage. Because state average yields include peanuts grown on WFB infested land as well as noninfested land, these yields were somewhat lower than normal yields would have been. From data gathered in this study, state average yields were normalized to determine what yields could be expected under the absence of white-fringed beetles.

Normalized yields were calculated as follows:

(1) Peanut acreage was broken down into three categories–uninfested, infested-treated, and infested-untreated–and each category was expressed as a percent of total peanut acreage.

(2) Each acreage category was multiplied by its corresponding percent of normal yields (taken from the study results).

(3) The products of the three categories are summed and this sum represents the *average percent of normal yields obtained on total acres* (assuming present levels of WFB infestation and damage).

(4) Dividing each state average yield by its corresponding average percent of normal yields equals the *normal yield* to be expected in the absence of white-fringed beetles.

Normalized yields based on 1975 data are calculated below.

Expected Alabama yields without WFB:

	% of total acreage		% of normal yield		Av. % of normal yield
uninfested	69	X	100	=	69
infested-treated	14	X	96	=	13.44
infested-untreated	17	X	84	=	14.28
	100%				96.72

$$\frac{\text{1975 state av. yield } 2{,}600 \text{ lb.}}{.9672} = \underline{\underline{2{,}688}} \text{ lb/a without WFB}$$

Expected Florida yields without WFB:

	%		%		%
unifested	50	X	100	=	50
infested-treated	20	X	100	=	20
infested-untreated	30	X	90	=	27
	100				97

$$\frac{3{,}230}{.97} = \underline{\underline{3{,}330}} \text{ lb/a without WFB}$$

APPENDIX A (continued)

Expected Georgia yields without WFB:

	%		%		%
uninfested	76	X	100	=	76
infested-treated	12	X	96	=	11.52
infested-untreated	12	X	84	=	10.08
	100				97.60

$$\frac{3{,}295}{.976} = \underline{\underline{3{,}376}} \text{ lb/a without WFB}$$

Therefore, the expected normal yield per acre (based on 1975 state average yields) would be as follows: Alabama, 2,688 lb; Florida, 3,330 lb; and Georgia, 3,376 lb.

APPENDIX B

CASH INCOME FROM PEANUTS EXPRESSED AS A PERCENTAGE OF CASH INCOME FROM ALL CROPS AND OF TOTAL CASH FARM INCOME FOR ALABAMA SAMPLE COUNTIES (1974), JACKSON COUNTY, FLORIDA (1975), AND GEORGIA (1975)

County or State	Percent of income for all crops from peanuts	Percent of total cash farm income from peanuts
Alabama a/ (total sample)	67	40
Coffee	73	29
Crenshaw	57	23
Dale	81	51
Geneva	41	26
Henry	85	70
Houston	61	45
Pike	75	39
Florida b/		
Jackson	60	45
Georgia c/	31	15

a/ source: Alabama Farm Income by counties, September 1975, Alabama Cooperative Extension Service in cooperation with Alabama Crop and Livestock Reporting Service.
b/ source: Prepared by the Jackson County Cooperative Extension Office Personnel.
c/ source: Georgia Agricultural Facts, Georgia Crop Reporting Service, SRS, USDA.