

THE IMPACT of DEMONSTRATIONS on FARMERS' ATTITUDES TOWARD **FERTILIZER**

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SUMMARY

The purpose of this publication is to report the results of a demonstration program in changing farmers' attitudes toward the use of fertilizer. The program studied was conducted in Miami County, Ohio, during the 1959 crop year. Field interviews were completed with 86 commercial farmers in Miami County before the demonstration program; 77 of these respondents were reinterviewed after the program was completed. Because it was felt necessary to control on as many factors as possible affecting fertilizer attitudes except the demonstration program, a "control" county was selected and 40 field interviews were completed before, and 37 interviews were completed after the demonstration program. No fertilizer demonstration plots were conducted in Champaign County, Ohio, the control county. Forty seven fertilizer demonstration plots were completed by farmers in Miami County in 1959. Major findings may be summarized as follows:

1. No significant changes in attitudes toward fertilizer, knowledge about fertilizer, or use of fertilizer could be measured as a result of the fertilizer demonstration program (utilizing data gathered from the farmer samples before and after the demonstration program). This finding is consistent with past investigations of information campaigns; no measurable change in attitudes, knowledge, or behavior has generally been found, at least over a relatively short period of time.

Aggregate data on total fertilizer tonnage sales (gathered separately from farmers' verbal reports) reported by fertilizer companies in Miami and Champaign Counties, however, indicated a change in farmers'

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fertilizer purchases. Reasons for the inconsistent findings between farmers' reported fertilizer use and aggregate sales data secured from fertilizer companies are difficult to explain, but may be partly due to (1) differences in measures of fertilizer use, and (2) differences in the exact time periods covered by the two sets of data (although both were gathered before and after the demonstration program was conducted).

2. Individual changes in attitudes toward fertilizer occurred during the demonstration program. Individual changes could take place although the aggregate balance of change was not significant. Those farmers whose attitudes became more positive had more education and tended to adopt farm innovations earlier.

3. Attitudes toward fertilizer, knowledge of fertilizer, and use of fertilizer were found to be interrelated. Knowledge of fertilizer acts as an "intervening variable" between attitudes and use of fertilizer, in other words, attitudes toward fertilizer are not as closely related to fertilizer usage at higher levels of knowledge about fertilizer as at lower levels of knowledge.

4. Farmers who soil test averaged 67 percent higher application of fertilizer nutrients on corn than did farmers who do not soil test. Soil testing acts as an intervening variable between attitudes and use of fertilizer. One way to decrease the negative effect of attitudes toward fertilizer on fertilizer use is to encourage farmers to test their soil.

INTRODUCTION

The American agricultural scene is typified by rapid social change. In 1930, one farmer supported 10 others and by 1960 one farmer supported 27 additional people. The efficiency of farming doubled in the past 15 years. However, if farmers were presently using the latest recommended practices, one farmer could support 45 people rather than 27.

One recommended practice that increases farm efficiency is the use of fertilizer. The trend in recent years has been toward a greater tonnage of fertilizer sold and a heavier application per acre. However, farmers are not yet approaching the recommended levels of economic fertilizer use. A nationwide study reported that 35 percent of U.S. farmers were not using commercial fertilizer.³ Agronomists and agricultural economists report that a vast majority of those farmers who are using fertilizer are not using it in optimum amounts. One study indicated that only nine percent of all U.S. farmers were using fertilizer

³National Analysts, Inc., A Study of Farmers' Attitudes Toward the Use of Fertilizer, Washington, D.C., National Plant Food Institute, 1958.

at the amount that would give them best returns in relation to other farm inputs.⁴

Extension workers as well as fertilizer salespeople have been greatly interested in raising the level of fertilizer use by American farmers. The present level of usage is still much below the optimum level most economical for crop production. However, increasing fertilizer usage is more than an economic problem. The farmer's attitudes toward fertilizer must be considered. It has generally been assumed that if one can change a farmer's attitudes toward fertilizer, a corresponding increase in fertilizer use will result. There is reason to believe, also, that a farmer's fertilizer use and his attitudes toward fertilizer are both affected by his knowledge about fertilizer. Knowledge about fertilizer may be an "intervening variable" since it affects the relationship between attitudes and use of fertilizer. An intervening variable is one which affects relationships between other related variables.

An understanding of the interrelationships of attitudes, knowledge, and use is important to those persons and organizations seeking to change farmers' levels of fertilizer application.

Demonstrations have long been recognized as a teaching method to encourage the adoption of farm innovations. The Extension Service conducted farm demonstrations as early as 1904 and Extension personnel make considerable use of the demonstration method today. This is especially true in the case of Extension teaching of agronomic practices. Little is actually known, however, about the effectiveness of demonstrations in securing adoption and in changing farmers' attitudes.

The National Plant Food Institute commissioned National Analysts, Inc.⁵ to study farmers' attitudes toward the use of fertilizer in 1958. One of the major objectives of this nationwide study was to determine the importance of demonstrations in securing the adoption of higher levels of fertilizer use by farmers.⁶ Their findings indicated:

1. Farmers relied heavily on neighbors and relatives for information on the use of fertilizer.

2. Demonstrations were named by 18 percent of the respondents as their chief source of information about what nutrients their crops needed. Only soil tests (39 percent) and own experience (34 percent) were more important than demonstrations.

⁴ibid.

⁵ibid.

⁶ibid.

3. Fifty four percent of the farmers said they thought demonstrations had some effect on farmers' use of fertilizer. Another 22 percent said it had a positive effect; only eight percent said it had no effect.

4. One fourth of the farmers said they had personally visited a fertilizer demonstration plot.

Wilkening and Santopolo found in North Carolina that "More than half of the non-demonstrators gave the name of a (TVA fertilizer) demonstrator as one of three or four persons visited most frequently." The names of demonstrators were given more often than the names of non-demonstrators as a source of information about improved farm practices.⁷

These studies have been concerned with demonstrations as a source of information about farm innovations, and with the usefulness of demonstrations as an incentive to adoption. None of the past research, however, has been concerned with how to change attitudes toward fertilizer or the use of fertilizer.

RESEARCH on ATTITUDE CHANGE

There is considerable sociological research on attitude change. One of the most prevalent types of research has been conducted in the experimental laboratory by social psychologists. These studies have indicated that in the experimental laboratory, attitudes can generally be changed by improving communication concerned with the particular attitude under study.

Maccoby and others pointed out that in field surveys, few attitudes appear to be changed by communication, while in experimental studies it is not uncommon for half or more of those exposed to a communication to be swayed by it.⁸ Therefore, a review of actual field studies are included in the present bulletin.

The National Opinion Research Council conducted research on the effect of an educational program to change attitudes toward the United Nations.⁹ They interviewed a random sample of residents in

⁷Eugene A. Wilkening and Frank A. Santopolo, *The Diffusion of Improved Farm Practices from Unit Test-Demonstration Farms in the Tennessee Valley Counties of North Carolina*, Raleigh, North Carolina Agricultural Experiment Station Mimeo Bulletin, 1952.

⁸N. Maccoby and others, "Critical Periods in Seeking and Accepting Information", Paper presented at Cincinnati, Ohio, 1959, American Psychological Association.

⁹Shirley A. Star and Helen MacGill Huges, "Report on an Educational Campaign: The Cincinnati Plan for United Nations", *American Journal of Sociology*, 55: 389-400, 1950.

Cincinnati, Ohio, in September, 1947, to determine the respondents' attitudes toward the United Nations. Immediately after the first interviews, a six months' educational campaign was launched through various newspapers, meetings, and other media. Eighty percent of the respondents interviewed in September were re-interviewed in March to determine attitude change. This "before" and "after" study indicated that the creation of interest is the first step in building public opinion and only thereafter will information be absorbed. Attitudes toward the United Nations did not change as a result of the information campaign.

Another before-after study of attitudes concerned the Bikini atomic tests in 1946.¹⁰ Random samples of the adult population of the United States were interviewed in June (before the Bikini tests) and in August (after the tests). The major finding of the Bikini study was that knowledge possessed by the public has a major effect upon attitude change.

A third longitudinal study on the effect of an educational campaign on attitudes toward mental health in Canada was completed by Cumming and Cumming.¹¹ A six month educational program in 1951 was designed to inform the residents of Prairie Town, Canada, about mental health. Questionnaires were administered to local respondents before and after the educational program. The data revealed no appreciable change in (1) beliefs about mental illness, or (2) attitudes toward the mentally ill. The researchers concluded (1) that mass media channels of communication were less effective in changing attitudes than group activities, and (2) that the respondents were motivated toward learning only what they felt was important to them.

Hyman and others attempted to determine why information campaigns fail.¹² Their evidence, obtained from national samples, indicated that people tend to expose themselves to information which is in agreement with their prior attitudes. Individuals also tend to avoid exposure to information not congenial with their prior attitudes. The authors listed five reasons why attitudes do not change with increased information: (1) there exists a hard core of "know nothings" who

¹⁰Leonard S. Cottrell, Jr. and Sylvia Eberhart, *American Opinion on World Affairs*, Princeton, N.J., Princeton University Press, 1948.

¹¹John Cumming and Elaine Cumming, "Mental Health Education in a Canadian Community", in Benjamin D. Paul (ed.), *Health, Culture and Community*, N.Y., Russell Sage Foundation, 1955, pp. 43-60.

¹²Herbert Hyman and others, "Some Reasons Why Attitude Campaigns Fail," *Public Opinion Quarterly*, 11:412-423, 1947.

are extremely hard to reach, (2) people who are already interested acquire the most information, (3) people seek information congenial to their prior attitudes, (4) people interpret the same information differently, and (5) information does not necessarily change attitudes. Hyman and others concluded that the success of campaigns does not rely simply on increasing the flow of information. Social and psychological barriers to attitude change must also be considered.¹³

The studies reviewed generally indicate that attitudes are very difficult to change and that interest and knowledge are crucial considerations before attitudes can be changed. A basic assumption throughout the present bulletin is that attitudes affect fertilizer use.

PURPOSE

The present bulletin is primarily concerned with reporting the effectiveness of a demonstration program in changing attitudes about the use of fertilizer. The objectives are:

1. To determine the extent of change in attitudes toward fertilizer as a result of a demonstration program.
2. To determine the extent of changes in knowledge about fertilizer and use of fertilizer as a result of a demonstration program.
3. To determine the extent to which attitudes toward fertilizer affect the relationship between knowledge and use of fertilizer.
4. To determine the characteristics of those farmers with attitude change.

METHODOLOGY

The present study utilizes an experimental design which permitted control on many factors which might have affected the findings. Two areas were chosen on the basis of their similarity. One of these was designated as the "treatment" area and the other was the non-treatment or "control" area. This is the same research design used by the agronomist when he measures the effect of fertilizer by applying it to one of two plots which are alike in all other respects. The difference in yield of the two plots is attributed to the effect of the fertilizer.

Two Ohio counties were chosen as the study areas. In the treatment county, an intensive fertilizer demonstration program was conducted. In the control county, there was no demonstration program. Figure 1 shows the research design for the present study. It was felt that a control county was needed due to the increasing use of fertilizer

¹³For example, see Walter McKain and others, Campaigns to Increase the Milk Consumption of Older Persons, Storrs, Connecticut, Storrs Agricultural Experiment Station Bulletin 344, (No date).

Before (1958)	After (1960)	
X_1 Attitude toward fertilizer in Miami County <u>before</u> demonstration program	X_2 Attitude toward fertilizer in Miami County <u>after</u> demonstration program	Difference $(X_2 - X_1)$
Y_1 Attitude toward fertilizer in Champaign County <u>before</u> demonstration program	Y_2 Attitude toward fertilizer in Champaign County <u>after</u> demonstration program	$(Y_2 - Y_1)$

Change in fertilizer attitudes due to demonstration program = $(X_2 - X_1) - (Y_2 - Y_1)$

$(X_1 - Y_1)$ = How well counties are matched

$(Y_2 - Y_1)$ = Changes occurring in attitudes without effect of demonstration program

Fig. 1.—Research design utilized in the present study

and more favorable attitudes toward fertilizer which would normally occur over a two year period. By utilizing a control county, the effect of other factors besides the main treatment (the demonstration program)¹⁴ could be reduced.

¹⁴For a complete discussion of the present design, see Samuel A. Stouffer, "Some Observations on Study Design", *American Journal of Sociology*, 55:335-361, 1950. It is not claimed that the present research design is any but the simplest type that includes a before-after measurement with a control; however, few of the studies reviewed in the previous section on attitude change featured both a before-after measurement and a control sample.

The “treatment” area was Miami County, located in West Central Ohio (Figure 2). Forty seven fertilizer demonstration plots were completed in this county. The control area was Champaign County, located just east of Miami County. No demonstration plots were located in Champaign County during the 1959 crop year. The extent of similarity of the two areas is shown in Table 1 for several important economic and social characteristics.



Fig. 2.—Location of treatment and control counties

Table 1.—Comparison of Respondents in the Experimental and Control Counties

Characteristics of Respondents	Champaign County	Miami County
1. Average number of acres farmed in 1958	188	156
2. Average number of acres owned in 1958	96.6	99.7
3. Percent farmers working off-farm more than 100 days	15%	31%
4. Years of education	9.6	9.5
5. Average age	44.7	49.1
6. Average social status rating	3.35	3.32
7. Fertilizer nutrients per acre on corn (in pounds)	116	105

In addition, both counties are generally similar as to soil type (Miami series), number of soil tests since 1950, main crops grown, location of fertilizer plants, and presence of ethnic groups.

THE SAMPLES

Interviews were conducted with respondents from both the treatment and control counties before and after the 1959 crop year (the year of the fertilizer demonstrations in the treatment area).

The “Before” Sample

Random area samples in both the treatment and control counties were selected and all farm homes in the selected areas (Figures 3 and 4) were contacted in December, 1958. Interviews were completed with all farmers operating 20 acres or more who could be contacted in three farm calls. The interviewers were undergraduates, graduate students, and faculty members in rural sociology. A training session was conducted for the interviewers to acquaint them with the research design and the interview schedule.

Eighty six farmers were interviewed in the treatment county (Miami). This was 3.8 percent of all farms in Miami County according to the 1955 Census. Forty farmers were interviewed in the control county (Champaign). This was 2.1 percent of all farms according to the 1955 Census. Hereafter, these samples will be referred to as the “treatment county before sample” and the “control county before sample” respectively.

Families in the sample areas not interviewed were those farming less than 20 acres, those not home after three interviewer calls, and refusals. Data were obtained as to existing attitudes and use of fertilizer, attitudes toward demonstrations, and other characteristics of the farms. The average length of the research interviews was about one hour.

The Treatment

During the 1959 crop year, 47 Miami County farmers carried out meadow and corn fertilizer demonstration plots.¹⁵ The plots on corn were at least eight corn rows in width across the field. Fertilizer was applied at three levels: (1) the farmers' normal rate of fertilization, (2) the amount recommended by soil tests, and (3) the soil test recom-

¹⁵Fifty-two farmers started demonstrations, however, five failed to complete them. For a complete discussion of the demonstration program see Everett M. Rogers and Frank O. Leuthold, *Demonstrators and the Diffusion of Fertilizer Practices*, Wooster, Ohio Agricultural Experiment Station Research Bulletin, (in press).

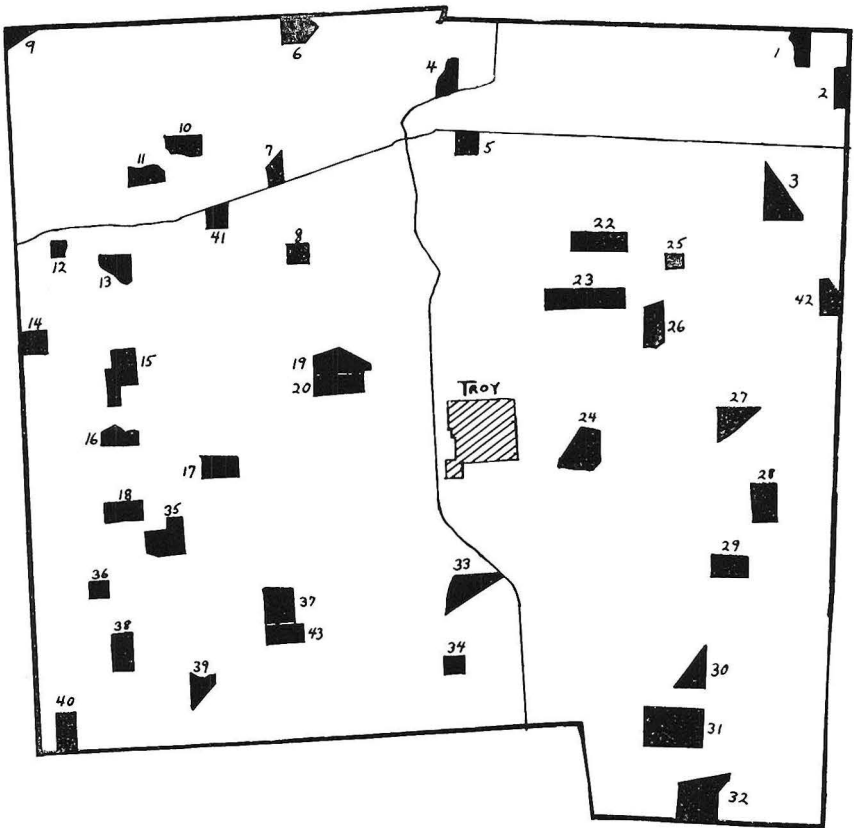


Fig. 3.—Sample areas in Miami County

mentation levels plus 50 pounds of nitrogen per acre. A kernel spacing of seven inches and a planting speed not to exceed five miles per hour were also specified for the demonstrators. Some farmers, in addition, also used their normal rate of kernel spacing along with their normal rate of fertilization to compare results between the two levels of plant population.

The fertilizer demonstration plots on meadow were at least four drill or spreader widths across the field. The crop preferred was alfalfa. Fertilizer was applied at two levels: (1) the farmers' normal rate of fertilizer, and (2) the amount recommended by soil tests.

The hay yield checks were made a few days before harvest. The corn yields were checked during October, before the corn was harvested.

Road signs were printed and placed on the farmers' demonstration plots in prominent locations in June, 1959. These signs were 28 inches by 44 inches in size with lettering in green on a bright yellow background.

In addition to road signs, other attempts were made to publicize the demonstrations. A May tour of hay and corn demonstrations on three farms was held. During August, a special tour of the two demon-

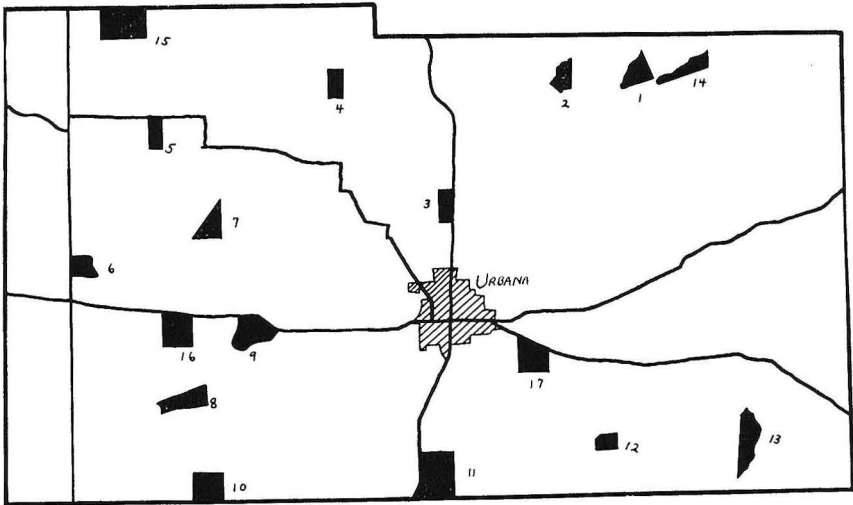


Fig. 4.—Sample areas in Champaign County

strations was held for fertilizer industry personnel. Corn yield tours were held in October for other demonstrators and the general public. A banquet for the demonstration farmers was held in November at which the results from the demonstration plots were presented. As a result of these publicity techniques, the majority (71 percent) of Miami County farmers were aware of the demonstrations.

The demonstration plots were the treatment in Miami County. The control county (Champaign) did not have demonstration plots. In order to determine the effectiveness of the demonstration plots and their concomitant effect upon farmers' attitudes toward fertilizer, both the experimental and control counties were restudied in 1960.

The Restudy Samples

During March and April of 1960, 77 of the original 86 farmers in the treatment county "before" sample were reinterviewed. Nine respondents could not be reinterviewed for the following reasons: (1) four refused to be reinterviewed, (2) four had taken non-farm jobs and



Photo 1.—Road signs 28 by 44 inches were placed on demonstration plots

were no longer engaged in farming, and (3) one could not be contacted after five visits to his farm.

Thirty seven of the original 40 farmers in the control county before sample were reinterviewed. Three could not be reinterviewed because they were no longer farming.

The Demonstrator Sample

The demonstrator farmers in Miami County were also interviewed after completing their demonstration plots. Demonstrators were selected by the Miami County Extension Agronomy Committee. The committee members nominated neighbors and friends they felt might be willing to cooperate in a demonstration program. The county agent sent those nominated a letter explaining the proposed demonstration program and a return postcard. The first 52 farmers to respond were included in the county demonstration program due to the limited size of the demonstration program.

The demonstrators were interviewed during December, 1959, after the completion of their demonstration plots, but before most meetings had been conducted on the demonstration results. The demonstrators in this program are probably somewhat similar to farmers selected as demonstrators in other demonstration programs.

MEASURING ATTITUDES TOWARD FERTILIZER

The present bulletin is concerned with farmers' attitudes toward fertilizer and factors related to these attitudes. Therefore, construction of an objective measure of attitudes toward fertilizer was necessary.

The attitude toward fertilizer scale consisted of eight items. Scale items two, three, four and five were used by Beal and Bohlen to determine farmers' attitude toward fertilizer.¹⁶ Item one was used by National Analysts, Inc.,¹⁷ in a nationwide study of farmers. Six of the eight items utilized were of a sentence completion nature. This type of projective technique was utilized in order to secure a more accurate response. Projective items are generally regarded as one method of avoiding bias from socially acceptable answers.

Judges were used to score responses to the attitude toward fertilizer scale. Three judges scored the scale item responses as either favorable, neutral, or unfavorable by using the criteria shown in Table 2. The judges were familiar with the fertilizer demonstration program and

¹⁶George M. Beal and Joe M. Bohlen, "Dealer and Farmer Attitudes and Actions Toward Fertilizer", Paper presented to National Plant Food Institute Chicago, February, 1958.

¹⁷National Analysts, op. cit.

Table 2.—Items in the Attitude Toward Fertilizer Scale

Scale Item*
1. As you may know, there is some disagreement as to whether commercial fertilizer or animal manure are best. If you had a choice between unlimited amounts of animal manure or commercial fertilizer for your farm, which would you choose?
2. If the cost per pound of nutrients were the same, which would you choose? Why?
3. Complete these statements in your own words. The thing I like most about fertilizer is _____
4. The thing I dislike most about fertilizer is _____
5. I'd use more fertilizer but _____
6. When I use fertilizer, the thing I worry about most is _____
7. I prefer low-analysis fertilizer because I _____
8. I don't always follow soil test recommendations because I _____
9. Some farmers say the chemicals in fertilizer have burned their crops. Do you think there have been harmful affects of fertilizer on crops?

*Each item was scored by the judges as favorable, 3 points; neutral, 2 points, unfavorable, 1 point.

the nature of attitudes toward fertilizer but not with the indentity of the respondents. Robinson's measure of agreement ("A") was utilized to determine the agreement among judges.¹⁸ The judges' agreement was generally high (Table 3) and indicates that relatively unstructured responses to projective questions can be independently scored with high agreement.

Reliability of the attitude toward fertilizer scale was determined by the test-retest method ($r = +.49$). Unidimensionality, determined by the Guttman technique, was 78 percent which is less than the 90 percent usually required. Internal consistency, as measured by item-to-total-score correlations, ranged from $+ .25$ to $+ .66$.

HOW WELL DID the EXPERIMENTAL DESIGN WORK?

Only three of the 37 respondents in the control county reported they had visited a demonstration program in the treatment county (while 55 of the 77 respondent in the treatment county were aware of the demonstrations). Two additional respondents indicated they had visited fertilizer demonstrations other than those in the treatment county. Therefore, a total of 13 percent of the respondents in the control county had visited fertilizer demonstration plots during the 1959 crop year.

¹⁸W. S. Robinson, "The Statistical Measure of Agreement", American Sociological Review, 22:17-25, 1957.

Table 3.—Agreement of Judges in Scoring Attitude Toward Fertilizer Responses

	Robinson's Measure of Agreement		
	Judge A	Judge B	Judge C
Judge A	—	.94	.91
Judge B	—	—	.85
Judge C	—	—	—

Several of the 1960 respondents indicated, when reinterviewed, that they had never been interviewed before about fertilizer (although they actually had been). It appeared that the “educational” effect of the 1958 interviews was minimal. The 1958 sample of farmers in both the treatment and control counties were not informed that the demonstrations were to be conducted, nor were they told that they were to be interviewed again at a later date.

In summary, five of the 37 respondents in the control county had contact with demonstration plots during the 1959 crop year. The educational effect of the original interviews appeared to be minimal on the basis of remarks made in the reinterviews.

CHANGES in ATTITUDES TOWARD FERTILIZER

The present study reports findings from a before-after study of changes in farmers’ attitudes, use, and knowledge about fertilizer in two counties of Ohio. Miami County, the treatment county, was exposed to a fertilizer demonstration program for one year. Champaign County, the control county, was not so exposed. Interviews were completed in both counties before and after the demonstration program. Therefore, it was possible to measure the respondents’ attitudes toward fertilizer prior to and after the demonstration program for both the treatment and control county.

Table 4 indicates that the change in attitudes toward fertilizer was negative but relatively small.¹⁹ The treatment county was characterized by less favorable attitudes toward fertilizer than the control county

¹⁹The attitude toward fertilizer scales administered in the 1958 and 1960 interviews were scored by the judges at the same time with identical criteria. Therefore, attitude change could not be attributed to the judging procedure.

both before and after the fertilizer demonstration. When average attitude toward fertilizer scores in Table 4 were tested by a two-way analysis of variance, no significant differences were found (1) between the respondents' attitudes before the treatment and after the treatment, or (2) for interaction between counties and years.²⁰

Table 4.—Average Attitude Toward Fertilizer Scores for the Treatment and Control County Before and After the Fertilizer Demonstration Program

County	Year		Differences in Average Score
	Before (1958)	After (1960)	
Treatment County	15.63	15.30	—0.33
Control County	16.32	16.20	—0.12
Differences in Average Scores	—0.69	—0.90	—0.21

Two possible reasons may explain the lack of attitude change. The relatively short period of time (16 months) between the before-after interviews may not have given a sufficient amount of time for a measurable attitude change to occur. Past research is consistent in indicating that attitudes do not change in measurable amounts during most opinion campaigns. An individual's attitudes are evidently quite stable and change only over a relatively long period of time and then only after considerable communication contact.

INDIVIDUAL CHANGE IN ATTITUDES TOWARD FERTILIZER

Although there was no significant change in attitudes toward fertilizer for the total sample of farmers in the present analysis, the data did not indicate that no change in attitudes toward fertilizer took place during the experiment. Twenty five farmers in the treatment county had a positive attitude change ranging from one to five points higher in their attitude toward fertilizer score. Twelve farmers' attitudes remained constant during the before-after interval as measured by the scale. Thirty eight farmers displayed a negative change in

²⁰F ratio for year is 0.44 and for interaction is 0.29 which is less than the 3.88 required for significance at the five percent level with one and 220 degrees of freedom. F for county is 4.35 which is greater than the 3.88 required for significance at the five percent level.

Table 5.—Relationship of Farmer Characteristics to Attitude Toward Fertilizer Change

Farmer Characteristics	Correlation	Level of Significance	Attitude Change Associated with:
1. Education	+.35	1%	High Education
2. Adoption-of-Farm-Practices Scores	+.24	5%	Early Adoption
3. Opinion Leadership	— .20	Not Significant	Not Associated
4. Social Status	+.07	Not Significant	Not Associated

attitudes toward fertilizer during the demonstration program in the treatment county.

Attitude change was not found to be related to contact with demonstrators in the treatment county. Analysis of variance indicated no differences in attitude change on the basis of audience contact or non-contact with demonstrators.²¹ Correlation between attitude change and contact with demonstrators (when regarded as continuous variables) was not significant.²² Contact with demonstrators had no direct effect on individual attitude change.

Do farmers whose attitudes toward fertilizer changed positively during the demonstration program differ from those farmers whose attitudes changed in a negative direction? The farmer who rents might be influenced by his landlord, either favorably or unfavorably, towards fertilizer. However, no significant difference was found between attitude change and owner-renter status.²³

Attitude change was not significantly related to knowledge of fertilizer (Figure 5).²⁴

Other characteristics of the farmers in the treatment county were related with attitude change (Table 5). Farmers with relatively more education had a more favorable attitude change, as did farmers who adopt new farm practices relatively early. Attitude change was not

²¹F is zero which is not significant.

²²Correlation is .07, which is not significant.

²³F is 2.66, which is less than the 3.98 required for significance at the five percent level with one and 75 degrees of freedom.

²⁴F is 1.25, which is less than the 3.98 required for significance at the one percent level with one and 75 degrees of freedom.

found to be significantly related to either opinion leadership or social status.

CHANGES in FERTILIZER USE REPORTED by FARMERS

Level of fertilizer use, measured by pounds of nutrients applied per acre on corn, was determined before and after the demonstration program for both the treatment county and the control county. Thus, it was possible to determine if the level of fertilizer usage (as reported by farmers) increased more in the treatment county than in the control county (Table 6).

Table 6 indicates that the change in fertilizer use was relatively small for both counties. When tested by a two-way analysis of variance, no significant differences were found (1) between respondents'

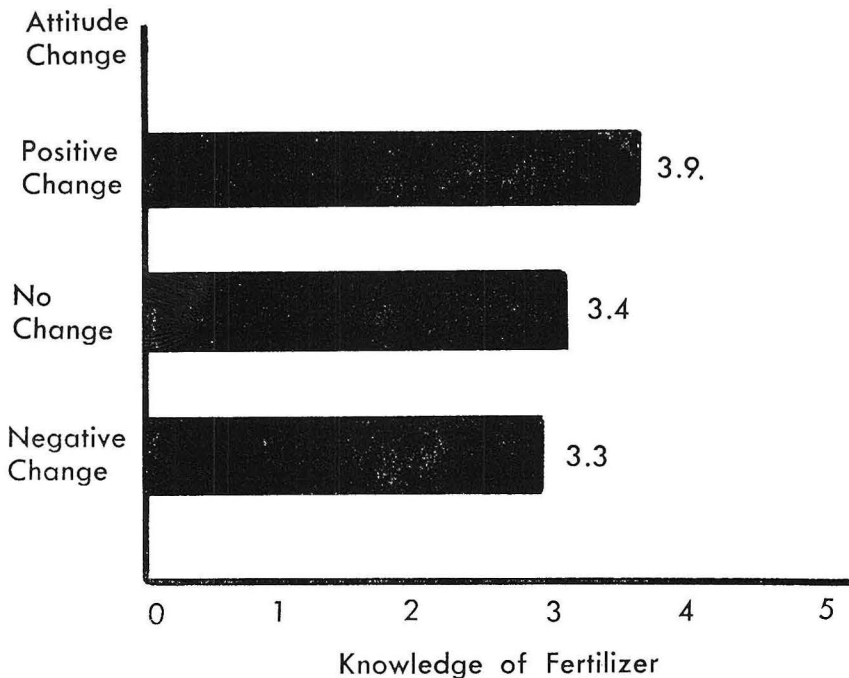


Fig. 5.—Relationship between attitude change and knowledge about fertilizer

Table 6.—Average Fertilizer Usage Reported by Farmers for the Treatment County Before and After the Fertilizer Demonstration Program

County	Year		Differences in Average Score
	Before (1958)	After (1960)	
Treatment County	104.9	109.2	+4.3
Control County	124.3	119.2	—5.1
Differences in Average Score	—19.4	—10.0	+9.4

use of fertilizer before and after the treatment, (2) between counties, or (3) for interaction between counties and years.²⁵

REPORTED by FERTILIZER COMPANIES

Another measure of fertilizer use was utilized in the present study in addition to that secured from the random samples of farmers in Miami and Champaign Counties. The aggregate tonnage of mixed fertilizer materials sold in both counties before and after the 1959 crop year was obtained from fertilizer companies (Table 7). The sales figures indicate a 44 percent increase in mixed fertilizer sales in Miami

Table 7.—Aggregate Mixed Fertilizer Sales Reported By Fertilizer Companies for the Treatment and Control County Before and After the Fertilizer Demonstration Program

County	Total Tonnage Fertilizer Sales		Difference in tonnage fertilizer sales	Percentage increase in tonnage fertilizer sales
	Before (Fall, 1958, and Spring, 1959)	After (Fall, 1959, and Spring, 1960)		
Treatment County	10,794	15,490	4,696	44%
Control County	11,240	13,374	2,134	19%

County, and a 19 percent increase in mixed fertilizer sales in Champaign County from 1958-59 to 1959-60.²⁶ A three percent increase

²⁵F for year is 0.02, for county is 2.11, and for interaction is 0.39, which is less than the 3.88 required for significance at the five percent level with one and 220 degrees of freedom.

²⁶The major fertilizer companies selling fertilizer in Miami and Champaign Counties were asked to provide these data on a confidential basis to the project staff.

per county occurred in Ohio during the same time period. Hence, it can be concluded that mixed fertilizer tonnage sales, as reported by fertilizer companies, increased more in the treatment county than in the control county or in Ohio.

Why did fertilizer use, as reported by farmers, not increase significantly as a result of the demonstration program while mixed fertilizer sales, as reported by fertilizer companies, increased as a result of the demonstration program? There are several possible explanations for these apparently inconsistent findings.

1. The measure of fertilizer use differed. The level of fertilizer use reported by farmers was measured in terms of pounds of nutrients applied per acre on corn. The measure of fertilizer use reported by fertilizer companies, of course, was in terms of aggregate tonnage sales in the two counties. The aggregate sales data do not indicate how much of the fertilizer sold was utilized on corn and how much on other crops.

2. The measures of change in fertilizer use covered two slightly different time periods although both were secured before and after the demonstration program. The farmers reported their fertilizer use for the 1958 crop season and planned for the 1960 crop season (when they were interviewed in the spring of 1960). The aggregate sales figures were reported by the fertilizer companies for the fall of 1958 and spring of 1959, and for the fall of 1959 and the spring of 1960.

Nevertheless, the inconsistent findings from the two sources of data on change in fertilizer use cannot be completely explained. There is a need for future research efforts to determine the relative accuracy of fertilizer use as reported by farmers and by fertilizer companies.

CHANGES in KNOWLEDGE ABOUT FERTILIZER

The degree of knowledge about fertilizer was determined before and after the demonstration program for both the treatment county and the control county.²⁷ It was possible to determine if the level of knowledge about fertilizer increased more in the treatment county than in the control county (Table 8).

Knowledge about fertilizer increased in both the treatment and control county,²⁸ but not by a significant amount.²⁹ The significant difference in knowledge about fertilizer from 1958 to 1960 indicates

²⁷Knowledge about fertilizer was measured by a six item scale. Typical items were, "If the price of a mixture of 3-12-12 is \$50 per ton, and the price of 6-24-24 is \$80 per ton, which is the best buy?" and "How may potash deficiency symptoms be recognized?"

Table 8.—Average Knowledge About Fertilizer Scores for the Treatment and Control County Before and After the Fertilizer Demonstration Program

County	Year		Differences in Average Scores
	Before (1958)	After (1960)	
Treatment County	3.08	3.52	+ 0.44
Control County	3.58	4.02	+ 0.44
Differences in Average Scores	-0.50	-0.50	0.00

that knowledge increased. However, there was no significant difference between counties. Therefore, fertilizer knowledge increased in both counties, but not as a result of the demonstration program.

KNOWLEDGE ABOUT FERTILIZER as an INTERVENING VARIABLE

The interrelationships among attitudes, knowledge, and use of fertilizer are shown in Table 9. Significant relationships exist between the three variables: attitudes, knowledge, and use. It was hypothesized earlier in the present publication that knowledge might be an intervening variable between attitudes toward fertilizer and use. The intervening effect of knowledge is diagrammed in Figure 6. Partial correlation was computed to determine if knowledge affects the relationship between attitudes and use of fertilizer.³⁰

²⁸Part of the increase in knowledge about fertilizer could have resulted from the educational effect of the first interview.

²⁹F ratio for county is 3.33 and for interaction is zero. These values are less than the 3.88 required for significance at the five percent level with one and 220 degrees of freedom. F ratio for year is 5.83 which is greater than the 3.88 required for significance at the five percent level.

³⁰Partial correlation is a technique whereby the effect of one variable is mathematically controlled (or removed) while examining the relationship between two other variables. In the present case, the effect of knowledge was mathematically controlled in order to determine the relationship between attitudes toward fertilizer and use when the effect of knowledge was removed.

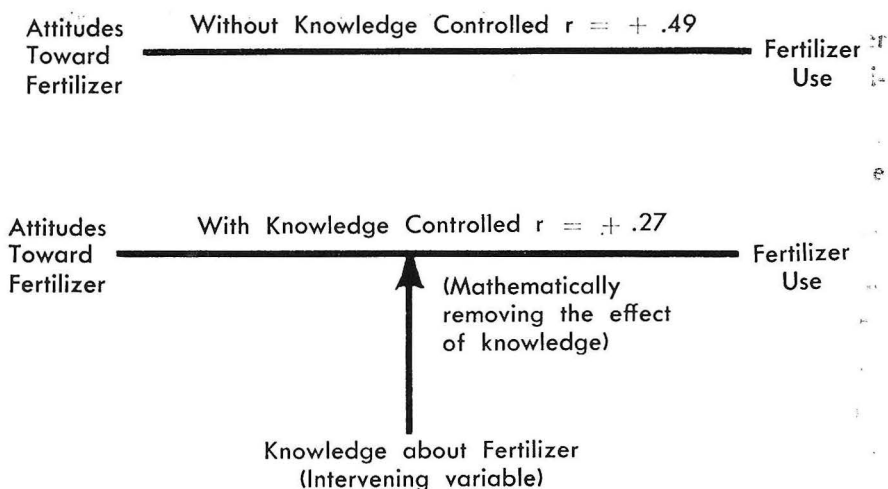


Fig. 6.—Intervening effect of knowledge on the relationship between attitudes toward fertilizer and use

Table 9.—Interrelationships Among Attitudes, Knowledge, and Use of Fertilizer

	Attitudes Toward Fertilizer	Knowledge About Fertilizer	Use of Fertilizer
Attitudes Toward Fertilizer	—	.45**	.49**
Knowledge About Fertilizer	—	—	.62**

**Significant at the one percent level

Figure 6 indicates that when the effect of knowledge about fertilizer is controlled the relationship between attitudes and use decreases from $+ .49$ to $+ .27$. When the difference in these two correlations was tested for significance, it was found that knowledge about fertilizer significantly affected the relationship between attitudes and use.³¹ In practical terms, this finding indicates that attitudes toward fertilizer are not as closely related to fertilizer use when knowledge about ferti-

³¹The standard score for difference between the two correlations is 21.58 which is greater than the 2.58 required for significance at the one percent level.

lizer increases. In other words, when farmers lack adequate knowledge about fertilizer, their attitudes (favorable or unfavorable) partly determine their fertilizer use.

SOIL TESTS AFFECT ATTITUDE and USE

Soil testing is one way in which farmers gain accurate knowledge about how much fertilizer is needed.³² Farmers who soil test were found to apply much heavier applications of fertilizer. The average pounds of fertilizer nutrients applied per acre on corn is 83.5 for the 23 farmers who do not soil test and 139.0 for the 48 farmers who soil test.³³ Those who soil test apply 67 percent more fertilizer nutrients per acre.

Does soil testing act as an intervening variable between attitudes and use of fertilizer? Table 10 indicates that there is no relationship

Table 10.—Soil Testing as an Intervening Variable Between Attitudes and Use of Fertilizer

	Farmers Who Soil Test (N=50)	Farmers Who do Not Soil Test (N=36)
Correlation between attitudes and use	.00	+.31**

**Significant at the one percent level.

between attitudes and use for farmers who soil test; however, for those who do not soil test, there is a significant relationship between attitudes and use.³⁴ This finding is particularly important for change agents who are striving to increase fertilizer usage. It appears that one way to decrease the effect that attitudes have upon fertilizer usage is to encourage farmers to test their soil.

³²Knowledge about fertilizer scores and soil testing are highly related. Correlation is .54, which is more than the .28 required for significance at the one percent level.

³³These data come from the original interviews in the treatment county with those 76 farmers who raised corn as their major crop.

³⁴In Table 10, N is 86 since all farmers interviewed could have soil tested. The ten farmers who do not raise corn as a major crop could soil test for wheat and meadow.

A SUGGESTED STRATEGY of CHANGE

The present bulletin has shown that attitudes, use, and knowledge of fertilizer are highly interrelated. It has also been demonstrated that knowledge about fertilizer is an intervening variable in the relationship between attitude and use of fertilizer. In a practical sense, the present study suggests a "dynamic" factor in changing fertilizer usage. The dynamic factor is knowledge about fertilizer. Since knowledge about fertilizer is probably easier to increase than a change in attitudes, change agents might utilize this indirect approach in attempting to increase the level of fertilizer usage.

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