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Acceptance and Diffusion of Hybrid Corn Seed in Two Iowa Communities

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CONTENTS

SUMMARY

This research constituted an analysis of the conditions and processes under which an important technical innovation, hybrid corn, was adopted in two prosperous agricultural communities in Iowa. Three general problems were studied: (1) the time pattern by which use of the seed spread; (2) the functions and importance of its diffusion agencies or media by which the seed spread; and (3) the relationship of characteristics (personal, economic and social) of farm operators to the rapidity with which they adopted the new seed.

1. During practically one decade hybrid corn came to be accepted by all farm operators in the areas studied.

2. The diffusion pattern was made up of three periods: (1) a long period of slow initial growth, (2) rapid rise in adoption and (3) a brief decline as the most resistant adopters accepted the technique.

3. Most operators deferred adoption of the seed until several years after they were familiar with its existence. Late adopters deferred much longer than did those accepting the seed early in the diffusion cycle.

4. The earliest adopters performed a special function for their communities in their roles as "experimenters."

5. Most adopters first accepted the seed in small quantities, gradually increasing their use as the years went by. Even late adopters usually went through such a period of trial use in spite of the currently larger plantings by those who had tried the seed earlier.

6. The diffusion media by which farm operators first learned of hybrid corn tended to differ from the media most influential in leading them to use it. This suggests a functional classification of diffusion agencies, as introductory and as activating media.

7. The major single source of original knowledge about hybrid seed was salesmen. The most influential single source of knowledge was "neighbors."

8. The importance of salesmen both as informants and influencers in the diffusion process was mainly during the early period of adoption, while the importance of neighbors was greater in the later years.

9. Size of farm enterprise, education, youthfulness and amount of social participation of the operator were all associated with early adoption.

10. Leadership in organized community affairs was not related to leadership in the adoption of the new technique.

11. Tenure status, mobility, extent of neighboring and nationality background had little or no association with time of adoption.

12. The associations of size of farm enterprise, education, age and extent of social participation with early adoption were in nearly all instances most pronounced when the latest and the earliest adopters were compared.

13. The forms of social participation associated with early adoption indicate a greater susceptibility to technological innovation among farm operators who had a more secular pattern of social life.

14. The analysis suggests that those members of an agricultural community most responsive to secularized contacts may represent a social type also most responsive to innovation in agricultural practice.

Acceptance and Diffusion of Hybrid Corn Seed in Two Iowa Communities[1]

By Bryce Ryan[2] and Neal Gross[3]

The development and diffusion of hybrid corn is already an epic in the history of scientific agriculture. Emerging from the experimental stages about 1927, this new seed was in practically universal use among Iowa farmers a little over 10 years later. Compared with many other scientifically approved practices its acceptance has been extremely rapid and complete. As in most instances of cultural or technological change, individuals varied in the date at which they took up the new technique. Although suprisingly rapid in its over-all diffusion, hybrid seed was in use by some Iowa farmers a full 10 years or more before being used by other farmers.

For the student of cultural change, a striking problem lies in the remarkable success of this diffusion. Equally challenging is the problem of why some farm operators turned to the new seed very quickly while others delayed such action. In its broadest implications the latter is an inquiry into the nature of technological conservatism and its antithesis. This study is related to both these issues. An attempt is made to describe the cultural conditions under which this new technique rose to phenomenal success, and to ascertain, if possible, conditions under which farm operators in two Corn Belt communities in central Iowa accepted readily or resisted the innovation.

OBJECTIVES AND HYPOTHESES OF THE STUDY

This research had the following basic purposes:

1. *To determine the time sequence of hybrid seed diffusion in the two communities.* Whereas not one farm operator in the areas studied had adopted hybrid seed in 1926, every commercial operator was planting it in 1941. What was the shape of the diffusion curve? How long a period elapsed between the introduction of the trait and its "community acceptance"? What distinctive periods were revealed as diffusion progressed?

[1]Projects 776 and 860 of the Iowa Agricultural Experiment Station. The authors are indebted to a number of individuals who have helped with certain phases of the study. Prof. C. A. Anderson of the University of Kentucky and Prof. R. E. Wakeley of Iowa State College offered numerous constructive suggestions and criticisms in the development of the study; Profs. C. W. Brown, P. G. Homeyer, O. Kempthorne, R. J. Jessen and J. A. Nordin of Iowa State College advised on certain aspects of statistical methodology; Prof. J. L. Robinson and Prof. J. C. Cunningham provided invaluable information on hybrid seed corn.

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2. *To determine the patterns of acceptance of individual farmers.* Questions arise as to whether farm operators fully accepted, partially accepted or merely experimented with the new seed when first planted. What were the time lapses between the year in which farm operators first heard of and the year in which they first adopted the new seed? Did such variations have any significance? Did most farmers follow a similar acceptance procedure? What benefits were derived by later adopters from the earlier acceptors?

3. *To determine the different functions and the relative importance of the various media diffusing knowledge of hybrid seed corn.* What was the relative effectiveness of the various informational channels? Did different media hold different functional roles in this process? Did the efficiency of different diffusion agencies vary over different periods in the adoption process?

4. *To determine whether rapidity of acceptance was related to certain personal, economic and social characteristics of the operators.* A major part of the study is devoted to determining the different characteristics of the farm operators adopting the seed at different stages in the diffusion process. What factors, personal, social and economic, were related to resistance to this technical innovation?

It is further necessary to state the hypotheses upon which the research was conducted. These were:

1. That the temporal diffusion pattern of the adoption of hybrid seed was characterized by three distinctive sequential periods—namely, slow initial growth, followed by a rapid rise in the rate of adoption and a final short period of decline;
2. That farm operators in general did not accept technological innovations immediately, but rather delayed acceptance for a considerable time after initial contact with the innovation;
3. That earlier adopters, however, waited a shorter period after initial contact with the innovation before acceptance than later adopters;
4. That earlier adopters performed a special function for the community in their roles as "experimenters" in technological innovation;
5. That diffusion agencies varied in importance over different periods of the diffusion process;
6. That diffusion agencies had different functions in the diffusion process;
7. That rapidity of adoption of the innovation was related to certain personal, economic and social participation characteristics of the farm operator;
8. That "leadership" in the adoption of farm practices was not related to other leadership roles in the community—in short, that leadership was situational.

The first hypothesis allows for the testing of Chapin's "S" curve of cultural change in an agricultural setting.[4] Whereas several researches have been concerned with diffusion processes on the state and national level,[5] this study may be viewed as an intra-community analysis.[6] In contrast to most studies in this field, the data for this study were derived from firsthand contact with the people involved.

The primary nature of the data of this study made it possible to develop and test the other hypotheses. These hypotheses simply represent the "hunches" of the investigators concerning the answers to a number of important questions about the acceptance of technological innovations in agriculture. The explanation of the derivation of hypotheses is at best a highly tenuous matter.[7] Yet it is certain that the experiences of extension and research workers in agriculture, as well as the literature pertaining to the problems analyzed, have provided hints leading to the hypotheses of this study. In addition as the investigation proceeded into the field work stage, unforseeable problems and new materials relevant to the study appeared. Wherever possible these unanticipated matters were included within the range of inquiry.

WHAT HYBRID CORN IS

Prior to the development of hybrid corn seed, corn in Iowa was open pollinated.[8] This means that pollination occurred in a random manner, making it impossible to identify the male parent plant. Under such conditions the farmer normally retained part of his own crop for seed. The genetic background of such seed was of course only partially known, and accurate prediction of performance was quite impossible. To overcome the difficulty of such rule-of-thumb methods of seed determination, a technique was developed for controlling the pollination process. This involved the inbreeding of plants. Hybrid seed is the product of crossing inbred lines.[9]

SIGNIFICANCE OF HYBRID CORN

The economic position of corn is outstanding in the North Central agricultural region. Hence the development of a genetically and

[4]F. S. Chapin. Cultural Change. The Century Co., New York. 1928.

[5]E. C. McVoy. Patterns of Diffusion in the United States, Am. Soc. Review, vol. V, April, 1940, p. 219-27; R. V. Bowers, Differential Intensity or Intra-Societal Diffusion, Am. Soc. Review, vol. II, Dec., 1937, p. 21-31; and H. R. Pemberton, The Curve of Culture Diffusion Rate, Am. Soc. Review, vol. I, Aug., 1936, p. 547-56.

[6]See C. R. Hoffer, Acceptance of Approved Farming Practices Among Farmers of Dutch Descent, Mich. Agr. Exp. Sta., Spec. Bul. 316, June, 1942, for another attempt to study factors related to differential acceptance of an approved farm practice.

[7]M. R. Cohen and E. Nagel. An Introduction to Logic and Scientific Method. Harcourt, Brace and Co., New York. 1934.

[8]For a non-technical discussion of the distinctions summarized here see Technology on the Farm, USDA, August, 1940, Chap. 21. Also, J. L. Robinson, The Story of Hybrid Corn. Iowa Agr. Ext. Serv., Circ. 234.

[9]For a clear discussion of this process see G. F. Sprague, Production of Hybrid Corn, Iowa Agr. Exp. Sta. and Iowa Agr. Ext. Serv., Bul. P48. Hybrid corn in the sense used here refers to hybrid seed, not to corn produced from such seed, which is less suitable for seed purposes.

economically superior seed type was a scientific achievement of great economic consequence. The qualities making hybrid superior to open-pollinated varieties were several. Basically, of course, the new seed offered greater corn yields.[10] Estimates of this difference vary, but it is not unreasonable to say that hybrid seed generally increased corn production by at least 20 percent.[11] In the early years of hybrid seed this increased productivity was considerably less.

But it was not increased yield alone that made hybrid corn desirable. It had also the advantage of a stronger stalk than that found in older varieties. This has had special significance from a technological standpoint, since ability to "stand" is a prerequisite for effective use of mechanical pickers.

Unquestionably from a genetic and agronomic standpoint the superiority of hybrid seed has been great, and this has been the case since at least the early thirties. Failures of the seed were relatively few, and usually resulted from an improper selection of seed for use in a particular locality. (The different strains of hybrid are localized to some extent for use in the general area for which they are designed.) In some years, in some areas, it may have been that inferior seed was actually sold, although there is no evidence that this is true for the communities studied. In these communities hybrid seed of high quality was produced locally.

It could of course be true that hybrid seed was genetically superior and at the same time economically unprofitable. Such a condition would place serious limitations upon this study. However, every evidence points to the economic superiority of hybrid seed from a very early date. Even in the early years of the diffusion when hybrid seed was much less productive than in later years, it can be demonstrated that simply in terms of yield alone, use of hybrid corn was economically sound.[12]

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[10]See Iowa Corn Yield Test, annual bulletin of the Iowa Agricultural Experiment Station. For a summary description of hybrid characteristics see also Technology on the Farm, op. cit., Chap. 21.

[11]A. A. Dowell and O. B. Jesness, Economic Aspects of Hybrid Corn, J. Farm Econ., vol. XXI, No. 2, 1939, p. 479, estimated a 15 to 20 percent increase. The late Iowa Corn Yield Test reports have included no open-pollinated lines, but in the 1939 report the advantage of hybrid over open-pollinated ranged from 8 percent to 32 percent in different districts.

[12]To test the profitableness of hybrid seed the following formula was constructed:

$$ER = (Pc \times I) - \frac{(Ps - Vo)}{A}$$

ER—Extra Returns per acre when hybrid seed used
Pc—Price of corn on market
I—Increase in output when hybrid seed used per acre
Ps—Price of bushel of hybrid seed
Vo—Value of farmers' own open-pollinated seed per bushel
A—Acres a bushel of hybrid seed would cover

Thus in 1930 when the price of a bushel of round-kernel hybrid seed was $10 and assuming that the value of a bushel of a farmer's own open-pollinated seed was 50 cents, and knowing that on an average an acre planted in hybrid seed would yield at least 6 more bushels of corn than an acre planted in open-pollinated, and knowing further that a bushel of hybrid would plant approximately 7 acres, we find there would have been $2.84 per acre profit extra by using hybrid seed rather than open-pollinated. In the year 1932, the year of lowest corn prices, 57 cents per acre more would have been obtained through the planting of hybrid seed. It should also be remembered that hybrid also had superior ability to stand and to resist drouth even at these early dates.

THE DATA FOR THE STUDY

This study rests largely upon the results of a field inquiry made in the summer of 1941. An extensive schedule of questions was used to obtain the required data from practically every farm operator in two central Iowa communities.[13] These communities, 15 miles apart, are located in the central cash grain area of the state. Both are typically rurban, and they represent fairly well the prosperous and commercialized agricultural communities in central Iowa. Schedules were analyzed for 331 operators. Since 64 of these had started farming after hybrid corn had come into use, this group has been treated separately. Ten other schedules were eliminated from the study because the operators could not be considered commercial farmers. Most of these operators had less than 20 acres of corn. The bulk of the analysis rests, therefore, upon 257 farm operators, all of whom operated throughout the diffusion period.[14]

Beyond these statistical data, secondary materials such as census materials and township assessor records have been used in order to understand the environment within which this local diffusion took place.

CERTAIN METHODOLOGICAL CONSIDERATIONS

LIMITATIONS OF THE UNILATERAL ECONOMIC APPROACH

Topically this analysis would belong in the field of diffusion research. But the processes of diffusion cut across many theoretical frameworks, and the present focus is not upon the distributive aspects of the spread of hybrid corn.[15] Rather the emphasis is primarily on the problems of and resistance to cultural change. Unlike many investigations, however, the change studied is purely technological, involving none of the culture lag concepts and few of the emotional resistances common to many instances of culture change.[16]

This inquiry provides a field of exploration in the relatively unexplored borderline between economics and sociology. The influence of sociological factors upon essentially economic decisions has long been recognized. In the present study hybrid corn has been used as a vehicle for empirical analysis of the influence of sociological factors upon a decision which is primarily an economic

[13]These are the communities of Grand Junction and Scranton in Greene County. For additional data on the sociological structure of these communities see C. Arnold Anderson and Bryce Ryan, Social Participation Differences Among Tenure Classes in a Prosperous Commercialized Farming Area, Rural Sociology, March, 1943, p. 16-24.

[14]Ideally we should reproduce the 1930 to 1940 populations of the communities. This is obviously impossible. The nearest approach to this, in 1941, was to include in-migrant replacements, and exclude beginning farmers. This results in curtailment of the upper age group in so far as retirement occurred for which replacement was by inexperienced operators. The sample is, further, exclusively composed of commercial farmers, as the area is almost exclusively one of commercial operation and the advantages of hybrid seed might be incomparable between commercial and noncommercial producers.

[15]This has not been attempted even on the intra-community level, since some operators had moved into the localities studied after adopting hybrid seed.

[16]William F. Ogburn. Social Change. Viking Press, New York. 1922.

one. On theoretical levels this problem has been defined from various viewpoints. Durkheim's concept of "the institution of contract" and Pareto's treatments of the "logical" and the "non-logical" are outstanding examples.[17] Most of these contributions, however, have defined or amplified theoretic frameworks of study rather than providing generalizations applicable to actual behavior.

This area has also been approached from the field of economics. Institutional economists have operated within this sphere, largely in revolt from certain unrealistic assumptions underlying classical economic theory. Veblen[18] offers classic analysis of the institutional aspects of certain forms of economic behavior, and more recently Parsons has emphasized the essential unreality of any attempt to divorce economic behavior from its cultural context.[19] The aspects of behavior studied here include, by definition, elements outside the assumptions upon which classical economic theory is based. Interestingly enough the area has been approached by some theoretical economists, through the concept of "uncertainty," an element imputed into economic decisions. However calculatingly even measurable uncertainties are ascertained, the actor must, as Knight points out, include in his judgment an estimation of that judgment.[20] The concept of "uncertainty" is thus a concept that can hardly be considered apart from the social and psychological forces affecting economic judgments.

Thus from diverse and even conflicting theoretical positions, an extra-economic climate has been postulated within which economic decisions take place. Just how sociological elements affect specific economic decisions is a question of both theoretical and practical significance. The trait of hybrid seed offers an exceptionally good means of entering this broader field. Its attributes are such that an exercise of full rationality, in the economic sense, would have caused all farmers to accept it at about the same time. While it would be difficult to place a date at which the perfectly rational man would have adopted hybrid seed, under the assumptions of classical economic theory, the adoption date would have been practically the same for all farm operators. That is, variations in the *rational* desirability of the seed between farmers were at a minimum—the trait was economically advantageous to all, and to much the same degree.

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[17]See particularly Talcott Parsons, The Structure of Social Action. McGraw-Hill Book Co., New York. 1937. In the field of sociology there are a number of monographs showing the influence of cultural milieu upon acceptance of innovations, notably W. M. Kollmorgen, "The Old Order Amish of Lancaster County, Pennsylvania", and C. R. Hoffer's "Acceptance of Approved Farming Practices Among Farmers of Dutch Descent," Michigan Agr. Exp. Sta., Sp. Bul. 317, 1942. The studies of T. N. Whitehead and others on the relationship of sociological factors to industrial efficiency are, of course, classics in this field.

[18]T. Veblen. The Theory of the Leisure Class. Huebsch, New York, 1919.

[19]See Talcott Parsons, op. cit.

[20]F. H. Knight. Risk, Uncertainty and Profit. London School Reprints of Scarce Works, No. 16 (1933).

This discussion suggests the hypothesis that variations in the date at which the seed was adopted were due in large part to non-economic factors. Thus if Farmer A adopted the seed in 1932 and Farmer B in 1939, and both were operating very similar farm enterprises, this study suggests that the answers to the problem of differential acceptance may be found in the realm of non-rational behavior. Either Farmer A was acting on the basis of too little evidence for a theoretically pure rational judgment, or Farmer B resisted the seed well after its demonstrated economic desirability, or both. Thus variations in acceptance date may be largely due to factors outside the framework of classical economic theory.[21] In this situation there must be a violation of one or more basic premises, such as acting in accordance with self-interest, lack of perfect knowledge, etc. Further there may be certain determinants of a non-economic nature, such as fear of the new, emotional attachment to old techniques, etc. While this inquiry does not attempt to systematically isolate such factors, the basic assumption is that conditions other than those hinging upon rational self-interest were operative in the time span of acceptances.

POSSIBLE LIMITATIONS TO ACCEPTANCE OF THE PRACTICE

Factors other than those conventionally defined as sociological might have influenced the timing of the decision to use hybrid seed. Three of these seem particularly worth noting: the availability of seed, the availability of cash or credit with which to purchase seed, and ignorance of the seed's existence. These all are objective determinants more or less outside the control of the actor. These, as truly as pure traditionalism, are factors outside the framework of rational behavior. Recognition of these possibilities at the outset of the study made it possible to take them into account in securing information from the farm operators.

Not one of the farmers interviewed attributed any delay in adoption to his inability to purchase the seed, either through lack of money or credit or because of the seed's unavailability.[22] In the communities studied these obstacles apparently did not exist. As for ignorance of hybrid corn, it is true that not all farmers were equally informed at an early date, and there were wide differences in extent of knowledge. However, ignorance of the development could not have retarded many operators, since about two-thirds of the farmers had heard of it before 1932. The following analysis will show that more than 95 percent of the operators had heard of it by 1935, although less than 25 percent had used it before that date.

[21]It is recognized that the indifference curve analysis and recent theoretic efforts to break out of the static analysis in economics have improved the shortcomings of certain phases of economic theory. However, in general, the limitations noted above still exist.

[22]In some instances landlords may have hindered the acceptance of hybrid seed by tenants. See section on "Background of the Diffusion."

Thus these limiting factors appear to have been at a minimum. The seed was a sound investment, recognized as such by a few from the outset, but by the majority only after years of observation and "mulling over." In any event the situational limitations to the adoption of the seed were so few that the relative date of acceptance becomes a fairly reliable measure of conscious "resistance."[23] It is no misuse of terms to label the least resistant farmers as "leaders" in the introduction of technological change. These leaders probably were less affected than others in their economic judgment by non-rational determinants. Certainly farmers refusing to accept hybrid corn even for trial until after 1937 or 1938 were conservative beyond all demands of reasonable business methods.

DEFINITION OF ACCEPTANCE

It was apparent in the early stages of the investigation that the word "acceptance" would have to be clearly defined. How much hybrid seed did an operator have to plant before he was an acceptor of the trait? Instead of taking some arbitrary percentage of corn acreage as the point where acceptance began, it was decided that for the purpose of this study it would be most meaningful to say that acceptance began in the year in which the farm operator first planted any hybrid seed. Thus, even though an operator planted less than 5 percent of his acreage to hybrid seed the first year, for the purposes of this study he is defined as an acceptor. Acceptance thus takes on the meaning of willing-

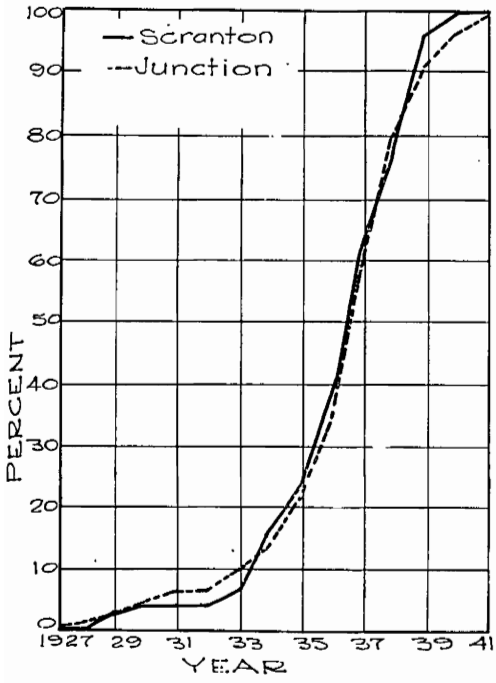

Fig. 1. Cumulative percentages of operators accepting hybrid seed in the two communities during each year of the diffusion process.

[23]Resistance is here used in the sense of volitional rejection of the superior seed in favor of an inferior predecessor well entrenched in the patterns and technicways.

ness to at least try the innovation. However, attention is also directed in this study to the relative proportion of corn acreage farmers placed in hybrid each year after acceptance.

COMBINING THE TWO COMMUNITIES

Although previous studies of the two communities by the Sociology Subsection of the Iowa Agricultural Experiment Station had shown their similarities in economic and social characteristics, it was also necessary to demonstrate the similarity of the diffusion pattern of the two communities before they could be combined for analytical purposes.

Figure 1 shows the high degree of similarity between the cumulative acceptance curves of the two communities. In 1933 there was only a 3 percent difference between the curves of the two areas, while the variations in 1930 equaled less than 1 percent. Therefore, the similarity of the diffusion patterns plus the likeness of economic and cultural background data justified combining the two communities. This procedure provided a larger number of cases for the analysis.

BACKGROUND OF THE DIFFUSION

The speed with which hybrid seed became a factor of national importance is well illustrated in table 1. Whereas hybrid seed was inconsequential in 1933, 10 years later it was planted on about one-half of the nation's corn acreage. While the dominance of hybrid was characteristic only of the Corn Belt, advances were made in every part of the nation.[24] The position of Iowa throughout the decade was clearly one of leadership, even when contrasted with the other major corn producing states. In 1939, when less than 40 percent of the Corn Belt's corn acreage was in hybrid, almost 75 percent of Iowa's corn land was planted in the new seed.

Within Iowa acceptance in different areas progressed with somewhat different rates of speed. Hybrid corn was most rapidly

[24]USDA mimeo release, "Hybrids Dominate Corn Acreage," July 10, 1943.

TABLE 1. PERCENT OF CORN ACREAGE PLANTED WITH HYBRID SEED BY YEAR FOR THE U. S., THE CORN BELT AND IOWA.*

Area	Year									
	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942
U. S.	0.1	0.4	1.1	3.1	7.9	14.9	22.5	30.4	39.1	45.7
Corn Belt	0.2	0.6	1.9	5.1	12.9	25.4	38.6	51.8	64.9	72.9
Iowa	0.7	2.1	6.0	14.4	30.7	51.9	73.4	90.3	96.9	98.9

*From USDA release, op. cit.

adopted by operators in the eastern area of the state, and most tardily by those in the southern and western portions of the state.[25] The communities under observation, located in the central cash grain area, were somewhat ahead of the state as a whole, and were highly representative of the area of which they are a part.

Any attempt to understand the spread of hybrid seed must take into account a number of factors external to the farm operator but of possible significance to the diffusion process. In the following section some of the more important conditioning factors are briefly analyzed.

EFFECTS OF ECONOMIC AND CLIMATIC CONDITIONS

The years in which hybrid seed was entering its period of commercial usefulness were years of economic depression and intermittent drouth. While these conditions were themselves related, they probably had separate and in part opposite influences on the spread of the new seed. From the standpoint of economic rationality, it might be expected that producers would search more diligently for efficient techniques under the pressure of economic stress. But such a response would be counterbalanced to some extent by other considerations. The use of hybrid seed required a cash outlay (frequently over $9 per bushel). In contrast, the use of open-pollinated corn required no cash expenditure, since a farmer's previous crop provided the current year's seed. During years in which farmers had no assurance that they would "break even," there was a strong tendency to avoid increased cash expenditures. It would of course be debatable to what extent this resistance was actually due to direct economic stress, and to what extent due to the psychological impact of depression and market uncertainties.[26] But whether due to objective circumstances or to the psychological impact of uncertainty, cash was carefully held back and additional commitments avoided. In total effect, it seems more reasonable to view the depressed agricultural economy as a retarding factor, rather than an impelling one.

While drouth added to the economic hardships of Iowa farmers in the thirties, its influence upon the adoption of hybrid seed must be considered separately. Like depression conditions, drouth influences were probably conflicting and are difficult to assess. For practical demonstrations of the hardiness of hybrid corn, the drouth years were opportune. The clear-cut superiority of hybrids in withstanding rigorous weather impressed many farmers.[27] But in two

[25]This difference was probably due to climatic and short-time economic conditions. See Bryce Ryan, "A Study in Technological Diffusion," Rural Sociology, vol. 13, No. 3, 1948, pp. 273-285.

[26]For example, in the two communities studied, both of which are well above the average in economic status, no operators attributed their delay to lack of money. Nor did any of them attempt unsuccessfully to obtain credit for purchasing hybrid seed.

[27]This fact was quite evident from the field investigation.

ways drouth operated negatively as well. First, drouth contributed to economic distress and uncertainties, thus enhancing the retrenchments in investments. Second, the production of hybrid seed itself was curtailed. This fact raises a problem of considerable importance, for an underlying assumption of this analysis is the relative freedom of the operator to adopt the seed at any given stage in the diffusion cycle.

It is true that any study of resistance to the adoption of hybrid seed covering a wide area would be affected by variations in the availability of seed. Drouth delayed the availability of seed in southern Iowa; also hybrids adapted to different localities were not developed at the same time. And it cannot be denied that the quantities of seed available for the state as a whole prior to 1939 would not have been sufficient to plant all corn acreage in hybrids.[28] But these facts do not indicate that farmers' desire to buy the seed far outstripped the amounts available for purchase. At least in the communities studied, no evidence was uncovered indicating that demand exceeded supply.[29] Operators interviewed in this study were asked whether or not they had tried unsuccessfully to get seed in any year. Not one operator had encountered any difficulty on this score. It seems reasonable, therefore, to maintain that in the communities studied, drouth probably had a positive influence upon rapidity of adoption. With seed available and with economic well-being above the average of farmers elsewhere, these farmers were desperate to repair the ravages of the hot dry years. In addition hybrid also demonstrated its stamina to every passer-by. In spite of the various handicaps induced by the distress of the thirties, hybrid seed captured Iowa's corn land in this decade.

INFLUENCE OF THE AGRICULTURAL ADJUSTMENT ADMINISTRATION

The Agricultural Adjustment Administration undoubtedly served to stimulate the use of hybrid seed. Under conditions of acreage restriction and price guarantees, greater than usual incentive was given an operator to increase per acre yield. A more productive seed permitted an operator to minimize the disadvantage of acreage reduction while maximizing the advantages of guaranteed prices.[30]

HYBRID AND THE CORN COMPLEX

Corn produced from hybrid seed has certain distinctive attributes which were relevant to its likelihood of adoption. On the positive

[28]See J. L. Robinson, op. cit.

[29]It might be added that there is considerable indirect evidence that similar circumstances would be found elsewhere. The expensive sales campaigns conducted by commercial producers during this period offer some evidence that demand was not overwhelming. Mr. Nelson Urban, sales manager for the Pioneer Hi-Bred Corn Company, concurred in this judgment.

[30]T. W. Schultz and O. H. Brownlee, Effect of Crop Acreage Control Features of A.A.A. on Feed Production in Eleven Midwest States, Iowa Agr. Exp. Sta., Res. Bul. 298, 1942.

side, it was an innovation which demanded slight if any modifications in the existing culture. Unlike many excellent practices or technical advances, it demanded practically no change in farm management practices. No special treatment or reorganization of time was required, although hybrid was better adapted to mechanical corn picking than were other varieties. The new trait fitted perfectly into the established corn complex, being almost perfectly substitutable for the single trait it displaced: i.e., another type of seed. Although mechanization has been stimulated by hybrid use, it was not necessitated by it.

Of great importance also was the fact that the new trait could be adopted in very small quantities.[31] No economically serious or personally dramatic decision was demanded of any operator who would adopt hybrid corn seed. Although some used large quantities at the time of first adoption, the majority preferred to try the new technique out on a small scale. Further, although the new type seed had certain characteristics which created suspicion in the minds of many farmers, these were generally without scientific foundation.

RESISTANCE TO HYBRID

Unlike many innovations, hybrid corn met with practically no organized resistance. The seed which it replaced was sponsored by no organized vested interests, since it had been produced usually by the individual farmer himself simply as part of his corn crop. But hybrid seed did not gain wide acceptance without some community-wide misgivings and rumors.

The new corn produced by hybrid seed had a smaller ear than that to which Iowa farmers were accustomed. Neither did it have the nice symmetry, nor the large kernels. It was not, in physical appearance, the type of ear which would lead farmers to exclaim, "This is *real* corn!" The rising popularity of hybrids depended in part upon the discarding of traditional standards for evaluating "good" corn. The idea that the old standards should be applied to the new corn was singularly difficult to dispel.[32]

The new seed also produced kernels which were somewhat harder than many open-pollinated varieties. This fact gave rise to the common statement that it was "too flinty" for the stock, which is the ultimate destination of most Iowa corn. Practical experience with hybrids eventually dispelled this conviction. Other rumors, myths and unfounded judgments had also attached themselves to the new seed. It was commonly believed that hybrid corn was excessively hard on the soil. While the invalidity of this belief has

[31] See pp. 680-681 below.

[32] Authority for this judgment rests upon the experiences recounted by salesmen and Extension Service workers. It could not be expected that many farmers would themselves volunteer such "reasons" for delay in adoption. However, many of these "negative" characteristics have subsequently been eliminated.

not been decisively proved, it is most unlikely that hybrid is more exhaustive per unit produced than other breeds.[33]

All of these views were, at one time or another, circulated in the communities studied. In response to questioning some farmers admitted earlier suspicions along most of these lines. Nearly one-half however, accounted for their own delay in adopting the seed in terms that can be generalized only as "fear of the new." Comments such as the following were commonly heard:

"I just figured I'd let the neighbors try it first."

"A man doesn't try anything new right away."

"Well, I had a good open-pollinated seed, so why change?"

The only other type of response commonly heard, from about one-fourth of the operators, referred to the expense of the commercial seed. Remaining answers were largely various types of evasion, since in all probability few farmers could in fact consciously explain their hesitancy.[34]

THE DIFFUSION PROCESS[35]

One of the major objectives of this research was to study the diffusion process of hybrid corn in the communities. Attention was directed not only to the time pattern of adoption for the farm operators individually and collectively but also to the spread of knowledge about hybrid corn. In addition, the important diffusion media were systematically studied.

This section is concerned with four major problems. These are: (1) the time pattern of the spread of knowledge about hybrid corn as well as the time pattern of adoption of the innovation; (2) the interrelationships between these two sequential sets of data; (3) the adoption pattern of farm operators who had only recently begun to farm in the two communities; and (4) the functional importance and the relative significance of the various diffusion mechanisms.

DIFFUSION OF KNOWLEDGE AND PRACTICE

Figure 2 shows the comparative percentages of all operators first hearing of hybrid corn in specified years and the percentages first adopting it. Knowledge on at least an elementary level had spread quite widely before hybrid itself was widely accepted. (Some operators had heard of the new seed before it was beyond the experi-

[33]In some localities farmers attempted to plant the offspring of hybrid seed and thus by misuse may have harmed the seed's reputation. There is no evidence that this occurred in the area studied.

[34]Early adopters were usually quite quick in pointing out that they had not delayed in adopting the seed. In a few cases operators asserted that they had been prevented from adopting by their landlords. This may have been true in several instances, although "prevention" even in these cases probably meant unwillingness of the landlord to pay half the cost of the seed. Several tenants reported that they paid the total cost rather than not use the seed once they decided that they wanted to plant hybrid seed.

[35]This section contains a refinement and further development of certain observations previously noted in Bryce Ryan and Neal Gross, The Diffusion of Hybrid Seed Corn, Rural Sociology, March, 1943.

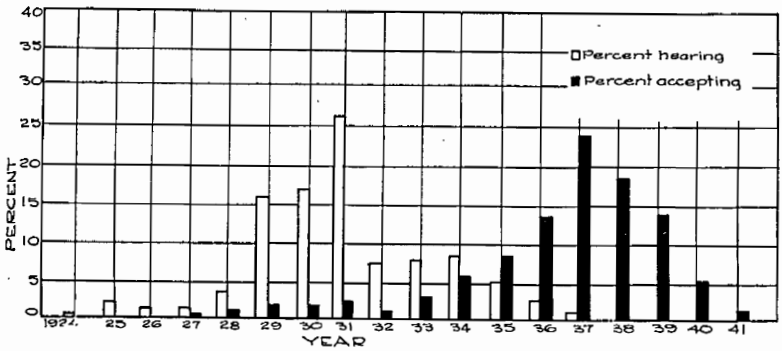

Fig. 2. Percentage of operators first hearing and percentage of operators accepting hybrid seed in specified years.

mental stage.) This spread of knowledge was highly concentrated in the three years 1929, 1930 and 1931. During this brief period about 60 percent of the operators first learned of the seed.

Very roughly there is a lag of about 5 years between the curve of information and the curve of acceptance. However, one could scarcely say that the time patterns of the two aspects of diffusion were closely similar. The spread of information followed a pattern even less similar to a normal frequency distribution than the curve of adoption.[36] The preliminary stages of diffusion covered a longer time span in terms of adoption than in knowledge. The modal frequency in knowledge came 7 years after the first operator heard of the seed; the modal frequency in adoption occurred 10 years after the trait was first accepted. Whereas the adoption curve is definitely "bell-shaped," the spread of knowledge curve is asymmetrical and even more highly concentrated around the mode. The adoption curve itself shows a long period of slow growth followed by a great wave of acceptance, which in turn is followed by a relatively short period in which the remaining stragglers accepted the new seed.

It is clear that the acceptance of the seed for use was delayed some time after initial contact. The lag between first information and first adoption was 5.5 years for all operators. This lag, however, varied markedly for those who adopted the seed early and those who adopted it late. (See table 2.) Thus the mean number of years before acceptance, after initial information, was 1.6 for those adopting prior to 1934. For those adopting in 1934 through 1936, the lag was increased to 4.4 years; for those adopting in 1937 to 1939, there was a delay of 6.4 years; and for the most resistant the delay amounted to 9.2 years.

[36]Neither curve is in fact a normal frequency. See Ryan and Gross, op. cit.

TABLE 2. PERCENTAGE OF OPERATORS IN FOUR ACCEPTANCE GROUPS WAITING SPECIFIED NUMBERS OF YEARS AFTER INITIAL INFORMATION ABOUT HYBRID SEED BEFORE ACCEPTANCE.

No. of years	Operators adopting hybrid seed				
	Percent prior to 1934	Percent in 1934-36	Percent in 1937-39	Percent in 1940-41	All operators
0	26.1	5.6	1.4	.....	6.2
1	26.1	2.8	2.8	.....	4.2
2	17.4	5.6	3.5	.....	4.6
3	17.4	14.0	9.8	.....	10.8
4	4.3	18.1	7.0	.....	9.3
5	.....	19.2	7.7	5.9	10.0
6	4.3	20.7	15.2	11.8	16.3
7	.....	11.2	14.6	11.8	12.4
8	.....	.....	11.1	5.9	6.6
9	.....	.....	12.6	11.8	7.7
10	.....	2.8	5.6	17.6	5.0
11 and over	.....	.....	3.5	35.2	4.2
Unknown	4.4	.....	4.2	.....	2.7
Total	100.0	100.0	100.0	100.0	100.0
No. of cases	23	72	145	17	257
Mean years waited	1.6	4.4	6.4	9.2	5.5

It is evident from these figures that isolation from knowledge was not a determining factor in late adoption for many operators. Those who adopted hybrid seed at the end of the diffusion cycle had heard of it almost as soon as the earliest adopters. The average operator adopting between 1927 and 1934 (inclusive) first heard of the seed in about 1928, while the latest adopters heard of it about 1931. Hence there is a difference of 3 years between these groups in hearing of the seed and a difference of over 7 years in adoption. Comparison of intermediate groups shows similar through smaller differences in the length of this deliberation period. It may be inferred from these observations, therefore, that isolation from channels of information was not a significant factor in the slowness of many operators to take up the new trait.

INCREASING ACCEPTANCE

As time went on, not only did more and more farmers turn to the new seed, but those who had already used it increased their use of

TABLE 3. MEDIAN PERCENT OF CORN ACREAGE PLANTED WITH HYBRID SEED FOR INDIVIDUAL YEARS, BY YEAR IN WHICH OPERATOR FIRST USED HYBRID SEED.

First used in	1933	1934	1935	1936	1937	1938	1939	1940	1941	No. of cases
Before 1934	38.0*	50.0	67.0	100.0	100.0	100.0	100.0	100.0	100.0	24
1934		20.0	29.0	42.0	67.0	95.0	100.0	100.0	100.0	16
1935			8.0	44.0	75.0	100.0	100.0	100.0	100.0	21
1936				20.0	41.0	62.5	100.0	100.0	100.0	36
1937					19.0	55.0	100.0	100.0	100.0	61
1938						25.0	79.0	100.0	100.0	46
1939							30.0	91.5	100.0	36
1940								69.5	100.0	14
1941									54.0	3
Total										259

*The median hybrid planting for this group in its first year of acceptance was 12 percent of total corn acreage.

it. Very few operators planted all of their corn acreage to hybrid in the first season they accepted it. (See table 3.) In fact this tentative pattern of acceptance characterized the majority who began using the seed even in 1940 and 1941. While the very late acceptors generally planted the new seed immediately on a larger share of their acreage than the earlier acceptors, the median planting for those first using hybrid in 1939 amounted to only 30 percent of their total corn acreage for that year. More surprising than the increase in the size of first plantings as time went on is the fact that the more conservative operators, with several years of community experience to guide them, were so experimental in their acceptance.

Although the size of first plantings increased very little with the passing years (until 1939), the later acceptors took a shorter time to reach practically complete adoption of the new seed. Thus, for example, the operators starting to plant hybrid in the years 1934, 1936 and 1937 all reached a 100 percent median planting for the first time in 1939.[37] However, in most years prior to 1939 the earlier the operators had started using hybrid, the larger the percentage of crop in the new seed. Although there were some exceptions to this, notably among operators starting in 1935, in general the later ac-

[37]The mean percentages of corn land in hybrid for each of these groups in 1939 were: 1934, 97.2; 1936, 82.1; 1937, 86.6. Means have not been used generally because of the skewed distributions, especially in the very early and very late phases of the acceptance process.

ceptors did not "catch up" with the earlier ones until almost complete adoption had been reached.

In a sense the early acceptors provided a community laboratory from which neighbors could gain some vicarious experience with the new seed over a period of years. The importance of this local laboratory is attested by the weight given "neighbors" as influences toward acceptance.[38] But at the same time it is evident that the more conservative operators would not accept other farmers' experience at full face value. This points up an interesting aspect of the learning process of farmers in the adoption of new seed and similar practices. The above analysis suggests that whatever the advantages demonstrated by community experience in an innovation of this type, most operators insist upon personal experimentation before complete acceptance. As previously noted, the experimentation period for hybrid corn was shortened for the late acceptors, but very few were willing to start at the point already reached by earlier adopters. The acceptance of hybrid was far from a conversion; individual self-demonstration was required even after visible evidence and objective comparisons were readily available.

ACCEPTANCE BY NEW FARMERS

During the period in which most established farmers were adopting hybrid seed, new operators were becoming farmers. Since this group did not have the opportunity to accept hybrid at early dates, it is necessary to consider them separately in their behavior toward hybrid seed.[39] This group is of particular interest in that one might conjecture that new men entering farm operation would be particularly alert to technological developments. This, however, does not seem to have been the case. Table 4 indicates that the new operators who started before 1938 all tended to adopt hybrid in about the same year, i.e., 1938. Thus, farmers beginning their farm enterprise in 1934 adopted the new seed at about the same time as farmers beginning operations in 1936. (By way of comparison, over 60 percent of the established operators were using hybrid seed before 1938.) Only after 1938 (when at least 80 percent of all

[38]See later section on "Agencies of Diffusion."
[39]In other parts of this study new farmers have been excluded from the analysis.

TABLE 4. MEAN NUMBER OF YEARS NEW FARMERS WAITED BEFORE ADOPTING HYBRID SEED, BY YEAR STARTED FARMING.

	Year started farming								
	1934	1935	1936	1937	1938	1939	1940	1941	Total
Years waited	3.6	2.9	1.5	1.1	0.7	0.2	0.0	0.0	....
No. of operators	13	10	11	7	10	5	5	3	64

established operators were using hybrid) did new farmers accept the seed generally with the opening of their farm enterprise.

While the small number of cases demands great caution and makes more refined analysis unwise, it seems unlikely that the new farmers were less resistant than established operators. Certainly there is no indication that new farmers of the period were "chafing at the bit" to escape from local conservatism.[40]

THE AGENCIES OF DIFFUSION

ORIGINAL SOURCES OF KNOWLEDGE

For a technique having such wide scientific and commercial implications, it is impossible to determine with exactness the relative importance of various diffusion agencies to individual farmers. The channels through which farm operators first learned of the new seed were undoubtedly more complex than the farmers themselves realized.

As hybrid emerged from the laboratory stage, its use was actively promoted by both commercial and educational agencies. Throughout Iowa the spread of information about hybrid seed became a major educational campaign in the thirties for both public and private enterprises. The Iowa Corn and Small Grain Growers Association in cooperation with Iowa State College conducted its corn yield tests as usual.[41] These scientifically accredited reports offered both

[40]It should be noted that the new operators followed essentially the same pattern of gradual increase in acreages as did the established operators.

[41]The first report on comparative corn yields was published early in 1921, for the 1920 tests.

TABLE 5. PERCENTAGES OF ALL OPERATORS CITING SPECIFIC ORIGINAL SOURCES OF KNOWLEDGE OF HYBRID SEED AND MOST INFLUENTIAL SOURCES.

Source	Percent	
	Original knowledge	Most influential
Neighbors	14.6	45.5
Salesmen	49.0	32.0
Farm journals	10.7	2.3
Radio advertising	10.3	....
Extension Service*	2.8	2.4
Relatives	3.5	4.2
Personal experimentation	——	6.6
All others**	9.1	7.0
Total***	100.0	100.0

* Including county extension agent, bulletins, etc.
** Including unknown.
*** Total number of cases=257.

direct and indirect stimulus to rapid acceptance of the seed. Not only did the state college, through the Extension Service, actively engage in educational programs, but perhaps even more significantly, it provided a source of knowledge and authority to commercial dealers through the Experiment Station. In some localities county extension directors and seed salesmen worked in close cooperation. The fact that reliable seeds came to be certified by the College also served to lend authority to justifiable commercial claims.

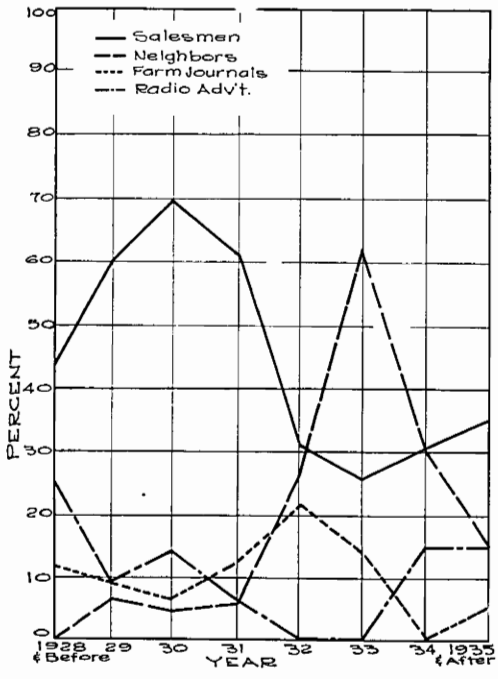

Fig. 3. Percentages of farm operators first hearing of hybrid seed through various channels, by year first heard.

In this chain of related sources, salesmen played a very significant role in actually bringing knowledge of hybrid seed to the individual farmer. Unlike many technological innovations in agriculture this trait was one that could be and was promoted actively by commercial interests. This fact undoubtedly was a significant reason for the phenomenal rapidity of the hybrid diffusion as compared with other types of campaigns conducted on a purely educational basis. Behind the hybrid movement lay not only the rational appeals and authority of research and governmental agencies, but also the initiative and ingenuity of private business interests.

It is thus not surprising to find that almost one-half of the farmers named salesmen as their original source of knowledge concerning hybrid corn. This is probably a fair representation of the activity of salesmen throughout the area. In fact, 70 percent of the farmers claimed to have received their earliest information on hybrid from commercial sources (including farm journals). See table 5. Most of the other farm operators first learned of it through neighbors.[42]

[42]In some instances the distinction between neighbor and salesman may not always have been clear, since local farmers frequently acted as salesmen for seed corn companies.

It is of further interest to try to answer the question, "Did the diffusion agencies acting as original sources of information vary in significance over different periods of the diffusion process?" The answer is definitely yes. Figure 3 illustrates the sharp fluctuations in the importance assigned these various media of dissemination, depending upon the year in which the trait was first made known to the farmer. Thus, salesmen were of major significance before 1933. Nearly 70 percent of the operators learning of hybrid in the year 1930 named salesmen as their initial source; 3 years later only 27 percent learned of the trait through salesmen. On the other hand, as salesmen declined in importance "neighbors" notably increased. In 1931 only 6 percent named neighbors, but in 1933 more than 60 percent named them. In the final years during which the most isolated operators were being reached, these two sources were about equal in significance. There are sharp fluctuations also for the minor sources of diffusion. Farm journals were significant mainly in 1932, while radio advertising was of some importance for the very early and the very late periods of the adoption cycle.

Some of these observations have been based on very few cases, since about two-thirds of the operators heard of hybrid seed in 1929, 1930 and 1931. All of these were years in which salesmen were very important as a diffusion agency. Hence, it was mainly a group of stragglers who were reached through other farmers. The speed with which knowledge of the new trait spread is probably in fact, as well as in farmer opinion, a tribute to the initiative of hybrid corn dealers. The unimportance of neighbors prior to 1932 is consistent with the earlier finding that only 5 percent of the operators were using the seed before that time. Observation of neighboring fields would probably not have become important until after that time.

MOST INFLUENTIAL SOURCES OF KNOWLEDGE

When the farmers were asked to evaluate their various sources of information on hybrid corn as to relative influence in leading them to take up the practice, neighbors were cited more frequently than any other medium (by 45.5 percent). While salesmen were also accorded considerable importance as influences, as well as original informants, only 32.0 percent of the operators felt that their judgment was influenced most significantly by salesmen. Nearly 7 percent believed that their personal experience was the only strong motivator.[43]

In analyzing the time pattern in the comparative influences of neighbors and salesmen, it is more reasonable to use a time scale by year of adoption of the trait than to use one by year of first information. Two-thirds of the early adopters credited salesmen with

[43]This was an evasion of the real issue since the desired information centered on the influence leading to use of the seed.

influencing them most, while two-thirds of the latest adopters credited their neighbors as being primary motivators (figure 4). With the passing years neighbors gained almost consistently in importance and salesmen lost. The bulk of the operators fall in the later years—hence, the much greater influence of neighbors in the total sample.

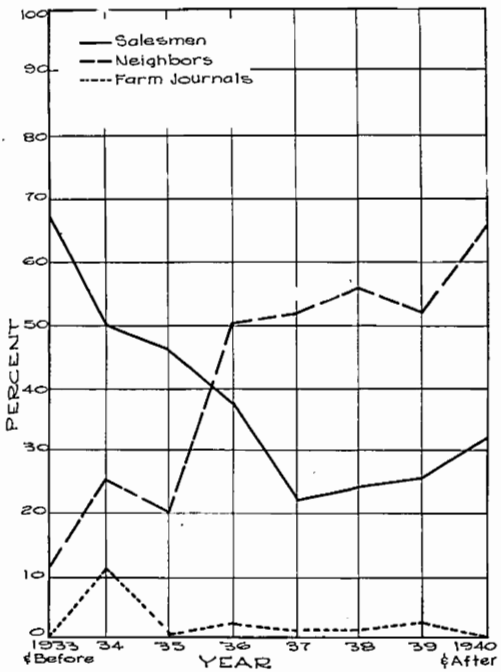

Fig. 4. Percentages of farm operators accepting hybrid seed in specified years assigning major influence to various sources.

Insofar as the farmers' evaluations were accurate, it may be suggested that the diffusion agencies are divisible into two moderately distinct types: those important as *introductory* mechanisms and those important as *activating* agents. Thus salesmen were credited with informing the majority of the operators, but neighbors were credited with convincing them. This is consistent with the extreme caution with which individual farmers took up the new trait. Salesmen no doubt were the major immediate sources of introductory knowledge, but experience within the community had more influence in terms of action. This stands out also in the almost complete lack of influence assigned to other impersonal agencies. The functional distinction between diffusion agencies is a problem warranting much greater attention both from scholars and from Extension Service administrators. The spread of knowledge and the spread of "conviction" are, analytically at least, distinct processes, and in the diffusion of hybrid seed have appeared to operate in part through different although complementary channels.

These observations, however, should not be interpreted out of their proper context. Many important media which in fact were probably most influential may not always have been so evaluated by the farmers. This is probably true in an indirect sense—i.e., while salesmen or neighbors were felt to be most influential, the

work of educational agencies gave tremendous stimulus to these groups. In this study, however, an evaluation is made only of the immediate sources for the individual farmer as reported by farmers themselves.

CONCLUSIONS

Eight observations may be made regarding the process of hybrid corn diffusion. (1) The majority of farmers first became informed of the seed within a very short time span. (2) Following a long period of growth, the use of hybrid corn swelled rapidly, and hybrid practically swept the area in the space of 4 years. (3) Lags between knowledge of the seed and its adoption were greater for those who resisted adoption longer. (4) The early acceptors provided a community laboratory in which their neighbors gained experience concerning hybrid corn. (5) The principal immediate sources of first knowledge were salesmen and neighbors. (6) Salesmen were important during those years in which the majority of farmers were learning of the new seed, whereas the later acceptors relied mainly upon neighbors as a source. (7) Sources influencing operators toward adoption were believed by them to be more personal than the sources of information; neighbors were most influential, while salesmen were most widely informative. (8) The diffusion agencies may, therefore, be classified into two functional types, *introductory* and *activating*.

THE RELATIONSHIP OF CERTAIN VARIABLES TO TIME OF ADOPTION

The search for the answer to the question of *why* some farmers adopted hybrid seed very early in the diffusion process and others very late permitted no simple or direct approach. A direct questioning approach to the farmers themselves led, as one might expect, to largely tautological replies.[44] Analysis of their responses simply reveals that early adopters were "less conservative," "more open minded" and "less bound by traditional patterns." There seems more purpose in attempting to probe into the relationships between objective characteristics of individuals and their rapidity in adopting the innovation. In this section the primary purpose is to delineate and interpret certain distinguishing characteristics of operators showing varying degrees of resistance to the new technique.

THE FOUR ADOPTION GROUPS AND METHODS OF ANALYSIS

In studying the factors associated with time of adoption, the operators have been classified, for preliminary analysis, into four groups. These are designated as groups A, B, C and D. Group A includes those farmers first adopting hybrid seed prior to 1934; Group B includes those adopting the seed in the years 1934, 1935 and 1936;

[44]See page 677 above. These speech reactions were in general not sufficiently meaningful nor incisive to warrant inclusion in systematic form.

Group C includes those adopting hybrid in the years 1937, 1938 and 1939; Group D includes those adopting hybrid in 1940 and 1941.[45] This procedure results in very small numbers of cases in the extreme groups, but it was deemed advisable to isolate as nearly as possible those who were most clearly resistant and those most highly susceptible to change. The construction of equal sized groups would have defeated the purpose of characterizing the most deviant. Groups A and D are small but are composed of exceptional individuals in terms of behavior toward adoption of the practice.

The general method of analysis in studying the association between rapidity of adoption and certain characteristics of the operators was to categorize the data on the basis of the two factors being associated (e.g., rapidity of adoption and age) and to test the resulting table for independence by the chi square test. The analysis of the data by this means was followed because there were no a priori considerations which suggested an *exact* model of the relationship between the two characteristics. An ordinary regression approach (say y on x or even y on x and x^2) would be susceptible to undue weighting of the extreme cases. The procedure of classifying each factor into a small number of groups and testing the table for association was therefore followed. It would be possible to use this analysis to formulate an exact regression model and then to fit this model, but such a procedure is not satisfactory from a logical standpoint.

THE CHARACTERISTICS STUDIED

Available literature on technological change among farmers offered scant basis for a priori assumptions or for specific hypotheses regarding characteristics relevant to willingness to accept innovations. Viewing this study as largely an exploratory enterprise, a rather wide range of background data was obtained.[46] These data may be broadly classified into three types: (1) those relating to personal characteristics and backgrounds of the operator, i.e., age, education and nationality background; (2) economic status characteristics, i.e., tenure status, mobility, acres farmed and acres in corn;[47] (3) social contacts and participation of the operator in community life, i.e., participation in organized groups, commercialized recreation, leader-

[45]This particular set of groupings was devised after careful study of the curve of adoption in the two communities. Breaks between groups have been made at what seemed to be the most critical points in the time pattern of diffusion. Thus 1934 seemed to mark the end of a pioneering period, while at the other extreme, adopters after 1939 were clearly laggards. Of the large middle group remaining, a division was made at the modal year of adoption, placing that year with the later C group.

[46]These data refer to conditions as of time of adoption, wherever feasible (e.g., age, tenure, size of corn acreage). Social participation data apply to activities in 1941.

[47]Income data are not presented in this analysis because of the unreliability of such data gained through the interview methods. It was judged that within this area, size of corn acreage and size of farm reflected economic status and were most closely interrelated. Size of corn acreage in the year hybrid was first planted has been used here as a measure of magnitude of the farm enterprise and reflects fairly well differences in economic status generally.

ship, neighboring with other families, reading, etc. Most detailed attention was given the latter group of variables.

PERSONAL BACKGROUND CHARACTERISTICS

Personal background characteristics deemed sufficiently relevant, and mensurable, for analysis in this context were age of operator, educational attainment and nationality descent. Of these variables, both age and education show some association with earliness of adoption. The more youthful operators adopted hybrid seed earlier, as did the better educated. While minor differences in the resistance of nationality groups appear, they are based on too few cases to be of any significance.[48]

AGE

Table 6 clearly indicates that youthfulness is related to earliness of adoption. (Chi square=33.15, d. f.=12, significant at 1 percent level.) The mean ages of the four acceptance groups rated according to rapidity of adoption are respectively 37.7, 42.2, 45.5 and 55.9 years. Of special interest is the large difference in age between the A and the D groups. The mean age difference between the earliest and the latest adopters was over 18 years. Further, whereas nearly two-thirds of the D group were aged 51 or older when they adopted hybrid seed, only one of 23 farm operators in the A group

[48]Nationality was in fact largely irrelevant in these homogeneous "American" communities. Only for one small group (the Irish) is there any cultural or social isolation or divergence, and this is very slight.

TABLE 6. PERCENTAGES OF OPERATORS IN FOUR ACCEPTANCE GROUPS ACCORDING TO AGE AT TIME OF ADOPTION AND MEAN AGE OF EACH GROUP.

Age	Period				All cases
	A** (Percent)	B** (Percent)	C** (Percent)	D** (Percent)	(Percent)
21-30	17.4	17.1	11.9	11.1	13.7
31-40	47.9	30.3	19.1	5.5	24.0
41-50	30.4	23.7	35.2	16.8	30.2
51-60	4.3	21.1	21.2	27.8	20.1
60 and over	.....	7.8	12.6	38.8	12.0
Total	100	100	100	100	100
No. of cases	23	72	144	17	256*
Mean years	37.7	42.2	45.4	55.9	50.6

*Data for one case unascertainable. Chi square=33.15 for all groups, d.f.=12, significant at P=0.01.

**Period A includes years prior to 1934; period B includes 1934 through 1936; period C includes 1937 through 1939; and period D includes 1940 and 1941.

TABLE 7. PERCENTAGES OF OPERATORS IN FOUR ACCEPTANCE GROUPS HAVING ELEMENTARY, HIGH SCHOOL AND COLLEGE EDUCATION,* AND MEAN GRADES COMPLETED FOR EACH GROUP.

Education	Period				All operators
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
Grades only	34.7	52.8	58.3	100.0	57.6
High school	34.7	38.8	34.0	0.0	33.1
College	30.6	8.4	7.7	0.0	9.3
Total	100	100	100	100	100
No. of cases	23	72	144	17	256**

*Only 2 percent of the total failed to complete the eighth grade. "High school" or "college" indicates one or more years in such institutions.
**Data were unascertainable for one case.
Chi square=26.77 for all groups, d.f.=6; significant at P=0.01.

had reached such an advanced age. In short, table 6 reveals that increasing age is a differentiating characteristic of all four acceptance groups.

EDUCATION

Not only were the earliest adopters somewhat younger than the latest acceptance group, they were also much better educated. Whereas nearly two-thirds (65.3 percent) of the A group had an education beyond the eighth grade, not one of the D operators had progressed so far. That educational achievement was related to rapidity of acceptance was further supported by a significant chi square at the 1 percent level when the null hypothesis was tested. (Chi square=26.77, d.f.=6, significant at 1 percent level.)

Table 7 indicates that the earliest and the later acceptance groups differed considerably when compared on the proportions of each group having advanced beyond the eighth grade. Differences are especially apparent when the A group is compared with the other groups according to percentage having any college education. Whereas less than 10 percent of the B and C groups and none of the D group reported any college education, nearly one-third (30.6 percent) of the A group had taken college work. Further, the proportion of each group with only grade school education increases with slowness of adoption. It should be noted, however, that the differences between the moderately early and moderately late adopters (groups B and C) are quite small.

NATIONALITY

Nearly one-half of the operators were of "American stock" avowing no distinct nationality descent, and there were no ethnic "is-

TABLE 8. PERCENTAGE OF OPERATORS IN FOUR ACCEPTANCE GROUPS ACCORDING TO NATIONALITY BACKGROUND.

Nationality	Period				All operators
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
"American"	47.9	53.5	42.9	35.3	45.5
German	26.1	18.3	28.3	17.6	24.9
Irish	13.0	9.9	13.6	35.3	14.0
Scotch-English	.....	11.3	6.2	11.8	7.4
Other	13.0	5.6	8.3	.....	7.4
Unknown	0.0	1.4	0.7	.....	0.8
Total	100	100	100	100	100
No. operators	23	72	145	17	257

lands" in the area studies. Table 8 indicates that the "Americans" were somewhat over-represented in the two early acceptance groups and under-represented in the latest. On the other hand there is no marked under-representation by "foreign" groups in the early periods. Only the Irish seem to have been slightly slower than others. These findings are wholly inconclusive regarding any differences between the stocks in their receptivity to hybrid corn, and it seems unlikely that this factor had significance.

ECONOMIC STATUS FACTORS

While economic factors as incentives for the acceptance of hybrid corn might be assumed to have been relatively constant for all operators, it is highly probable that larger operators were more receptive to profitable changes. Although they had more to gain, there is little reason for believing that their proportional gain would be greater than for smaller operators.[49] Thus the size of farm enterprise, itself, probably did not constitute a significant factor as an influence toward early adoption. Rather it reflected a probable tendency toward greater farming ability and managerial success and greater awareness of agronomic and economic developments. Indeed there is no doubt of the tendency for the larger scale operators to accept hybrid corn more rapidly than other farmers.

CORN ACREAGE

Table 9 reveals that there are significant variations between the extreme acceptance groups as well as a steady drop in corn acreage

[49]This assumes that all were in commercial production as is the case. It should be noted, however, that hybrid corn was better adapted to mechanical picking and hence somewhat more economical for large-scale operators in the long run.

TABLE 9. TOTAL ACRES IN CORN AT TIME OF ADOPTION OF HYBRID SEED FOR OPERATORS IN FOUR ACCEPTANCE GROUPS, PERCENTAGES AND MEANS.

Acres in corn	Period				All operators
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
Under 40 acres	8.7	.....	6.0	27.8	7.1
40 to 79	34.8	41.3	54.8	50.0	48.7
80 to 119	21.7	48.0	27.0	11.1	31.6
120 and over	34.8	10.7	10.2	11.1	12.6
Total	100	100	100	100	100
No. operators	23	71	145	17	256*
Mean corn acreage	108.5	84.4	73.2	60.4	78.7

*Data unascertainable for one case.
Chi square for all groups=39.17, d.f.=9; significant at P=0.01.

with each successive adoption category. (Chi square=39.17, d.f.=9, significant at 1 percent level.) There is a difference of 48 acres in the average corn acreage of the earliest and latest acceptors. The mean corn acreages for the A, B, C and D groups were respectively 108.5, 84.4, 73.2 and 60.4. It is further evident that the earliest adopters had an unusually high proportion of very large operators. Over one-third (34.8 percent) of the A group as compared to slightly over one-tenth of the other groups had at least 120 acres in corn.

TENURE STATUS

The tenure position of farmers appears to hold slight association with earliness of adoption. (Chi square=10.04, d.f.=6; not significant at 5 percent level.) Owners tended to be over-represented among the very early acceptors, but they were also over-represented

TABLE 10. PERCENTAGE OF OPERATORS IN FOUR ACCEPTANCE GROUPS IN EACH TENURE STATUS AT TIME OF ADOPTION.

Tenure status	Period				Total	No. of operators
	A	B	C	D		
Owners	14.8	27.1	48.7	9.4	100	107
Related tenants	6.3	29.2	60.3	4.2	100	48
Unrelated tenants	5.0	29.4	60.6	5.0	100	102
All operators	9.3	28.4	55.6	6.7	100	257

Chi square=10.04, d.f.=6; not significant at P=0.05.

TABLE 11. PERCENTAGE OF OWNERS IN THE FOUR ACCEPTANCE GROUPS MAKING SPECIFIED NUMBER OF MOVES IN PAST 5 YEARS.

No. of moves	Period				All operators
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
None	100.0	96.4	79.6	80.0	86.9
One	... ..	3.6	20.4	20.0	13.1
Total	100	100	100	100	100
No	15	28	54	10	107

Chi square=7.81, d.f=3; not significant at P=0.05.

among the latest. Related tenants, who in most social characteristics approximate the owner class more nearly than unrelated tenants,[50] were no more rapid in their adoption than the latter. It cannot be concluded that any tenure group was particularly rapid nor any particularly slow. (See table 10.)

INTER-FARM MOBILITY

In view of the importance of neighbors as sources of conviction on the use of hybrid corn, it might be thought that considerable inter-farm mobility would furnish wider contacts and hence be associated with earlier adoption. This does not seem to have been the case insofar as moves within the past 5 years are a reliable measure of mobility. In view of the great differences between owners and unrelated tenants (related tenants are too few to warrant special analysis), these groups are analyzed separately. In neither case does mobility appear to have influenced adoption, nor has it reflected a

[50]See Anderson and Ryan, op. cit., for an analysis of this problem based upon a study of the same communities.

TABLE 12. PERCENTAGE OF UNRELATED TENANTS IN THE FOUR ACCEPTANCE GROUPS MAKING SPECIFIED NUMBER OF MOVES IN PREVIOUS 5 YEARS.

No. of moves	Period				All operators
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
None	40.0	56.7	53.2	40.0	52.9
One	60.0	43.3	43.6	60.0	45.1
Two	.....	....	3.2	.....	2.0
Total	100	100	100	100	100
Number	5	30	62	5	102

Chi square=0.75, d.f.=3; not significant at P=0.05.

state of mind more conducive to acceptance of the innovation. (See tables 11 and 12.) There is some evidence that more of the later adopting owners were mobile, but the entire group was so immobile that little reliability could be attached to such differences. (Chi square=7.81, d.f.=3; not significant at 5 percent level.) For the unrelated tenants there is no evidence whatever that mobility was related to resistance. (Chi square=0.75, d.f.=3; not significant at 5 percent level.)

SOCIAL PARTICIPATION

Of special interest are the distinguishing characteristics in social participation of the innovative and conservative operators. A number of questions of general sociological significance immediately arise. Did the earliest acceptors in contrast to later acceptors participate more actively in community activities? Were leaders in local organizations also leaders in the adoption of hybrid corn seed? What types of social participation were related to rapidity of acceptance? These and similar problems are analyzed in the following section.

In order to investigate the relationships between social participation and time of adoption, several categories of social participation have been established. The classifications used are neighborliness, commercial recreation, organizational affiliation, and extent of reading.

NEIGHBORLINESS

While patently a very crude measure of the scope of primary group affiliation in the community, the extent of neighboring (close inter-family contact) shows no relationship with time of adoption.

TABLE 13. NUMBER OF OTHER FAMILIES VISITED FREQUENTLY BY RESPONDENT'S FAMILY (CLASSIFIED BY TIME OF ADOPTION), PERCENTAGES AND MEANS.

No. of neighbors	Adoption groups				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
Three or less	35.0	29.6	36.9	47.0	35.5
Four and five	34.7	33.9	26.2	11.8	28.3
Six and over	30.3	36.5	36.9	41.2	36.2
Total	100	100	100	100	100
Total cases	23	71	141	17	252*
Mean no. of neighbors	4.3	5.4	5.0	4.8	5.0

*Data unascertainable for five cases.
Chi square=4.75, d.f.=9; not significant at P=0.05.

The lack of association might be considered as surprising in view of the importance ascribed to neighbors as influential sources of information on hybrid seed adoption. However, lack of relationship is of special interest in view of rather consistent positive associations between early adoption and organizational contacts.

Table 13 indicates that slight and insignificant differences exist among the acceptance groups in terms of neighbors visited regularly. (Chi square=4.75, d.f.=9; not significant at 5 percent level.) The A operators averaged 4.3 neighbors, the B's 5.4, the C's 5.0 and the D's 4.8. Although the D's made slightly more contacts than the A's, the B's and C's both displayed more "neighborliness" than the D acceptors. Further, the differences are not large enough to be important in terms of social contact and isolation.

The percentage distributions also reflect a similar lack of relationship. For example, in all adoption groups the proportions of operators with three or less and six and more neighbors differ slightly. In sum, while this measure of "neighborliness" is quite limited, there is no indication either in the means or the percentage distributions that extent of primary group contacts influenced receptivity to the innovation.

ORGANIZATIONAL PARTICIPATION

TOTAL NUMBER OF ORGANIZATIONS

In practically all measures of participation in organized secondary groups, there is some association with earliness of adoption of hybrid seed. Thus even in terms of the number of organizations to

TABLE 14. TOTAL NUMBER OF ORGANIZATIONS BELONGED TO BY FARM OPERATORS IN THE FOUR ACCEPTANCE GROUPS, PERCENTAGE DISTRIBUTION AND MEANS.

Number of organizations	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
None	.....	6.9	11.0	41.2	11.2
One	17.4	30.6	28.9	17.6	27.8
Two	26.1	26.4	28.3	35.3	27.8
Three	17.4	15.3	17.2	5.9	15.8
Over three	39.1	20.8	14.6	.....	17.4
Total	100	100	100	100	100
No. cases	23	72	145	17	257
Mean	3.0	2.3	2.2	1.1	2.2

Chi square=32.45, d.f.=12; significant at P=0.01.

which the farmer belonged, there is evidence of association with adoption.

Table 14 reveals that differences between the earliest and the latest groups of adopters are marked; for example, all of the A operators belonged to one or more organizations, whereas 41.2 percent of the D group had no organizational membership. The A and D operators are likewise different in the proportions of those belonging to three or more organizations. Differences between the two intermediate groups of acceptors are not great, although the B group tends to be slightly more participating than the C group. (Chi square=32.45, d.f.=12; significant at 1 percent level.)

TABLE 15. MEAN NUMBER OF ORGANIZATIONS BELONGED TO BY OWNERS AND UNRELATED TENANTS IN THE FOUR ACCEPTANCE GROUPS.

Tenure status	Period				Number
	A	B	C	D	
Owners	3.0	2.6	2.5	1.0	107
Unrelated tenants	2.8	1.9	1.6	1.0	102

Since it is well known that tenure classes differ in their participation in organized groups, it is pertinent to determine if the association noted here is evident for both owners and unrelated tenants.[51] As one would expect, the owners generally have a higher incidence of membership, but in each tenure class there is an association with rapidity of adoption. (Table 15.) In each tenure class it is also

[51]Tenure differences in participation are largely a product of mobility (see Anderson and Ryan, op. cit.). Mobility as a factor in time of adoption has already been treated.

TABLE 16. PERCENTAGES OF OPERATORS IN FOUR ADOPTION GROUPS BELONGING TO VARIOUS TYPES OF ORGANIZATIONS.

Type of organization	Period				Percent of all operators
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	
Religious	87.0	90.3	80.0	47.1	81.3
Occupational*	39.1	18.1	18.6	11.8	19.8
Fraternal	56.5	31.9	31.7	23.5	33.4
Recreational	17.4	11.1	6.2	.....	8.2
Civic	26.1	18.1	13.8	.....	14.2
No. cases	23	72	145	17	257

*Mainly Farm Bureau.

evident that the differences between the large middle acceptance groups are small, and the differences in the extremes quite large.

It is further pertinent to inquire into the differences among the acceptance groups according to membership in organizations of different types. Table 16 provides the information needed for such an analysis. The evidence indicates that there is an association between time of adoption and membership for each type of organization. As in most measures the two extreme groups stand out sharply from the intermediate ones in almost every instance. Unlike the gross measurement of total memberships in organizations, here there are some discriminations between the B and C adoption groups. Thus, in the case of membership in civic and recreational groups, gradations occur between each adoption group.

EXTENT OF PARTICIPATION

Membership is of course a limited measure of organizational participation; it becomes more accurate when associated with a measure of attendance. Accordingly a participation measure was devised to take into account both membership and attendance, with principal weight placed on attendance. In this scale the operators were given scores on the following basis: One point was given for membership in an organization, one point if attendance was indicated at one-fourth or less of the meetings held by the organization (regardless of membership); two points were given if from one-fourth to one-half of the meetings were attended; three points if one-half to three-fourths were attended; and four points if more than three-fourths were attended. Obviously this composite measure

TABLE 17. PARTICIPATION SCORES OF OPERATORS IN FOUR ACCEPTANCE GROUPS, PERCENTAGE DISTRIBUTION AND MEANS.

Score	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
0	4.3	10.0	13.3	41.2	13.2
1-4	4.3	23.3	19.2	5.9	18.7
5-7	26.1	20.1	22.9	29.4	22.6
8-10	21.7	23.3	20.1	17.6	21.0
11-25	43.6	23.3	24.5	5.9	24.5
Total	100	100	100	100	100
No. cases	23	72	145	17	257
Mean	11.2	8.0	7.8	4.5	8.0

Chi square=24.75, d.f.=12; significant at P=0.05.

of participation is heavily weighted on the side of actual attendance rather than nominal membership.

It is evident from table 17 that the earliest and the latest acceptors differed greatly in participation scores, whereas the differences between the intermediate groups were slight. Thus, the mean score of the A adopters was 11.2 compared to 4.5 for the D group. The scores for the B and C groups were respectively 8.0 and 7.8.

The contrast is striking in the A and D groups in respect to zero participation and very high participation scores. Whereas 4.3 percent of the earliest acceptors had a zero score, over two-fifths of the D group had a zero score. In the highest scoring interval, 11 to 25, were found 43.6 percent of the earliest acceptors and only 5.9 percent of the latest adopters. In sum, decisive differences existed between the leaders and laggards in the diffusion process. Although the intermediate groups fell between these extremes, the differences between the B and C groups were slight.

LEADERSHIP IN COMMUNITY ACTIVITIES

Leadership in agricultural communities is of great interest to sociologists and extension workers. It has been pointed out that too few mechanisms are in operation to develop leadership in rural areas.[52] The success of local, state and even national agricultural programs at the community level may ultimately depend upon an understanding of and the effective use of local leadership.[53]

A problem of considerable significance lies in the degree to which leadership is confined to a specific type of activity by a specific

[52]Dwight Sanderson. Leadership for Rural Life. Associated Press, New York, 1940, pp. 68-93.

[53]For treatment of problem of relationships between governmental and local programs, see Neal Gross, A Post Mortem on County Planning, Journal of Farm Economics, August, 1943.

TABLE 18. TOTAL NUMBER OF OFFICES CURRENTLY HELD BY OPERATORS IN THE FOUR ACCEPTANCE GROUPS, PERCENT DISTRIBUTIONS.

Number of offices	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
None	77.3	84.7	78.6	94.1	81.4
One	18.2	9.7	15.2	5.9	13.2
Two or more	4.5	5.6	6.2	0.0	5.1
Total	100	100	100	100	100
No. cases	22	72	145	17	256*

*Data unascertainable for one case.
Chi square=3.38, d.f.=6; not significant at P=0.05.

individual.[54] Are certain farmers "leaders" in specific spheres of action, but not in others? More specifically, are leaders in community life also leaders in technological development? The evidence of this study does not indicate that leadership in technological advance bears any significant relationship to leadership in community organizations.

The most striking observation from an analysis of table 18 is the large proportion of operators in all groups that acted in no organizational leadership capacities. In all adoption groups at least three-fourths of the farm operators showed no leadership in organizational roles. Except for the group most resistant to hybrid seed, there is no evidence of any positive association between officership in local organizations and earliness in adoption of the seed. (Chi square=3.38, d.f.=6; not significant at 5 percent level.) The differences between the A, B and C groups, for example, in percentage of operators holding two or more offices are slight, and these small differences indicate that the C group is characterized by more officerships proportionally than the earlier acceptance groups. This is evident in spite of the fact that the earliest adopters belonged to more organizations than later acceptors (table 14), and hence had greater opportunity to demonstrate leadership. However, the fact remains that the D group operators were marked by very little officership, since only one of the 17 held any office.

Similar conclusions must be drawn from table 19 in which leadership is measured in terms of memberships on committees in various organizations. (Chi square=5.01, d.f.=6; not significant at 5 percent level.) Seventy-seven percent of the A's, 86 percent of the B's, and 77 percent of the C's did not participate in any committee

[54]This problem has been treated at some length in Bryce Ryan, Social and Ecological Patterns in the Farm Leadership in Four Iowa Townships, Iowa Agr. Exp. Sta., Res. Bul. 306.

TABLE 19. PERCENTAGE OF OPERATORS IN FOUR ADOPTION GROUPS HOLDING COMMITTEE MEMBERSHIP.

Number of committee memberships	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
None	77.3	86.1	76.5	94.1	80.6
One	9.1	8.3	15.2	5.9	12.0
Two or more	13.6	5.6	8.3	.....	7.4
Total	100	100	100	100	100
No. cases	22	72	145	17	256*

*Data unascertainable for one case.
Chi square=5.01, d.f=6 (rows 2 and 3 combined); not significant at P=0.05.

activities. However, 94 percent of the D's were similarly inactive.[55] Yet, among the first three acceptance groups (i.e., A, B and C) only small and irregular differences are evident.

The implications of this evidence are significant for extension specialists. The analysis suggests that individuals characterized by extreme technological conservatism are the least active in leadership roles. On the other hand, the bulk of the leadership did not come from the earliest acceptance group, but rather was dispersed among the A, B and C operators. In consequence, insofar as adoption of hybrid seed is concerned, the analysis indicates that leadership in community activities is not necessarily related to "farm practice" leadership.

PARTICIPATION IN AGRICULTURAL ADJUSTMENT ADMINISTRATION PROGRAMS

The participation of farmers in programs of the Agricultural Adjustment Administration represents a somewhat different measure than activity in community affairs generally. It is, in a sense, another measure of receptivity to cultural change. Perhaps more significant is the fact that acreage restriction operated as an incentive to increased productivity per acre and thus increased the normal stimulus to adopt a more productive seed. Whatever may be the importance of these underlying factors, there is no doubt but that AAA participation was associated with early adoption. (Table 20.) (Chi square=24.88, d.f.=6; significant at 1 percent level.) Not only does the association appear in the extreme groups, but for the two intermediate groups of adopters the B group, on the average, had participated in the program nearly 1 year longer than the C group.

[55]It should be remembered, however, that the D operators on the average belonged to only 1.1 organizations as compared to 2.2 for all operators and therefore had fewer opportunities to assume "leadership roles." See table 15.

TABLE 20. NUMBER OF YEARS IN AAA FOR ALL OPERATORS IN FOUR ACCEPTANCE GROUPS, PERCENTAGE DISTRIBUTION AND MEANS.

Years in AAA	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
0-3	21.6	23.7	33.8	58.9	32.0
4-7	8.8	27.8	37.2	29.4	31.3
8-9	69.6	48.5	29.0	11.7	36.7
Total	100	100	100	100	100
No. cases	23	72	145	17	257
Mean years	6.8	6.1	5.2	3.1	5.4

Chi square=24.88, d.f.=6; significant at P=0.01.

The mean number of years participated in the AAA was 6.8 for the A's, 6.1 for the B's, 5.2 for the C's and 3.1 for the D's.

NON-ORGANIZED SECONDARY PARTICIPATION

In a highly commercialized and secularized agricultural community, unorganized and relatively impersonal contacts account for a great share of the social relationships entered into by farmers. Measures of such activities, perhaps even more clearly than preceding ones, reflect secularization of the behavior of people in agriculture. Hence it is of significance to inquire into the bearing of such behavior upon the acceptance of rational technology. In general, it appears that the wider and more frequent the impersonal contacts, the less resistant was the farmer to hybrid seed.

Table 21 reveals that the very earliest adopters had taken nearly three times as many trips to Des Moines (the nearest metropolitan center) as the very latest acceptors. In the proportion of operators visiting Des Moines four or more times, the difference between the A and D groups is especially apparent. Whereas 39 percent of the A group had visited Des Moines four or more times, not quite 6 percent (one case) of the D group had made this many visits. Al-

TABLE 21. NUMBER OF TRIPS TO DES MOINES IN 1940 FOR OPERATORS IN THE FOUR ACCEPTANCE GROUPS, PERCENTAGE DISTRIBUTION AND MEANS.

Number of trips	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
None	8.7	22.2	27.1	35.4	24.8
1-3	52.3	47.2	45.1	58.8	47.3
4 and over	39.0	30.6	27.8	5.8	27.9
Total	100	100	100	100	100
No. cases	23	72	144*	17	256
Mean trips	4.3	3.2	3.2	1.5	3.2

*Data unascertainable for one case.
Chi square=5.87, d.f.=6; chi square not significant at P=0.05.

though the mean number of trips of the B and C groups were intermediate between the extreme groups, the differences among the four acceptance groups were not statistically significant. (Chi square= 5.87, d.f.=3; not significant at 5 percent level.)

The A group operators are also differentiated from the D group adopters on the basis of the number of trips to local trade centers. Thus the mean number of trips for the earliest adoption groups was 156 compared to 112 for the latest group. (Table 22.) Although

TABLE 22. NUMBER OF TRIPS TO LOCAL TRADE CENTER IN 1940 FOR OPERATORS IN FOUR ACCEPTANCE GROUPS, PERCENTAGE DISTRIBUTION AND MEANS.

Number of trips	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
0-100	26.0	26.5	31.9	52.9	31.0
101-150	30.5	51.2	45.2	17.7	43.6
151-250	43.5	22.3	22.9	29.4	25.0
Total	100	100	100	100	100
No. cases	23	72	144	17	256*
Mean trips	156	129	122	112	127

*Data for one case unascertainable.
Chi square=11.59, d.f.=6; not significant at P=0.05.

the mean number of trips of the intermediate groups fell between the mean number of trips of the very earliest and latest acceptors, differences among the four groups are not statistically significant. (Chi square=11.59, d.f.=6; not significant at 5 percent level.) The unreliability of these differences is attested by the greater proportion of D operators than of B and C operators taking over 150 trips to the local trade center.

COMMERCIALIZED RECREATION

A more specific measure of secularization in social relationships is participation in commercialized recreation. The attendance at such events during the year was totaled to provide a commercial recreational score for each operator. While the score is heavily weighted by motion picture attendance, only a crude measure of the extent of such contacts was sought. Activities included were public dances, movies, bowling, pool and athletic events. Table 23 shows that frequent attendance at such events is associated with early adoption of hybrid corn. (Chi square=16.15, d.f=6; significant at 5 percent level.) However, in this instance, the very early acceptors were not exceptionally active. More accurately, a considerable number were wholly inactive while others were above average in activity. However, the mean number of events attended was very slightly above the B average. Interestingly enough the B group was more active than the C group in this type of activity. As has been found in most other measures of participation, the D group was extremely low in its participation; nearly 60 percent attended no commercial recreational activities whatsoever, compared to 26 percent for the A adopters.

TABLE 23. NUMBER OF COMMERCIALIZED RECREATIONAL EVENTS ATTENDED DURING YEAR BY OPERATORS IN FOUR ACCEPTANCE GROUPS, PERCENTAGE DISTRIBUTION AND MEANS.

Number of events	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
0	26.0	15.3	22.1	58.8	23.6
1-15	30.5	37.5	40.0	23.5	37.0
16-60	43.5	47.2	37.9	17.7	39.4
Total	100	100	100	100	100
No. cases	23	72	145	17	257
Mean events attended	21.6	20.3	15.9	8.1	16.4

Chi square=16.15, d.f.=6; significant at P=0.05.

Similar inactivity on the part of the most resistant farmers is shown in the attendance at fairs and husking contests. (Table 24.) The D operators were usually very infrequent attenders; the mean average attendance of the latest adopters was less than one-half that of the other adoption groups. It should be noted that quite a number of the A acceptors attended no fairs, but those who did attend went to a considerable number. The most active group of all in this measurement was the moderately early group B; these operators were much more active in fair attendance than were the moderately resistant group C.

TABLE 24. NUMBER OF FAIRS ATTENDED IN 1938, 1939 AND 1940 BY OPERATORS IN FOUR ACCEPTANCE GROUPS, PERCENTAGE DISTRIBUTION AND MEANS.

Number of fairs attended	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
0	19.0	4.3	12.1	17.6	10.0
1-4	42.9	54.3	62.9	76.5	59.6
5-over	38.1	41.4	25.0	5.9	30.4
Total	100	100	100	100	100
Data unknown	2	2	5	.....	9
No. cases	23	72	145	17	257
attended	3.5	4.1	3.3	1.6	3.5

Chi square=15.31, d.f.=6; significant at P=0.05.

READING

In most measures of participation through reading more clear-cut relationships are found with early adoption than for more direct forms of participation. In the reading of Iowa State College bulletins this is particularly evident. (Table 25.) Farmers who read bulletins adopted hybrid seed much more rapidly than those who did not read them. (Chi square=19.70, d.f.=6; significant at 1 percent level.)

TABLE 25. NUMBER OF IOWA STATE COLLEGE BULLETINS READ BY OPERATORS IN FOUR ACCEPTANCE GROUPS IN 1941, PERCENTAGE DISTRIBUTION AND MEANS.

Number of bulletins read	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
0	31.8	50.0	64.5	88.2	58.0
1-6	41.0	37.5	23.0	11.8	26.4
7-over	27.2	12.5	12.5	.....	13.8
Total	100	100	100	100	100
No. cases	22	72	145	17	256*
Mean	5.5	3.3	2.5	.5	2.8

*Data unascertainable for one case.
Chi square=19.70, d.f.=6; significant at P=0.01.

Between each later adoption group there were successive declines in the average number of bulletins read in 1941. The mean number of bulletins read in 1941 ranged from 5.5 for the earliest adopters to .5 for the latest. Perhaps more important than numbers read is whether or not the farmer was in touch with college bulletins. (Nearly three-fifths of the sample were not, in the preceding year for which information was obtained.) Whereas less than a third of the A group had read no bulletins, one-half of the B and nearly two-thirds of the C had been without this means of contact. Only two of the 17 D operators had read such materials in the preceding 12 months.

It has been seen that earliness of adoption is related to close contact with an important source of agricultural information. Alertness to a single technical innovation and an interest in agricultural science as shown by reading college bulletins would reasonably be associated. There is some indication that extensive reading in general was also associated with rapidity of adoption. While this association is not as clear as the association with college bulletins read, in general it tended to be true in the communities studied. (Table 26.)

TABLE 26. PERCENTAGE OF OPERATORS READING LIBRARY BOOKS IN FOUR ACCEPTANCE GROUPS IN 1941 AND MEAN NUMBER OF BOOKS READ, BY THOSE READING ANY.

	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
Not Reading	65.4	77.9	86.0	94.1	82.5
Reading	34.6	22.1	14.0	5.9	17.5
Total	100	100	100	100	100
No. cases	23	70	145	17	255**
Mean number read	11.4	10.9	11.0	*	7.9

*One case.
**Data unascertainable for two cases.
Chi square=7.26, d.f.=3; not significant at P=0.05.

Perhaps the most interesting point in table 26 is the large proportion of the farm operators reading no library books at all.[56] Thus, over four-fifths (82.5 percent) of the farmers reported no use of local library facilities. However, despite the high proportion of all operators not reading any library books, the D operators were extremely inactive in library use when compared to the A group. Thus, one-third of the A's as compared to only one of the 17 D operators read *any* library books. Further, of those who read any library books in the earliest adoption group, the mean number of books read was 11.4. Differences between the four acceptance groups however, were not statistically significant.[57] (Chi square=7.26, d.f.=3; not significant at 5 percent level.)

In view of the extremely high proportion in each group not using library books at all, the regular taking of magazines and newspapers is probably a more accurate expression of miscellaneous reading. This includes daily and weekly newspapers, farm journals and popular magazines.[58]

Table 27 shows an unmistakable association between the number of newspapers and journals regularly available to the operators and early adoption. While differences in means are not large, the mean of each later adoption group is less than the preceding one. More informative are the percentage distributions. Nearly three-fifths of the D's fall into the lowest subscription category as compared with only one-eighth of the A's; at the other extreme more than one-half

[56]See C. Arnold Anderson and Neal Gross, Can Iowa Have Better Public Library Service, Iowa Agr. Exp. Sta. and Iowa Agr. Ext. Serv., Bul. P50, 1943, for an analysis of the library situation in Iowa.

[57]However, if the mean number of books read for all A operators (not just those reading) is compared with similar means for other groups, the A adopters averaged 4.0 books as compared to 2.5 for the B and 2.1 for the C group.

[58]Practically all farmers in the study took one or more farm journals, one local weekly newspaper and one city daily newspaper.

TABLE 27. NUMBER OF MAGAZINES AND NEWSPAPERS TAKEN BY OPERATORS IN FOUR ACCEPTANCE GROUPS, PERCENTAGE DISTRIBUTION AND MEAN NUMBER TAKEN.

Number of magazines and newspapers	Period				Total
	A (Percent)	B (Percent)	C (Percent)	D (Percent)	(Percent)
0-6	13.0	19.5	34.8	58.9	31.2
7-8	30.5	38.8	27.1	35.2	30.4
9-over	56.5	41.7	38.1	5.9	38.4
Total	100	100	100	100	100
No. cases	23	72	144	17	256*
Mean	9.3	8.0	7.7	6.1	7.8

*Data unascertainable for one case.
Chi square=19.48, d.f.=6; significant at P=0.01.

of the A's are in the highest subscription bracket as compared with only one-seventeenth of the D's (one case). Between the intermediate acceptance groups differences are smaller, although nearly twice as many C operators as B operators were in the lowest reading category.

DISCUSSION

This study provides no adequate bases for statistically predicting susceptibility to a technological innovation. But in any exploratory study of social behavior involving complex motivations, frames of mind, and some dependence upon external conditions, one can scarcely expect to derive simple touchstones of prediction. Results must be suggestive rather than definitive. The fact remains, however, that the two extreme adoption groups were in sharp contrast, and there is a tendency for the points of contrast to have some importance in determining adoption dates for the intermediate acceptors. Factors have been uncovered which condition the rapidity with which a technological innovation is adopted. In the large intermediate acceptance groups, where these conditions are neither strongly nor weakly manifest, there is no way of knowing the determinate elements which entered the climate of decision.

From a practical standpoint our characterization of the innovators and of the most resistant may have valuable implications. Insofar as the decision to adopt hybrid seed typifies technological innovation generally, it might be inferred tentatively that preliminary acceptance of a new technique would most readily be attained among the socially active, younger, better educated and large-scale opera-

tors.[59] Conversely, a program directed toward those with narrow social contacts, older age, less education and small holdings would have less probability of rapid success.

In this connection our negative findings are of particular interest. A presumption that leaders in the social and organizational life of the community are leaders in technological change appears unjustified. While it may well be that such social leaders are influential in spreading a technique, there is no indication that they are the most active in introducing it. From a theoretic standpoint this distinction is significant also, since it tends to confirm the hypothesis that leadership in rurban communities is a particularized phenomenon rather than a general undifferentiated attribute of certain persons.[60] Technological leadership is here clearly distinguished from organizational leadership.

The meaning of size of farm enterprise is difficult to assess. Insofar as it bears association with early adoption, this could arise from a number of equally tenable conditions—i.e., maintenance of closer touch with sources of technical knowledge, greater unconcern over the speculative use of a small acreage, etc.

Our most significant observation is in the many evidences that wide social contact is associated with a psychological climate conducive to technological change. This is not to be deemed simply a product of integration of the individual in his local community. Many of the particular variables apply to extra-community activities. Nor is it likely that these relationships are merely the reflections of relative proximity to sources of information. (It has been observed that ignorance of hybrid seed's existence at least could have been no serious deterrent, and sources of further knowledge were available to all.) Some of the participation measures are, it is true, direct expressions of alertness to technologic developments —e.g., reading Extension Service bulletins. But it seems unlikely that certain other measures would directly reflect such awareness. The existence of interrelationships between many of the participation measures could scarcely be doubted; however, the demonstration of independence in any of these factors would not be meaningful, since none of them could reasonably be designated as a determinant, and each of them is more probably the product of a more basic underlying condition. Each of the participation variables showing association with adoption is in varying degrees an element in a well known sociological configuration. As a complex these measured traits suggest an individual's identification with a particular way of life contrasting sharply with the traditional, familistic agricultural associational pattern. The kinds of social participa-

[59]The results of C. R. Hoffer's study (op. cit.) of Michigan celery-growing farmers directly corroborates our findings in respect to the importance of social participation and age. Size of farm enterprise was not among the variables he studied.

[60]See Ryan, Bryce, op. cit.

tion and contact associated with receptivity all tend to be peculiarly secular.[61] Technological leadership is here probably associated with responsiveness to basic secularizing features in American agricultural life. Participation in special interest groups, contacts with trade centers, extensions of interaction through secondary means, audience participation, etc., all serve to minimize the influence of traditional rural experience.[62] Each of these approaches an antithesis to characteristic features of solidary primary group rural living.[63]

Most observers today realize that many segments of American farm life are becoming urbanized. The growing secular structure of farm living is probably the most dominant rural sociological trend of the time. The evidence of this study suggests that the farmers most emancipated from the traditional closely built neighborhood life more readily emancipate themselves from a traditional technique. This implies a direct functional relationship between community secularization and the development of personalities amenable to technical change. If these inferences are justified, then the data also support the hypothesis that the process of secularization in the rural community produces distinct social types. The contrasting characterizations of the extreme adoption groups on such a complex of sociological factors, strongly suggest that we are dealing not merely with suggestible and non-suggestible personalities, but with social types approaching behavioral extremes on the continuum of folk-urban society.[64]

This suggests, therefore, that there may be a solid configurational relationship between the urbanization of rural behavior and our observation that the more secularized more readily adopt a technical change in the farm enterprise. Whether this flexibility implies greater susceptibility to change of all types, or greater rationality, or both, cannot be determined. This could be ascertained only by studying responsiveness to various types of innovation.[65]

The impact of secularization has been experienced in varying degrees by the various operators; the research suggests that the most

[61]See Neal Gross, "Sociological Variation in Contemporary Rural Life," Rural Soc., Vol. 13, No. 3, 1948, pp. 256-269; Neal Gross, "Cultural Variables in Rural Communities," Amer. Jour. Soc., Vol. 53, No. 5, 1948, pp. 344-350.

[62]It is unfortunate that intensive participation in the "ruralistic" structures of the community must rest as a residual category. Our single measure of this, extent of neighboring, showed no relationship to receptivity, and other measures were not developed due mainly to the great difficulty of devising them short of a case study approach.

[63]For an analysis of this problem in a sharply contrasting rural culture see Irwin T. Sanders, "The Social Contacts of a Bulgarian Village" Rural Sociology, Vol. 4, No. 3, 1939, pp. 315-327. Professor Sanders demonstrates clearly that "contact" without positive interaction with the secular world may produce negativism toward change rather than stimulation to it. His conclusion appears applicable not only to the Bulgarian peasant, but to the most nonparticipatory operators in this relatively secular rural community.

[64]For present purposes it matters little whether the specific analytical framework of Tönennies, Redfield, Sorokin and Zimmerman, Becker or of Maine is used. The essential contrast, and process, is implicit and/or explicit in each of these.

[65]See Neal Gross, "The Differential Characteristics of Accepters and Non-Accepters of an Approved Technological Practice," Rural Sociology, vol. 14, No. 2, 1949, pp. 148-156, for a consideration of this problem.

urbanized rural type is most responsive to this major technical improvement in farming. Conversely those least touched by this process are the most resistant to the change. Thus the innovative role which has historically characterized urban populations here enters the agricultural scene through those farm individuals least "rural" in their way of life. If this conclusion is substantiated by wider study of technical change, its implications for agricultural policy are evident. The interest of a technically progressive agriculture may not be well served by social policies designed to preserve or revivify the traditional rural-folk community. Finally, it must be pointed out that this research has in many instances only touched "surface" characteristics of the leaders and laggards in accepting technological innovations. Subsequent researches on this problem might profitably consider in some detail the sociopsychological profiles (e.g. motivations, social perception, aspirations and attitudes) of early and late adopters of new agricultural practices.