Pesticides

SCHOOL OF AGRICULTURAL ECONOMICS AND EXTENSION EDUCATION

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THE FARMER DECISION PROCESS IN PURCHASING CORN HERBICIDES

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1.0 INTRODUCTION

In the Fall of 1976, a cooperative research project was initiated between several leading firms in the Canadian corn herbicide industry and the School of Agricultural Economics and Extension Education at the University of Guelph. The major objectives established for this research were:

(1) To analyze the corn herbicide purchasing decisions of Southwestern Ontario farmers,

(2) To develop and analyze a model of the farmer decision process in purchasing corn herbicides, and

(3) To analyze the distribution system for corn herbicides in Ontario.

The purpose of this report is to present the findings of this research as they relate to the second objective, the development and analysis of a model of the farmer decision process in purchasing corn herbicides. Results related to the first objective are reported in Funk and Vincent (1977).

1.1 The Research Problem

The primary objective of the farm input marketer is to develop marketing programs which create strong preference for, and eventual purchase of, his product and/or services. To accomplish this objective, it is imperative that the marketer have a clear understanding of the nature of the process used by farmers in making their purchasing decisions. Because the aim of the farm marketer is to influence this decision process, the success of his efforts depends upon his understanding of how the buying decision is made: that is, What creates a buying situation? What is the process by which alternatives are identified and decision criteria established? How are alternatives evaluated and selected? Answers to these and similar questions will enable the farm input marketer to develop more effective and efficient

marketing programs.

1.2 Research Objectives

The general objective of this research is to investigate the nature of the farmer decision process in purchasing corn herbicides. To accomplish this general objective, the specific research objectives are:

(1) To determine the factors which cause farmers to experience doubts or problems with their weed control programs,

(2) To determine the sources farmers consider useful for obtaining information on corn herbicides,

(3) To determine the extent to which farmers participate in shopping activities for obtaining herbicide information,

(4) To determine the salient product and company attributes farmers evaluate when purchasing a corn herbicide,

(5) To investigate farmers' perceptions of, and preferences for, existing brands of corn herbicides,

(6) To analyze the nature of the purchasing decision for corn herbicides, and

(7) To examine the possibilities for market segmentation in the corn herbicide market.

1.3 Data Sources

The sources of data for this study were two surveys of Southwestern Ontario corn producers. The first survey was carried out in December 1976 utilizing a structured, personal interview as the method of data collection. In this survey, detailed information was obtained from a sample of 175 farmers on their corn herbicide purchasing behaviour and decisions for the crop year 1976. The second survey was carried out during the summer of 1977 and consisted of sending a mail questionnaire to each member of the

original sample. The purpose of the follow-up mail survey was to update the purchase information for crop year 1977.[1]

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[1] For a detailed discussion of the questionnaire design and sampling plan used in this research see Funk and Vincent (1977).

2.0 THE FARMER DECISION PROCESS MODEL

The need for a theoretical model to guide marketing research has long been recognized. Moreover, as activities in marketing research expand in complexity and scope, it has become even clearer that what is critically needed is not merely a model which explains the effects of market forces on sales, but one which can explain how marketing activities influence the buyer's behaviour (Lunn, 1974).

To date, the most successful response to the above need has been the approach to buyer behaviour theory which has come to place major emphasis on the consumer decision process. Through the skillful incorporation of concepts and findings from the behavioural sciences into models of buyer behaviour, this decision process approach has been able to provide rich insights into the buyer's goals, attitudes, and behavioural responses.

The central idea underlying the decision process approach is that the purchasing act itself is only one component in a complex purchasing decision process. This idea is well brought out by Engel, Kollat and Blackwell who assert: "According to this approach, a purchase is <u>one point</u> in a particular course of action undertaken by a consumer. In order to understand that one point (the act of purchasing) it is necessary to examine the events that precede and follow the purchase" (1972, p.7).

The purpose of this section is to present a comprehensive model of the farmer decision process in purchasing corn herbicides. The conceptual scheme of this model draws heavily on the model of industrial buying behaviour developed by Webster (1965), and the consumer decision process models developed by Engel, Kollat, and Blackwell (1972) and Howard and Sheth (1969).

The proposed corn herbicide decision process model is illustrated in Figure 2.1. As shown in this figure, the decision process consists of five

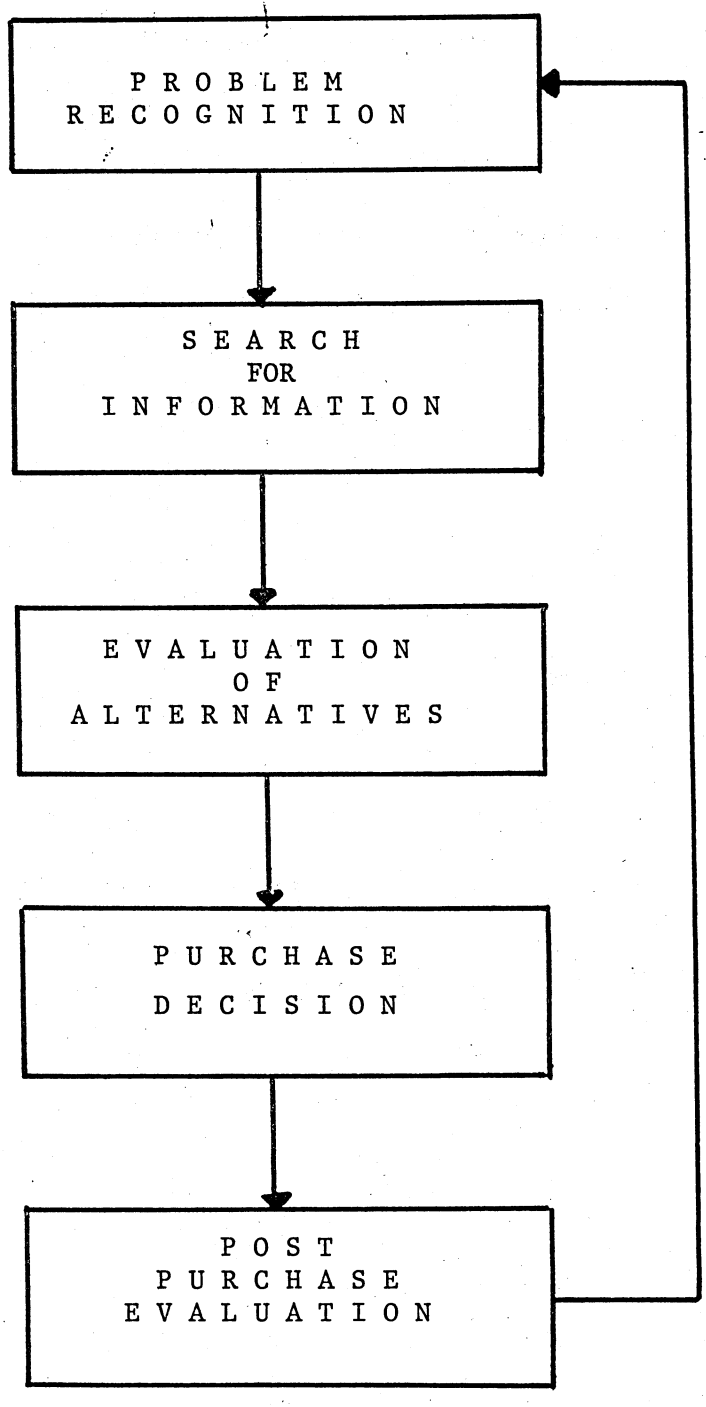

FIGURE 2.1

THE CORN HERBICIDE PURCHASE DECISION MODEL

sequential stages: (1) Problem Recognition, (2) Search for Information, (3) Evaluation of Alternatives, (4) The Purchase Decision, and (5) Post-purchase Evaluation.

2.1 Problem Recognition

The decision process begins when the farmer recognizes a problem. In the context of the corn herbicide purchase decision, a problem emerges when a difference exists between the farmer's expectation of a corn herbicide and the actual level of performance and service experienced in using the herbicide. In more specific terms, a problem is recognized when a discrepancy exists between the desired and actual levels of goal attainment associated with the purchase and use of a corn herbicide in the farming operation. Some of the specific goals or expectations which farmers may have are thought to be related to the following product and service characteristics: (1) level of weed control, (2) cost per acre, (3) convenience in measuring and mixing, (4) convenience in timing and method of application, (5) crop safety, (6) residue or carryover, (7) dealer service, and (8) company and salesman service.

Dissatisfaction with the actual level of goal attainment in relation to any of the above characteristics can cause the farmer to recognize a problem with his corn herbicide. For example, a particular corn grower may recognize a problem if he finds that a given brand of corn herbicide gives him unsatisfactory weed control, or that the residue of the brand is too high for his crop rotation pattern. Moreover, farmers can be expected to differ in the intensity of problem recognition because of variations in the degree of importance they attach to the above performance and service characteristics, and because of differences in their levels of tolerance concerning discrepancies between desired and actual levels of performance.

Differences between desired and actual levels of goal attainment may also result from an increase in the farmer's expectations of the product. As a result, it is possible that exposure to information in the commercial and social environment may cause a farmer to increase his expectations of a corn herbicide to the extent that his desired level of goal attainment becomes greater than his customarily accepted level of product performance. The information most effective in inducing this form of problem recognition is thought to flow from: (1) the marketing action of commercial firms, in particular, advertisements, personal selling, company-organized farmer meetings and farm shows, and (2) other non-commercial sources in the environment such as dealers, other corn growers, extension agents, and government publications.

2.2 Search for Information

Once a problem is recognized, the farmer moves to the second stage of the decision-process, the search for information. This stage involves the expenditure of time and effort in the active search of the commercial and social environment for relevant information on alternative corn herbicide brands or treatments which may lead to a solution of the farmer's problem. The information the farmer seeks to obtain at this stage pertains to product performance and service characteristics such as product efficacy, cost per acre, and company service.

Central to the farmer's search process is the identification and selection of information sources. Many personal and impoersonal sources are available to the Ontario corn grower. Personal information sources include chemical salesmen, dealers, other corn growers, extension agents, university personnel, custom applicators, county weed inspectors, and farmer meetings. Impersonal sources include government publications (especially Publication 75)[2],

[2] Publication 75 is an official publication of the Ontario Ministry of Agriculture and Food which makes herbicide recommendations for most crops grown in the province.

advertisements, company pamphlets and package labels.

Farmers can be expected to differ in the extent to which they engage in searching activities. As a step toward explaining these differences, the following factors are hypothesized to be related to farmers' overall searching behaviour: (1) problem intensity, (2) importance of the purchase, (3) attitude toward searching, (4) past experience, (5) perceived brand differences, (6) risk attitudes, (7) self confidence, (8) attitudes toward information sources, (9) price sensitivity, and (10) weed and herbicide knowledge.

2.3 Evaluation of Alternatives

Having collected information on alternative brands of corn herbicides, farmers then go through a choice process in which they evaluate these alternatives. The fundamental idea in this stage is that farmers have certain choice or decision criteria which are used, to evaluate different brands of corn herbicides. The brand which best satisfies these decision criteria is the one for which the most favourable attitude will be formed, and consequently the one most likely to be purchased. Some examples of criteria used to evaluate corn herbicides are weed control, company reputation, cost, and ease of mixing and measuring.

2.4 The Purchase Decision

On the basis of the prior evaluation procedure, the alternative which offers the best prospect of solving the farmer's problem will be purchased. That is, the farmer will purchase the brand which best accords with his expectations of a corn herbicide and offers him the greatest probability of achieving his desired level of goal attainment.

Although it is possible that the purchase decision will result in a switch to a different brand or supplier, this will not occur in all instances. If, in the process of search and evaluation, the farmer does not identify a

superior brand, goals or expectations may be modified and a decision to continue with the use of the present brand may be taken.

2.5 Post-purchase Evaluation

Post-purchase evaluation assumes an important role in the farmer's buying process. The outcome of this stage is determined by the kind of experience the farmer has in using the product previously purchased. If the purchased brand proves to be satisfactory, favourable attitudes are formed towards the brand, and the farmer's brand preferences strengthened. On the other hand, if an unsatisfactory experience occurs, unfavourable attitudes towards the brand may result, and a buying situation created with strong possibilities for brand switching.

2.6 General Observations on the Farmer Decision Process Model

In applying the above model to the case of the farmer decision process in purchasing herbicides, it is important to note four possible problems. First, one inevitable consideration in the application of a theoretical decision process model to farmer buying behaviour is the fact that these models are usually applied to consumer markets, whereas farmer buying more appropriately belongs to the domain of producer markets. Although this is true, it does not necessarily mean that the basic tenets of decision process models are not applicable to producer markets. Rather, it suggests the need for models which focus on the particular characteristics of producer markets while, at the same time, incorporating the fundamental concepts of the decision process approach. Such models have appeared in the literature; however, they have concentrated on the complex decision-making process of large industrial organizations and have little direct relevance to the sole proprietorship farming operation (Webster and Wind, 1972).

Second, the above model represents a simplified view of a decision process which in the real world is more complex and dynamic. However, any attempt to capture the more complex dimensions of this process may lead to a model of unmanageable size. The model presented here is considered appropriate for the purposes of this study insofar as it depicts the essential features of the corn herbicide decision process in a manner which permits meaningful investigation and analysis within a reasonable period of time.

Third, the model portrays a very rational decision process which is more appropriate in buying situations characterized by limited and extensive problem solving, but may be over-rational for the farmer for whom the corn herbicide purchase has become a routine decision. Farmers in the latter category may bypass the search and evaluation stages and move directly to the purchase decision. Such farmers can be expected to be highly brand loyal.

Finally, there are a number of exogenous variables influencing the decision process which have not been explicitly considered in the above presentation of the model. These variables include socio-economic characteristics such as age, farm income, education, farm size, and farm type. Farmers' behaviour may differ at one or more stages of the decision process because of differences in any of these characteristics. The influence of these variables will be considered in the empirical analysis discussed in the following section.

3.0 RESULTS

This section presents the detailed empirical results of the sample survey of 175 Ontario corn growers. These results are reported individually for each stage of the farmer decision process in accordance with the research objectives specified in Section 1.2. A summary of the major findings, together with their implications, is reserved for Section 4.0.

3.1 Problem Recognition

A problem is recognized when a discrepancy exists between a farmer's expectations of a corn herbicide, and the actual level of performance and service achieved in using the product. Since one of the objectives of any well-conceived marketing program is to prevent problems from arising in the minds of present customers, while promoting problems in the minds of potential customers, it is important that the sources of these problems be identified, and their relative importance determined.

3.1.1 Potential Problem Sources

To investigate potential problem sources, the farmers were asked to rate themselves on a four-point scale in response to a series of 18 statements designed to depict situations which might cause them to experience doubts or problems with their current weed control program. These statements were intended to reflect the two general conditions postulated by the decision process model to give rise to problem recognition: (1) a decline in the actual level of product performance and service and (2) an increase in product and service expectations.

For each statement the farmers were asked to indicate whether the hypothetical situation would: (1) definitely cause them to doubt or question their corn weed control program, (2) might cause them to doubt or question their corn weed control program, (3) probably would not cause them to doubt or question their corn weed control program, or (4) definitely would not cause them to

TABLE 3.1

SITUATIONS CAUSING FARMERS TO RECOGNIZE PROBLEMS WITH THEIR CORN HERBICIDES

Problem Sources	Factor Loading	Category Importance Scale	Percentage of Farmers Reporting: Definitely Cause Doubts	Might Cause Doubts	Probably Would Not Cause Doubts	Definitely Would Not Cause Doubts
WEED CONTROL		286				
1. If I thought I was getting poor weed control with the brand I was using.	.56		42	38	11	9
2. If my weed control this year seemed to be slightly poorer than last year.	.71		12	47	25	16
3. If I heard of another brand that supposedly controlled a broader spectrum of weeds than the brand I was using.	.29		28	45	17	10
OTHER PRODUCT ATTRIBUTES		275				
1. If I heard about another brand of corn herbicide that did not have residue or carryover problems.	.48		40	27	18	15
2. If I heard of another brand that required less expensive application equipment than the brand I was using.	.55		26	27	15	32
3. If I heard of another brand that seemed easier to measure and mix.	.61		25	29	20	26
4. If I thought the brand I was using caused some minor damage to my corn crop.	.41		40	35	15	10
AVAILABILITY OF PRODUCT INFORMATION		314				
1. If my dealer could not provide adequate information on the brand I was using.	.78		37	25	16	22
2. If the manufacturer could not provide adequate information on the brand I was using.	.60		71	16	5	8
COST CONSIDERATIONS		273				
1. If I heard about a brand of corn herbicide that was somewhat less expensive per acre than the brand I was using.	.44		37	30	15	18
2. If the price of the brand I was using increased by five percent while the prices of other brands remained more or less the same.	.64		29	23	26	22

TABLE 3.1 contd....

SITUATIONS CAUSING FARMERS TO RECOGNIZE PROBLEMS WITH THEIR CORN HERBICIDES

Problem Sources	Factor Loading	Category Importance Scale	Percentage of Farmers Reporting: Definitely Cause Doubts	Might Cause Doubts	Probably Would Not Cause Doubts	Definitely Would Not Cause Doubts
INFLUENCE OF ADVERTISEMENTS AND PERSONAL SELLING		222				
1. If a salesman suggested that I could get better weed control with the brand he was selling.	.54		7	35	28	30
2. If an advertisement I read for another brand of corn herbicide implied I could get better results using this brand.	.70		6	34	37	23
INFLUENCE OF OTHER INFORMATION SOURCES		296				
1. If the dealer I had been buying my corn herbicide from suggested that I could get better results by using another brand.	.56		25	48	16	11
2. If after reading Publication 75 (Guide to Chemical Weed Control), I realized that it didn't recommend the brand I was using for the type of weed problem I had.	.43		40	34	14	12
3. If my extension agent suggested that I could get better results by using another brand of corn herbicide.	.54		25	46	16	13
4. If information I obtained at a farmer meeting for another brand of corn herbicide seemed to imply that I could get better results by using another brand	.63		16	51	19	14
5. If I noticed that my neighbours and friends, with similar weed problems as myself, seemed to be getting better weed control by using a different brand.	.51		57	33	6	4

doubt or question their corn weed control program.

Factor analysis was employed with the aim of grouping the 18 statements into sharper and more meaningful categories.[3] As a result of this analysis, the following categories were derived: (1) weed control, (2) other proudct attributes (3) availability of product information, (4) cost considerations, (5) influence of advertisements and personal selling, and (6) influence of other information sources. The first four categories relate to problem recognition brought about by the exposure to new information which causes an increase in the farmer's expectations, while the latter two relate to problem recognition brought about by exposure to new information which causes an increase in the farmer's expectations. Table 3.1 presents a summary of farmers' responses to the 18 statements.

(1) Weed Control. The first category considered in Table 3.1 is weed control. As expected, the results show that poor product performance with respect to weed control is an important source of problems to a large proportion of herbicide users. For all the statements in this category, only a very small percentage of the farmers stated that the situations definitely would not cause them to experience doubts or problems with their present weed control program.

(2) Other Product Attributes. In addition to poor weed control, problems can also arise as a result of farmers'concerns for other product attributes such as residue, application methods, measuring and mixing, and crop safety. While the results in Table 3.1 suggest that inadequate product

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[3] Principal components factor analysis with an orthogonal rotation was used with the criterion that all factors with an eigenvalue greater than 1.0 be initially extracted from the matrix of correlation coefficients (Wells and Sheth, 1971). Using this criterion, six factors were extracted which together accounted for 60 percent of the total variance. In defining factors, only variables having loadings greater than 0.40 were considered with the exception of one case where it was believed that the particular variable was associated with the factor under consideration. The factor loadings for each variable are shown in Table 3.1.

performance in any of these areas can cause doubts or problems in the minds of many farmers, the attributes which appear to be most important are residue and crop safety.

(3) Information Availability. A lack of product information can also be a significant source of problems for corn growers. Examination of the responses to the two questions in this category reveals that approximately 60 percent of the farmers definitely would or might experience doubts or problems if their dealer could not provide adequate information. This increased to over 80 percent if the farmers felt that the manufacturer could not provide adequate information about his product.

(4) Cost Considerations. Although not as important as some of the previous factors, farmers concern for costs can also result in problems. The findings here showed that although two-thirds of the farmers felt that they definitely or might experience doubts after hearing of a less expensive brand, almost one-half indicated that a price increase of five percent relative to other brands probably or definitely would not cause them to develop doubts or problems.

(5) Influence of Advertisements and Personal Selling. Advertisements and personal selling are particularly interesting because they reflect the direct attempts of manufacturers and dealers to create problems in the minds of potential customers. The farmers' responses to the two situations in this area suggest that while these marketing techniques have limited effectiveness in definitely causing problems, they have the potential to cause problems for a surprisingly large proportion of farmers.

It is necessary to qualify the above results regarding the potential influence of advertisements and personal selling on problem recognition. because the statements used in this category tend to reflect the promotion

of only one dimension of product performance, namely, weed control. It is possible, however, that advertising and personal selling efforts which promote other attributes such as low residue may in effect have a stronger influence on problem recognition. The important point is that it may not be advertising or personal selling per se which induces problem recognition, but rather the content of the particular message which the company salesman or advertisement is trying to convey to the farmer.

(6) Influence of Other Information Sources. In addition to advertisements and personal selling, information from other commercial and non-commercial sources can cause farmers to experience doubts or problems with their current weed control programs. Of the other sources listed in Table 3.1, other farmers and government publications which make recommendations on herbicide use appear to be the most important in definitely causing doubts, while dealer recommendations, extension agent suggestions, and farmer meetings can potentially cause doubts to arise among sizeable proportions of farmers.

3.1.2 Relative Importance of Potential Problem Sources

With a view toward providing some insight into the relative importance of the problem sources shown in Table 3.1, a category importance scale was developed by computing a weighted average[4] of the percentages of farmers responding to statements in each category.

The results of the above procedure are shown in Table 3.1 in the column labelled "category importance scale." On the basis of this scale, the six categories were ranked as follows in terms of their potential influence

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[4] Weights were assigned as follows:

1 = definitely would not cause doubts.
2 = probably would not cause doubts.
3 = might cause doubts.
4 = definitely would cause doubts.

on problem recognition:

(1) Availability of Product Information

(2) Influence of other Information Sources.

(3) Weed control.

(4) Other Product Attributes.

(5) Cost Considerations.

(6) Influence of Advertising and Personal Selling.

These results show that while all the sources listed in Table 3.1 have some probability of causing problems, the possibility of a lack of product information has the greatest potential, while advertisements and personal selling have the least potential.

3.1.3 Causes and Timing of Problem Recognition

In order to investigate the actual causes and timing of problem recognition in the last crop year the farmers were asked (1) whether they experienced any doubts or problems with their brands of corn herbicides at any time during the past year, (2) what circumstances caused these doubts, and (3) when these doubts were experienced.

Thirty-four percent of the farmers reported that they had experienced doubts or problems with the brands of corn herbicide used in the last crop year. The circumstances which caused these farmers to experience problems are shown in Table 3.2 which shows that the most dominant circumstance which led to problems in the 1976 crop year was unsatisfactory weed control. Of the remaining circumstances, mixing problems and unfavourable weather conditions were the most prevalent.

This result seems to contradict the findings reported in Section 3.1.2 where it was noted that the availability of product information was potentially the most important source of problem recognition. In interpreting these

TABLE 3.2

CIRCUMSTANCES CAUSING FARMERS TO EXPERIENCE DOUBTS OR PROBLEMS WITH THE BRAND OF CORN HERBICIDE USED DURING 1976

Circumstances	Percentage of Farmers
Unsatisfactory Weed Control	59
Mixing Problems	16
Unfavourable Weather Conditions	15
Corn Injury	3
Timing of Application Considerations	3
Concern for Residue or Carryover	2
Cost per Acre Considerations	2
	100

TABLE 3.3

MONTHS OF THE YEAR DURING WHICH FARMERS EXPERIENCED DOUBTS OR PROBLEMS WITH THE BRAND OF CORN HERBICIDE USED IN 1976

Months	Percentage of Farmers
May	16
June	50
July	23
August	5
September	6
	100

results, the key word is "potentially." While information availability is "potentially" the most important source of problems to farmers, it was not considered important during 1976 because farmers perceived this type of information to be readily available. The point is that if farmers would perceive deficiencies in this area, the lack of product information from dealers or manufacturers would be a potent source of problems to a large number of corn growers.

Table 3.3 illustrates the months during which farmers experienced problems with their corn herbicides during the last crop year. Understandably, more problems were reported to be experienced during the actual weed growing periods of May, June, and July.

3.1.4 Problem Intensity

In addressing the issue of problem intensity, the principal objective was to group farmers into appropriate categories on the basis of some assessment of differences in the severity or intensity of problems experienced in the last crop year.

Two methods were used to measure the degree of problem intensity in the last crop year. Both methods were developed on the assumption that weed control is the dominant source of farmers' problems. Examination of the results previously presented in Tables 3.1 and 3.2 suggests that this assumption is tenable.

The first method of measuring problem intensity involved showing farmers six numbered photographs of corn fields containing different levels of weed infestation progressively varying from number 1, a field completely free of any weed infestation to number 6, an extremely weed-infested field. Farmers were then asked to respond to two questions concerning these photographs: (1) Which photograph best describes the level of weed control you

achieved in your corn this year? and (2) Which photograph best describes the minimum acceptable level of weed control you would tolerate? The difference between the responses to these two questions was assumed to represent an index of farmers' satisfaction with their corn weed control, and hence a measure of problem intensity in 1976.

On the basis of their responses to the above questions, the farmers were classified into three groups corresponding to different goal attainment levels. Table 3.4 shows that 57 percent of the farmers fell into the group labelled "satisfied" where the level of weed control achieved was greater than the minimum level of weed control desired; 28 percent fell into the group labelled "marginally satisfied" where the level of weed control achieved was equal to the minimum level of weed control desires; and 15 percent were classified in the "dissatisfied" group where the level of weed control achieved was less than the minimum level of weed control desired.

For the second method of measuring problem intensity, the farmers were asked to indicate: (1) the specific weeds they treated in their corn in 1976, and (2) the weeds which they were unable to control. Given the number of weeds treated and the number which escaped treatment, it was possible to compute a percentage failure rate for each respondent representing the proportion of treated weeds which were not controlled. Farmers were then grouped into the four failure rate categories shown in Table 3.5. Results here showed that 19 percent of the respondents had either no escapes or a failure rate below one percent. These farmers can be considered as belonging to the group experiencing the lowest level of problem intensity. At the other extreme, the group experiencing the highest level of problem intensity is represented by the 13 percent who had failure rates of 50 percent or greater.

In order to determine which method most accurately describes the manner

TABLE 3.4

DEGREE OF SATISFACTION WITH CORN WEED CONTROL DURING 1976

Goal Attainment Levels	Number of Farmers	Percentage of Farmers
Satisfied		
Level of weed control achieved is greater than the minimum level of weed control desired.	100	57
Marginally Satisfied		
Level of weed control achieved is equal to the minimum level of weed control desired.	49	28
Dissatisfied		
Level of weed control achieved is less than the minimum level of weed control desired.	26	15
	175	100

TABLE 3.5

ESTIMATED FAILURE OR ESCAPE RATE FOR WEEDS TREATED BY FARMERS IN 1976

Failure Rate Categories	Number of Farmers	Percentage of Farmers
Failure rate below one percent	33	19
Failure rate between 1 and 19 percent	46	26
Failure rate between 20 and 49 percent	74	42
Failure rate of 50 percent and over	22	13
	175	100

in which farmers experience problems with their corn herbicides, the results of each were cross-tabulated with the previously defined categories reflecting the actual existence of doubts or problems during the 1976 crop year. The results of this analysis indicated a much stronger association between the failure rate categories and the actual existence of doubts or problems than was the case for the goal attainment levels. As a result, the conclusion of the analysis is that farmers tend to experience weed control problems more on the basis of the number or percentage of weeds controlled than on the basis of some arbitrary assessment of actual versus minimum levels of control.

In retrospect, the failure of the goal attainment method to produce more fruitful results can possibly be attributed to two factors. First, the photographs of the corn fields were mainly characterized by grass problems with minimal broadleaf infestation. As a result, these photographs were likely to have elicited dubious responses from farmers for whom broadleaf weeds were the major problem in the past year. Secondly, many farmers experience weed problems in the nature of one or two weeds in particular areas of their field. This feature makes it difficult to capture their actual level of weed infestation in one overall photograph of a corn field, although some attempt was made to overcome this problem where it occurred by having farmers indicate the percentage of total corn acreage described by each applicable photograph. In contrast, such a pattern of weed problems is more amenable to the measure of problem intensity which takes into account the number of weeds which actually escaped treatment.

3.1.5 Farm and Farmer Differences in Sources of Problems

In designing herbicide marketing programs, the primary objective of the market planner is to develop marketing strategies which stimulate problems in the minds of potential customers, while at the same time preventing problems

from arising with present customers. To successfully accomplish this objective requires not only information on the relative importance of various problem sources as previously discussed, but also some indication of the extent to which different types of farmers view each of these sources as problems. To examine this latter question, the responses to the situations described in Table 3.1 were analyzed by six important farm and farmer characteristics: (1) farm size, (2) corn yields, (3) farm type, (4) age and farming experience, (5) education, and (6) herbicide knowledge.[5] The generalized results of this analysis are shown in Table 3.6.

The information in Table 3.6 shows the type of farmers for whom each situation represents a greater potential source of problems. For example, in the case of weed control the results show that non cash grain farmers with medium experience are more prone to recognize problems if this year's weed control is poorer than that achieved last year. Likewise, very large cash grain producers are more likely to recognize problems if they hear of a broader spectrum weed control treatment.

Although the information in Table 3.6 shows several differences among farm and farmer characteristics in the extent to which the various situations can be sources of problems, the most important are:

(1) Minor crop damage is a greater potential source of problems to younger farmers with higher education and lower herbicide knowledge,

(2) Inadequate dealer information is a greater source of problems for non cash grain farmers with higher education and lower corn yields,

(3) Herbicide costs are greater sources of problems to larger producers

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[5] The detailed procedures used in this analysis are discussed fully in Appendix A. The reader is strongly encouraged to read this appendix before proceeding since the interpretation of the results depends upon an understanding of the measurement and analytical procedures used.

TABLE 3.6
FARMER DIFFERENCES IN THE IMPORTANCE OF PROBLEM SOURCES

Problem Sources	Farm and Farmer Characteristics					
	Farm Size	Corn Yields	Farm Type	Age and Experience	Education	Herbicide Knowledge
WEED CONTROL						
1. If I thought I was getting poor weed control with the brand I was using.						
2. If my weed control this year seemed to be slightly poorer than last year.			Non-Cash Grain**	Medium**		
3. If I heard of another brand that supposedly controlled a broader spectrum of weeds than the brand I was using.	Very Large**		Cash Grain**		Medium*	
OTHER PRODUCT ATTRIBUTES						
1. If I heard about another brand of corn herbicide that did not have residue or carryover problems.						Low**
2. If I heard of another brand that required less expensive application equipment than the brand I was using.	Large & Very Large *			High**		
3. If I heard of another brand that seemed easier to measure and mix.						High*
4. If I thought the brand I was using caused some minor damage to my corn crop.				Young**	High*	Low*
AVAILABILITY OF PRODUCT INFORMATION						
1. If my dealer could not provide adequate information on the brand I was using.		Low*	Non-Cash Grain**		High*	
2. If the manufacturer could not provide adequate information on the brand I was using.					High**	
COST CONSIDERATIONS						
1. If I heard about a brand of corn herbicide that was somewhat less expensive per acre than the brand I was using.	Large & Very Large*					
2. If the price of the brand I was using increased by five percent while the prices of other brands remained more or less the same.	Large & Very Large**				High**	High*
INFLUENCE OF ADVERTISEMENTS AND PERSONAL SELLING						
1. If a salesman suggested that I could get better weed control with the brand he was selling	Medium**					
2. If an advertisement I read for another brand of corn herbicide implied I could get better results using this brand.			Non-Cash Grain*	Medium*		
INFLUENCE OF OTHER INFORMATION SOURCES						
1. If the dealer I had been buying corn herbicide from suggested that I could get better results by using another brand.						
2. If after reading Publication 75 (Guide to Chemical Weed Control), I realized that it didn't recommend the brand I was using for the type of weed problem I had.				Young**	High**	
3. If my extension agent suggested that I could get better results by using another brand of corn herbicide.						
4. If information I obtained at a farmer meeting for another brand of corn herbicide seemed to imply that I could get better results by using another brand.	Medium, Large, and Very Large*	High**				
5. If I noticed that my neighbours and friends, with similar weed problems as myself, seemed to be getting better weed control by using a different brand.			Non-Cash Grain*	Young**		Low**

* = Significance .10;

** = Significance .05.

with higher levels of education and herbicide knowledge,

(4) Herbicide advertisements are more influential in causing problems among non cash grain farmers with medium experience,

(5) The recommendations contained in Publication 75 are more influential in causing problems among more highly educated, younger farmers, and

(6) The level of weed control achieved by other farmers is a greater potential source of problems to younger, non cash grain farmers with lower levels of herbicide knowledge.

3.2 Search for Information

Once a problem has been recognized, the farmer moves to the second stage of the decision process, the active search of the commercial and social environment for information on alternative corn herbicide brands or treatments. In this stage he attempts to secure information on such factors as product efficacy, cost per acre, residue, and company service.

In this section the search process provides the structure for the investigation of: (1) farmers' use and evaluation of information sources, (2) farmers' participation in searching activities, and (3) factors related to overall searching behaviour.

3.2.1 Evaluation of Information Sources

Ontario corn growers have a large number of commercial and non-commercial sources from which they can obtain information on various aspects of herbicides. To investigate their evaluation of these sources, the corn growers were asked to specify the five sources they considered most useful in: (1) helping select the best herbicide to achieve good weed control, (2) providing information about new corn herbicides, (3) providing advice in the case of problems with corn herbicides, (4) providing information regarding methods and rates of application, (5) providing information regarding safety precautions in the use and

handling of herbicides, (6) providing information on hazards or possible harmful consequences to the crop from the use of herbicides, and (7) providing information on residue problems when changing crops.

The data in Table 3.7 show the commercial and non-commercial sources considered by the farmers and the percentages of farmers rating each source as "most important" and "important." For the sake of clarity those sources rated most important by a large percentage of producers are also shown in graphic form in Figure 3.1.

Based on these results, several general observations can be made. First, in regard to commercial sources, it is clear that with the exception of providing information in the event of product problems, chemical salesmen are not viewed as exceptionally important information sources. Dealers, on the other hand, tend to be highly regarded information sources in almost all areas, especially in the critical marketing areas of selecting the best herbicide to achieve good weed control, informing farmers on new herbicide products, and providing advice in the event of problems with currently used products.

Farmer meetings and farm magazine advertising in general are not regarded as important sources of information except in the one area where farmers perceive them as playing a major role -- providing information on new products. In this area they are rated as either "most important" or "important" by a sizeable proportion of growers. The same is true for package labels; while they are not considered important in most areas, they are by far the most important source in the specific areas of providing information on safety precautions, application methods and rates, and crop damage.

In regard to the non-commercial sources, the most important in every area except dealing with specific herbicide problems in Publication 75. Other

TABLE 3.7

PERCENTAGES OF FARMERS RATING INFORMATION SOURCES
MOST IMPORTANT OR IMPORTANT FOR VARIOUS USES

Information Sources	Selecting Best Herbicide		New Herbicide		Herbicide Problems		Application Methods		Safety Precautions		Crop Damage		Residue Problems	
	Most Important %	Important %	Most Important %	Important %	Most Important %	Important %	Most Important %	Important %	Most Important %	Important %	Most Important %	Important %	Most Important %	Important %
Commercial Sources														
Chemical Salesmen	7	6	5	8	8	17	4	5	4	5	6	8	4	8
Dealers	38	12	28	16	52	14	23	16	10	23	27	13	29	21
Farm Shows		4	2	9				1		1		2		1
Farmer Meetings		11	12	13		3	1	2	1	3	2	5	1	4
Farm Magazine Ads		4	12	9					1					3
Company Pamphlets		4	2	4		1	1	5	2	6	1	2	1	1
Package Labels	1	3				1	35	18	66	15	26	15	6	3
Company Research Plots	—	—	—	—	—	1	—	—	—	—	—	—	—	—
	46	44	61	59	60	37	64	47	84	53	62	45	41	41
Non-Commercial Sources														
Publication 75[1]	35	15	21	15	2	6	25	22	9	19	15	16	12	16
Other Corn Growers	4	15	4	4	3	11	1	11		4	2	12	2	11
Farm Magazine Articles		4	2	9		1		2	1	3		3	1	2
Extension Agents	4	4	2	5	16	23	4	7	2	9	8	9	15	14
University Personnel	1	4	1	1	4	6		2		1		1	3	4
Government Research Stations	4	5	7	4	13	11	1	7	1	6	8	12	17	8
Custom Applicators	3	4		1	1	3	5	1	2	1	2	2	1	1
Own Experience	2	2				1		1	1	4	2		7	2
All Others	1	3	2	2	1	1	—	—	—	—	1	—	1	1
	54	56	39	41	40	63	36	53	16	47	38	55	59	59

[1] Publication 75 is an official publication of the Ontario Ministry of Agriculture which makes recommendations on herbicide use for a wide variety of crops.

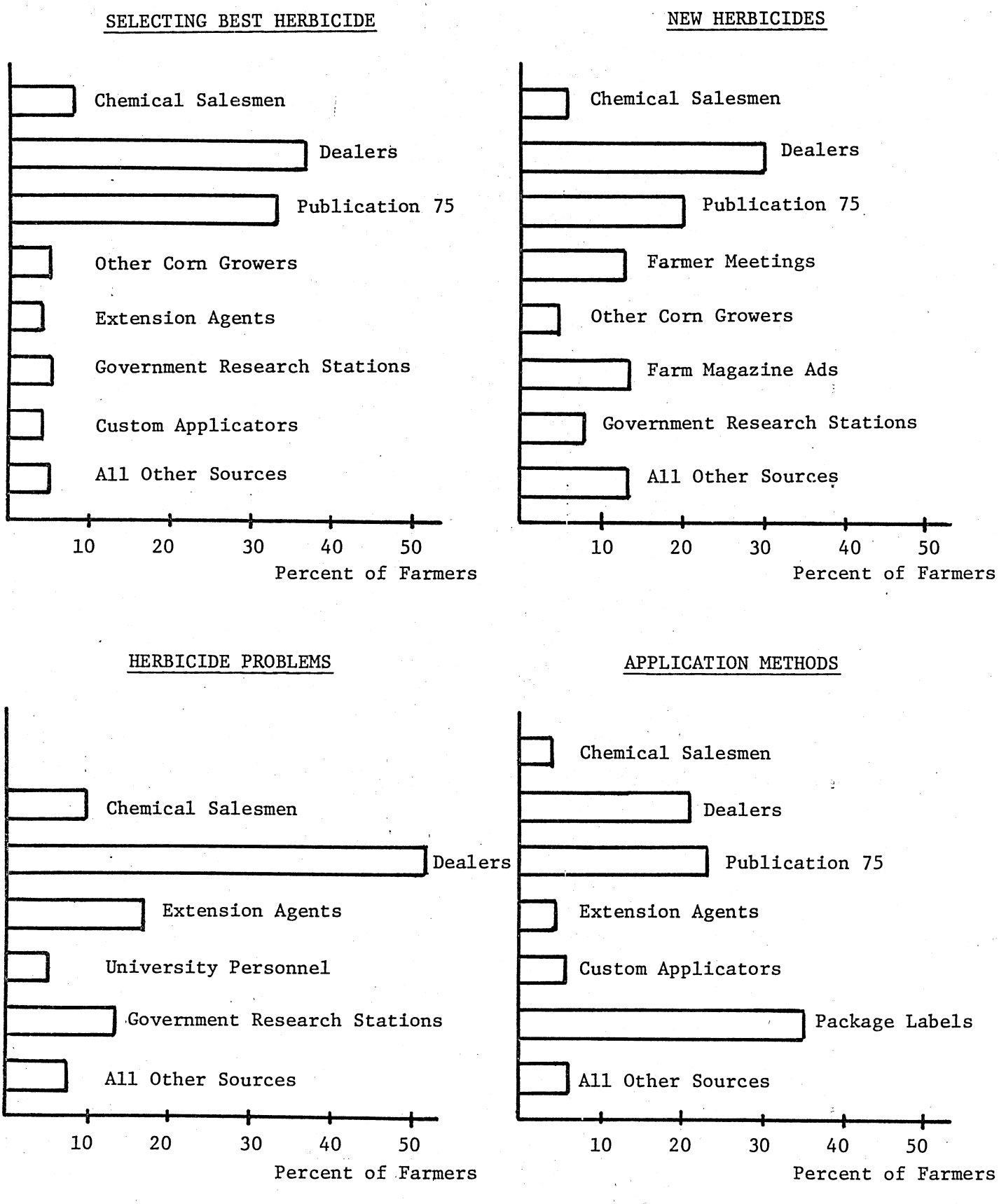
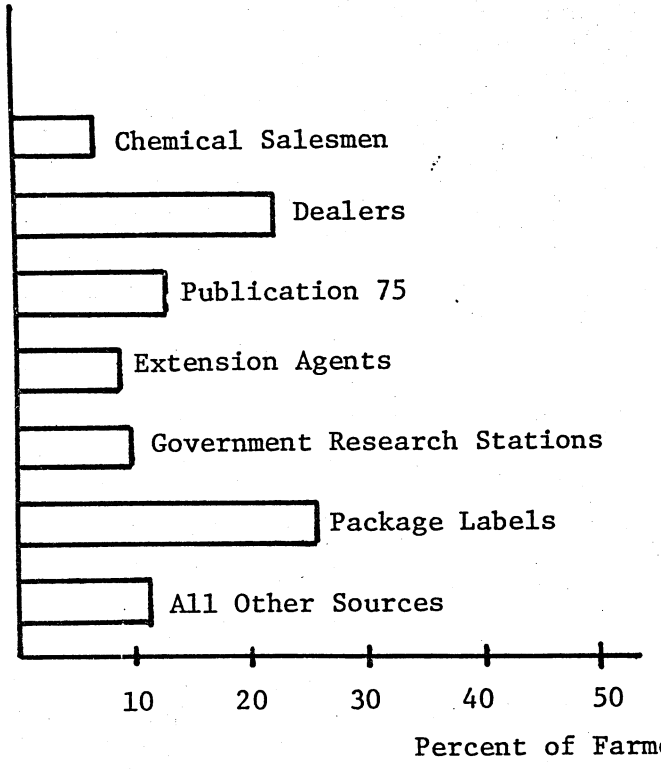


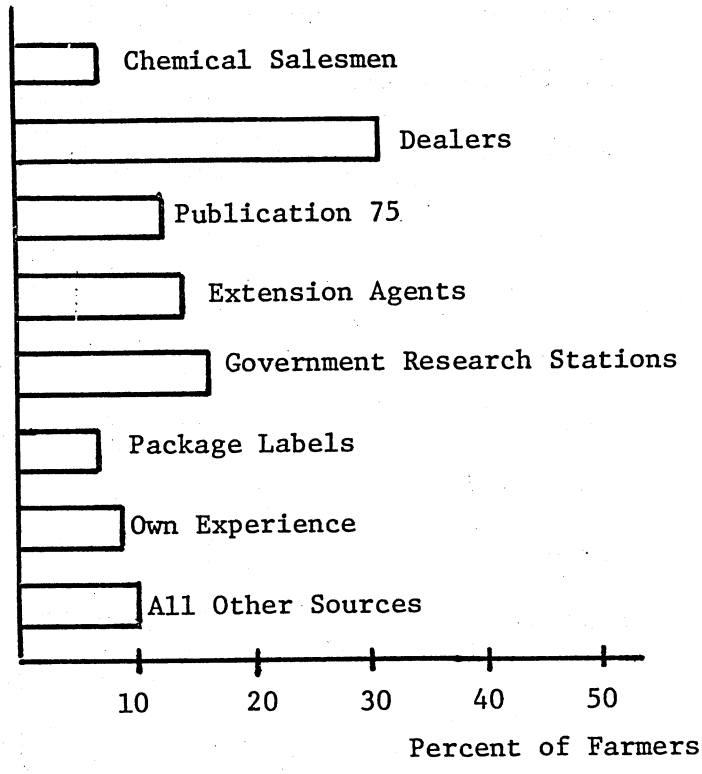
FIGURE 3.1

"MOST IMPORTANT" INFORMATION SOURCES

CROP DAMAGE



RESIDUE PROBLEMS



SAFETY PRECAUTIONS

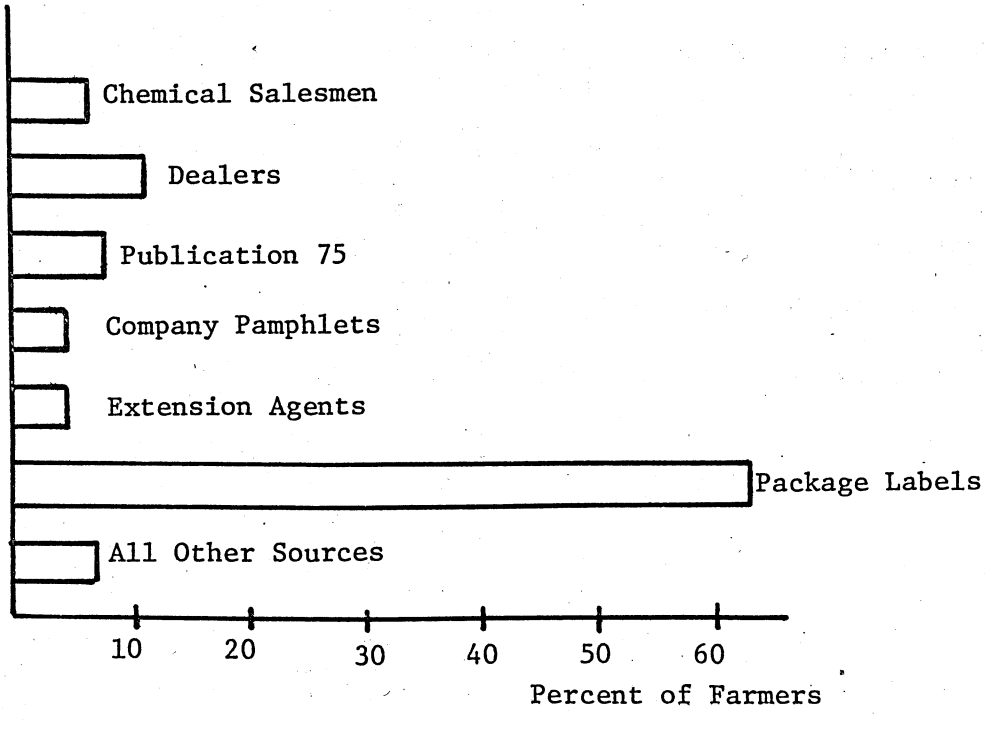


FIGURE 3.1 (contd...)

"MOST IMPORTANT" INFORMATION SOURCES

non-commercial sources of importance to some growers are other corn farmers, extension agents, and Government Research Stations. The last two sources are considered particularly useful in dealing with specific herbicide problems which arise during the course of the crop year.

3.2.2 Searching Activities

In the course of gathering information on alternative corn herbicide products and brands, farmers can engage in a variety of shopping activities. Although a common characteristic of these activities is that they require some commitment of time, effort, and perhaps expense on the part of the farmer, the extent of this commitment can range from simply scanning farm magazines and observing herbicide advertisements to spending hours or even days attending farmer meetings or visiting test plots.

To investigate corn farmers' shopping activities for herbicides, fifteen different shopping activities were identified and the farmers asked to indicate the extent of their participation in each of these activities. The results of this analysis are shown in Table 3.8.

The first two activities shown in Table 3.8 relate to reading Publication 75 and farm magazine advertisements. Results here show that while approximately twice as many farmers read farm magazine advertisements as Publication 75, the percentage of farmers reading Publication 75 thoroughly is much higher than the corresponding percentage for farm magazine advertisements.

Two additional shopping activities deal with contacting herbicide dealers and salesmen. Of these two activities, a substantial proportion of the farmers reported contacting at least one herbicide dealer during 1976, while the opposite was true for herbicide salesmen. Moreover, with respect to the farmers contacting herbicide dealers, 41.1 percent reported that they

discussed their program with the dealer, and 54.0 percent reported that they not only discussed their weed control program with the dealer, but also sought his advice on which brand or treatment to use.

In addition to dealers and salesmen, corn farmers can also obtain relevant information from government extension personnel, other corn growers, and custom operators, of these three sources of information, most farmers tend to favour other corn growers although even here the percentage reporting no discussions with this reference group is fairly high. In all three cases, almost all the farmers who did report contacts indicated that they not only discussed weed control programs, but also sought advice on which programs to use.

Farmers can also obtain corn herbicide information from company or dealer sponsored farmer meetings. Slightly under one-half of the sample indicated that they did not attend any of these types of meetings during 1976, while 38.3 percent reported attending at least two meetings and 16.6 percent more than two.

Finally, the last group of shopping activities considered in Table 3.8 deals with visiting test plots set up and maintained by government agencies, herbicide companies, universities, soil and crop associations, and other corn farmers. Although none of these types of test plots were visited by a large percentage of corn growers, the most frequently visited were those of government agencies and herbicide companies. Part of the reason for the low reported participation in this type of shopping activity is because of the relatively low awareness of the existence of these plots.

3.2.3 Farm and Farmer Differences in The Use of Shopping Activities

In addition to assessing overall participation in various shopping activities, an attempt was made to determine the type of farmer most likely

TABLE 3.8

FARMER PARTICIPATION IN SHOPPING ACTIVITIES, 1976

Shopping Activites	Percentage of Farmers Reporting		
	Did Not Read	Scanned	Read Thoroughly
1. Read Publication 75	27.4	20.0	52.6
2. Read Farm Magazine Advertisements	14.3	48.6	37.1
	None	Two	More than 2
3. Number of Farm Meetings Attended	45.1	38.3	16.6
	None	One	More than 1
4. Number of Herbicide Dealers Contacted	31.4	45.7	22.9
	Did Not Discuss	Discuss Only	Discuss and Seek Advice
5. Government Extension	80.6	0.0	19.4
6. Other Corn Growers	37.7	0.0	62.3
7. Herbicide Dealers	4.0	41.1	54.9
8. Custom Operators	76.6	5.0	18.4
		No	Yes
9. Contact Herbicide Company Salesmen		84.6	15.4
10. Set-up on Farm Test Plots or Strips		66.3	33.7

	Aware	Not Aware	Visited	Not Visited
11. Government Test Plots	45.7	54.3	17.1	82.9
12. Company Test Plots	41.7	58.3	13.1	86.9
13. University Test Plots	25.7	74.3	6.3	93.7
14. Soils and Crops Test Plots	32.0	68.0	10.3	89.7
15. Other Corn Growers Test Plots	1.1	98.9	0.0	100.0

to participate in each of these activities. The generalized results of this analysis are shown in Table 3.9.

Although the analysis reported in this table reveals several significant characteristics related to participation in different shopping activities, it is difficult to observe any apparent patterns with the exception that large, progressive, cash grain farmers with medium to high education and high herbicide knowledge tend to participate more heavily in most of the shopping activities considered than do other types of farmers.

3.2.4 Extent of On-Farm Visits by Company, Government and Extension Personnel

Although not a direct shopping activity on the part of farmers, on-farm visits by company, government, and extension personnel are a closely related activity. During the course of each interview session the farmers were asked to indicate the extent to which they were visited on their farms by dealers, manufacturer representatives, distributor representatives, government extension personnel, and university personnel.

The results shown in Table 3.10 indicate that over 75 percent of the farmers were not contacted by any of these people during 1976. The most frequent on-farm visits were reported by dealers, with 23.0 percent of the sample reporting at least one dealer visit during 1976.

3.2.5 Factors Related to Searching Behaviour

The responses to the questions reported in Table 3.8 indicate considerable variability in the extent to which farmers participate in searching activities. An attempt was therefore made to determine the factors which are related to farmers' overall searching behaviour. According to the decision process model, the following factors were hypothesized to be related to this activity:[6]

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[6] See Appendix B for a full discussion of how these variables were defined and measured.

TABLE 3.9

FARMER DIFFERENCES IN PARTICIPATING IN SHOPPING ACTIVITIES

Shopping Activities	Farm and Farmer Characteristics					
	Farm Size	Corn Yields	Farm Type	Age and Experience	Education	Herbicide Knowledge
Read Publication 75	Large and Very Large**	High*			High**	
Read Farm Magazine Advertisements	Medium* and Large					
Contact Herbicide Dealers	Large*		Cash Grain*	Medium* and High		
Contact Herbicide Salesmen	Large and Very Large**					Low and Medium*
Contact Government Extension		High**	Cash Grain**		Medium and High**	High**
Contact Other Corn Growers		High**	Dairy and Other*			
Contact Custom Operators				Low and Medium*		
Attend Farmer Meetings	Medium and Large*	High*	Livestock* and Cash Grain		High*	

TABLE 3.9 (contd....)

FARMER DIFFERENCES IN PARTICIPATING IN SHOPPING ACTIVITIES

Shopping Activities	Farm and Farmer Characteristics					
	Farm Size	Corn Yields	Farm Type	Age and Experience	Education	Herbicide Knowledge
Set-up on Farm Test Plots		High**		Medium**		
Visit Government Test Plots	Large**		Cash Grain**			Medium and High**
Visit Company Test Plots			Cash Grain*			High**
Visit University Test Plots	Large and Very Large*		Cash Grain**	Medium*		
Visit Soils and Crops Test Plots						High*

* = Significance .10,

** = Significance .05.

TABLE 3.10

EXTENT OF ON FARM VISITS BY DEALERS, MANUFACTURER AND DISTRIBUTOR REPRESENTATIVES, AND GOVERNMENT AND EXTENSION PERSONNEL, 1976

Number of on-Farm Visits	Percentage of Farmers Reporting Visits by				
	Dealers	Manufacturer Representatives	Distributor Representatives	Government Extension	University Personnel
None	77.1	85.1	89.7	92.0	98.9
1 Visit	9.1	7.4	3.4	4.6	1.2
2-3 Visits	11.5	4.0	3.4	2.8	0.0
4-5 Visits	1.2	1.7	1.7	0.0	0.0
More than 5 Visits	1.2	1.7	1.7	0.6	0.0
	100.0	100.0	100.0	100.0	100.0

(1) Problem Intensity - The greater the intensity of the farmer's problem, the more time and effort he will spend searching for information. To study the impact of problem intensity on the search process, the sample was divided into two groups with respect to differences in the intensity of problems experienced in the last crop year. The measure of problem intensity employed was the failure rate categories introduced and discussed in Section 3.1.4. Using this measure, farmers with a failure rate under 20 percent constituted the low problem intensity group and farmers with a failure rate exceeding 20 percent were classified in the high problem intensity group.

(2) Importance of The Purchase - The more important the farmer considers the corn herbicide purchase, the more intensive he will search for information on different brands of corn herbicides. In this analysis purchase importance was measured by two variables -- gross farm income and farm type. It was anticipated that cash grain farmers and farmers with higher gross farm incomes would search more than other farmers.

(3) Attitude Toward Searching - Farmers whose attitude toward searching is such that they search for information as a matter of course will spend a greater amount of time and effort participating in shopping activities. This hypothesis gives recognition to the idea that farmers may engage in search as a routine process independent of problem recognition.

Several motivations may underlie farmers' participation in routine searching behaviour. First, less experienced corn growers, confronted by situations of extensive problem solving, can be expected to continually search for information in their commercial and social environments as they strive to become more conversant with corn herbicides as a product class and develop proper choice criteria by which to judge different brands within the product class. Secondly, some farmers may, as a rule, seek to obtain information on

alternative corn herbicides in an effort either to capitalize on the best deals or better equip themselves with knowledge in anticipation of problems. In addition, a farmer may engage in routine search if his normal preoccupation is to continually try to attain improved levels of product performance. In this latter context, a farmer may be considered to be in a perpetual state of problem recognition if his desired level of goal attainment always exceeds the actual level of performance he achieves. Finally, farmers who assume, or have thrust upon them the roles of opinion leaders in their communities, may find it necessary to always be knowledgeable about corn herbicides in order to better fulfill their roles.

(4) Past Experience - Less experienced corn growers will engage in a relatively greater amount of searching activities as they strive to develop more familiarity with corn herbicides as a product class and with different brands within the product class. Conversely, the more experienced the corn grower, the closer he tends to approach a routine buying situation, and the less time and effort he devotes to searching. In this analysis past experience was measured by years of corn growing experience.

(5) Perceived Brand Differences - Farmers who perceive large differences among brands of corn herbicides will expend more time and effort in gathering information to better evaluate and compare these differences.

(6) Risk Attitude - Farmers with higher levels of risk aversion will tend to engage in a relatively greater amount of searching as they attempt to reduce uncertainty in their buying process.

(7) Self Confidence - The more knowledgeable and competent the farmer considers himself in the areas of corn growing and corn weed control, the less advice and information he will be inclined to seek on alternative corn herbicides and their uses.

(8) Attitude Toward Information Sources - The more favourable the farmer's attitude toward information sources, the more time and effort he will devote to searching activities. In this regard, two types of information sources were considered -- advertising and personal selling (salesmen and dealers).

(9) Price Sensitivity - The more price sensitive the farmer, the more time he will spend searching the market for lower cost products or products he perceives as providing better value for the money spent.

(10) Herbicide Knowledge - Farmers with higher levels of herbicide knowledge will search less than other farmers.

3.2.6 Regression Model

Regression analysis was used to test the above hypotheses. In the regression model the dependent variable was the farmer's overall participation in searching activities, while the independent variables were:

FR = Failure rates
FR = 1 if failure rate exceeds 20 percent; otherwise zero.

GI1 = Gross income
GI1 = 1 if gross income is between $50,000 and $100,000; otherwise zero.

GI2 = Gross income
GI2 = 1 if gross income is greater than $100,000; otherwise zero.

FT1 = Farm type
FT1 = 1 if farm type is cash grain; otherwise zero.

FT2 = Farm type
FT2 = 1 if farm type is dairy; otherwize zero.

FT3 = Farm type
FT3 = 1 if farm type is other; otherwise zero.

YCG1 = Years of corn growing experience
YCG1 = 1 if corn growing experience is between 11 and 25 years; otherwise zero.

YCG2 = Years of corn growing experience
YCG2 = 1 if corn growing experience is greater than 25 years; otherwise zero.

ATS = Attitude toward searching score

PBD = Perceived brand difference score

RA = Risk attitude score

SC = Self confidence score

ATSD = Attitude toward salesmen and dealers score

ATA = Attitude toward advertising score

PS = Price sensitivity score

WHK = Weed and herbicide knowledge score

3.2.7 Regression Results

The above model was estimated using the stepwise regression subroutine of SPSS.[7] The equation selected for interpretation contained the variables shown

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[7] Using the stepwise regression subroutine of SPSS, the variable having the largest squared partial correlation with the dependent variable is chosen for entry at each step. Thus the variable that explains the greatest amount of variance in the search score is entered in the first step, and for each subsequent step the variable entered is the one which explains the greatest amount of variation not explained by the variables already in the equation. The "best" step was judged to be the one associated with the highest adjusted R^2. In this way an independent variable added to the equation at each step was only accepted if it increased the adjusted R^2 (Afifi and Azen, 1972). The rationale underlying this approach is that because of chance fluctuations, any independent variable which enters an equation is likely to increase R^2. This is corrected by the use of the adjusted R^2 which takes into account the number of independent variables in the equation and the number of cases (degrees of freedom). The formula for the adjusted R^2 used in SPSS is

$$\text{Adjusted } R^2 = R^2 - \frac{(K-1)}{(N-K)}(1 - R^2)$$

where K is the number of independent variables in the regression equation, N is the number of cases, and R^2 is the unadjusted square of the multiple correlation coefficient.

TABLE 3.11

RESULTS OF REGRESSION ANALYSIS OF SEARCH BEHAVIOUR

Variable	Variable Name	Unstandardized Coefficient	Standardized Coefficient	Standard Error	t-Value
FR	Failure rate above 20 percent	0.0542	0.0635	0.0542	1.000
GI1	Gross income between $50,000 and $100,000	0.1691	0.1849	0.0652	2.590***
GI2	Gross income over $100,000	0.1555	0.1724	0.0676	2.299**
FT1	Cash Grain Farm	0.1086	0.1273	0.0563	1.930*
FT3	Other Type of Farm	0.2947	0.1604	0.1157	2.550***
ATS	Attitude Toward Searching	0.0589	0.2940	0.1320	4.462***
YCG1	11 to 25 years of Corn Growing Experience	0.0646	0.0757	0.0538	1.202
PBD	Perceived Brand Differences	0.0227	0.1235	0.0113	2.007**
RA	Risk Attitude	0.0177	0.0666	0.0166	1.066
ATSD	Attitude Toward Salesmen and Dealers	0.0156	0.0830	0.0123	1.273
ATA	Attitude Toward Advertising	0.0600	0.3017	0.0132	4.563***
WHK	Weed and Herbicide Knowledge	0.0066	0.1494	0.0028	2.288**

* = Significance .10

** = Significance .05

*** = Significance .01

in Table 3.11. Variables not included in this equation were price sensitivity, the variable for dairy farms, and the variable for over 25 years of corn growing experience. Of the twelve variables shown in Table 3.11, eight were determined to be significantly related to overall searching behaviour. All twelve variables accounted for 38 percent of the variability in the search scores.

The relative importance of each variable can be determined using the standardized regression coefficients. Thus for the significant variables, the order of importance is: (1) attitude toward advertising, (2) attitude toward searching, (3) gross income between $50,000 and $100,000, (4) gross income over $100,000, (5) "other" type of farm, (6) weed and herbicide knowledge, (7) cash grain farm, and (8) perceived brand difference.

In terms of the hypotheses listed in Section 3.2.3, the results of the regression analysis fully support three and five, partially support two and eight, and reject one, four, six, seven, nine, and ten.

The first hypothesis states that the greater the intensity of the farmer's problem, the more time and effort he will spend searching for information. This hypothesis could not be accepted since the variable used to measure problem intensity was not found to be significantly related to searching activity. Instead, it appears that most searching is routine as suggested by the third hypothesis and supported by the strong positive relationship between attitude toward searching and searching activity.

The second hypothesis proposed a positive relationship between the importance of the purchase, expressed in terms of gross farm income and farm type, and searching activity. For the most part this hypothesis was supported by the results. Both gross income variables and the cash grain variable were found to show a positive and significant relationship with searching activity.

Contrary to the expectations, the "other" farm type variable was found to be strongly related to searching activity. The "other" farm category included all farms whose main source of income was from activities other than livestock, cash grain, and dairy.

In hypothesis four, a negative relationship was hypothesized between years of corn growing experience and searching activity. Results of the regression analysis showed a positive relationship between these variables although this was not found to be statistically significant.

A strong positive relationship was found between perceived brand differences and searching activity. This result substantiates hypothesis five and indicates that the larger the differences farmers perceive among herbicide brands, the more time and effort they spend in gathering information to evaluate and compare these differences.

Neither risk attitudes nor self confidence were found to be significantly related to searching activity. As a result, hypotheses six and seven were not supported by the results.

The eighth hypothesis stated that the more favourable the farmer's attitude toward information sources, the more time and effort he will devote to searching activities. Of the two types of information sources considered, the results showed a strong, positive relationship only for attitude toward advertising.

In the case of hypothesis nine, no significant relationship was established between price sensitivity and searching. As a result, farmers for whom price is a more important factor apparently do not spend more time shopping than other farmers.

Finally, hypothesis ten postulated that farmers with higher levels of weed and herbicide knowledge would search less than other farmers. The idea

behind the hypothesis was that because of their higher knowledge levels these farmers would not need to search as much as farmers with lower knowledge levels. The results of the regression analysis, however, indicated the opposite situation to be the case: farmers with higher levels of weed and herbicide knowledge actually search more than other farmers. As a result, it appears that the direction of causality implied in the original hypothesis is not correct. That is, the extent of participation in searching activities is one factor which determines a farmer's knowledge level, rather than being determined by this variable.

3.3 Evaluation of Alternatives

In the third stage of the decision process farmers evaluate alternative herbicide brands and suppliers and arrive at a purchase decision.

The process of evaluation involves the formation of attitudes (preferences) toward alternative brands. This is done by comparing evaluation criteria (expressed in terms of product attributes) with brand beliefs (expressed in terms of each brand's position on these attributes). The result of this process is an ordering of alternative brands in terms of their relative preference, and the selection of the most preferred brand for purchase.

3.3.1 Evaluation Criteria

To investigate the relative importance of various evaluation criteria, the farmers were asked to rate fifteen possible criteria on a four point scale ranging from (1) extremely unimportant to (4) extremely important. Factor analysis was used to group the fifteen criteria into the following categories for further analysis: (1) marketing programs, (2) herbicide application, (3) herbicide salesmen, (4) weed control, (5) cost/damage, and (6) herbicide

dealers.[8]

A summary of the responses to these questions is shown in Table 3.12. These results show that the vast majority of farmers use good weed control (broadleaves, grasses, and perennials) as the most important criterion by which they judge a corn herbicide. In addition, other important criteria are measuring and mixing, method of application, label information, cost per acre, crop damage, residue, and dealer service.

Using the factors identified in Table 3.12, the analysis was extended to investigate farm and farmer differences in the importance of the six evaluation criteria. The results of this analysis are presented in Table 3.13 and show those categories for which the respective evaluation criteria are proportionately more important. For example, in the case of the factor labelled "marketing programs," the results show that the three criteria making up this factor are relatively more important to older, more experienced farmers with lower levels of education than to other types of farmers. Other interesting results are the greater importance attached to the factors "herbicide salesmen" and "cost/damage" by non cash grain farmers, and the greater importance placed on "herbicide dealers" by farmers with low levels of weed and herbicide knowledge.

3.3.2 Brand Beliefs

Farmers' perceptions of existing corn herbicide brands were investigated by an analysis of the direction and intensity of their attitudes towards the four major brands. The measuring device employed was the semantic differential. This technique involves having respondents evaluate some concept

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[8] Principal components factor analysis with varimax rotation was used with the criterion that all factors with an eigenvalue greater than 1.0 be initially extracted from the matrix of correlation coefficients (Wells and Sheth,1971). Using this criterion, six factors were extracted which together accounted for 70 percent of the total variance. The factor loadings for each variable are shown in Table 3.12.

TABLE 3.12

IMPORTANCE OF EVALUATION CRITERIA

Evaluation Criteria	Factor Loading	Percentage of Farmers Responding			
		Extremely Unimportant	Slightly Unimportant	Slightly Important	Extremely Important
Marketing Programs					
Farmer Meetings	.48	8.0	17.7	49.1	24.6
Company Literature	.88	9.1	18.9	54.3	16.6
Company Advertisements	.82	12.6	24.6	50.9	10.9
Herbicide Application					
Measuring and Mixing	.89	0.6	1.7	20.6	76.6
Method of Application	.74	1.1	2.3	22.3	73.7
Label Information	.29		0.6	13.1	86.3
Herbicide Salesmen					
Salesmen Service	.85	20.0	12.0	33.1	34.3
Salesmen Knowledge	.88	15.4	8.0	27.1	54.3
Weed Control					
Control of Broadleaves	.60			10.9	88.6
Control of Grasses	.60		0.6	2.3	96.6
Control of Perennials	.73		0.6	10.9	88.6
Cost/Damage					
Cost per Acre	.39	2.3	4.0	32.6	60.6
Crop Damage	.49		1.7	9.1	89.1
Residue	.61	1.7	4.0	28.8	65.1
Herbicide Dealers					
Dealer Service	.50	2.3	2.9	17.7	77.1

TABLE 3.13

FARMER DIFFERENCES IN THE IMPORTANCE
OF EVALUATION CRITERIA

Evaluation Criteria	Farm and Farmer Characteristics					
	Farm Size	Corn Yields	Farm Type	Age and Experience	Education	Herbicide Knowledge
Marketing Programs				Older, More** Experienced	Low**	
Herbicide Application				Older, More** Experienced		
Herbicide Salesmen			Non-Cash* Grain	Middle-Age**		
Weed-Control						
Cost/Damage			Non-Cash* Grain			
Herbicide Dealers						Low*

* = Significance .10,

** = Significance .05.

along a group of scales where each scale consists of two opposing adjectives or statements separated by a continuum of assumed equal intervale. Respondents are asked to indicate, by a check on each scale, the point which best describes their perception of the extent to which the concepts under study possess a set of given attributes. In the context of this study, the concepts evaluated were the four major brands of corn herbicides, and the attributes were the fifteen company and product characteristics described earlier. The mean scores for each attribute on each brand are reported in tabular form in Table 3.14 and in graphic form in Figure 3.2.

One-way analysis of variance was used to test for significant differences among mean scores for each attribute. Where significant differences were found, Dumcan's multiple range test (Kirk, 1968) was used to determine which pairs were significantly different. Table 3.14 shows the results of the one-way analysis of variance tests and reveals that significant differences are present among mean evaluation scores for eight of the fifteen attributes. These attributes are: (1) measuring and mixing, (2) method of application, (3) control of broadleaves, (4) control of grasses, (5) control of perennials, (6) cost per acre, (7) damage to corn crop, and (8) carryover or residue. It is interesting to note that all these attributes relate to product performance characteristics.

Results of the application of Duncan's multiple range test to the mean evaluation scores for the above eight attributes are reported in Table 3.15 In this table the mean scores are divided into homogeneous subsets along each attribute. Each subset includes those mean scores which are not significantly different from each other at a five percent level of significance. For example, with respect to the attribute cost per acre, the mean evaluation scores for Bladex, Lasso and Sutan are not significantly different from each other, but are all significantly different from the mean evaluation score for Aatrex.

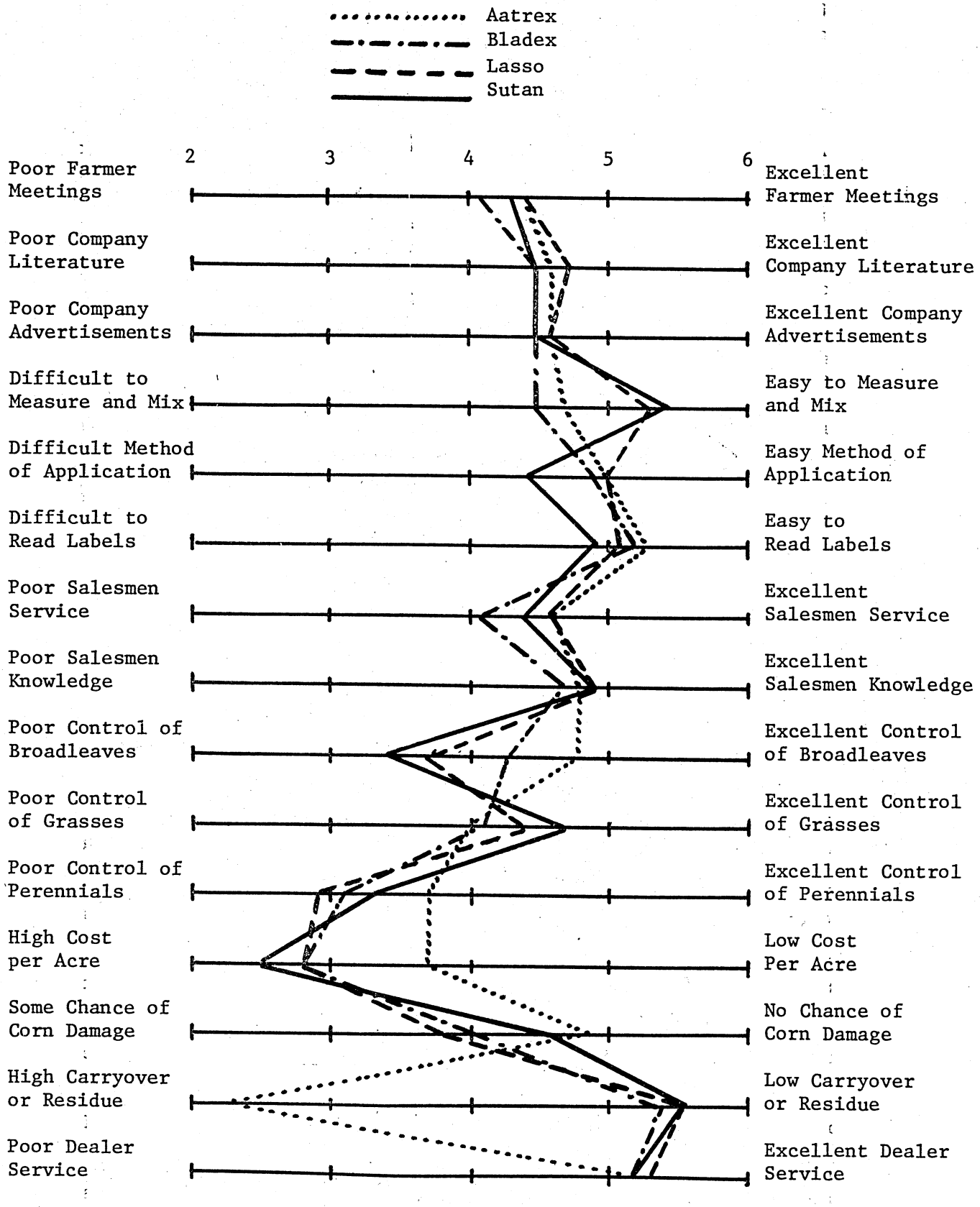

FIGURE 3.2

BRAND PROBILES FOR THE FOUR MAJOR CORN HERBICIDE BRANDS

TABLE 3.14

MEAN EVALUATION SCORES FOR CORN HERBICIDE BRANDS

Company or Product Attributes	Evaluation Scores								F Value[2]
	Aatrex		Bladex		Lasso		Sutan		
Marketing Programs									
Farmer Meetings	4.4	(94)[1]	4.1	(56)	4.4	(58)	4.3	(52)	0.272
Company Literature	4.6	(129)	4.5	(87)	4.7	(84)	4.5	(83)	0.527
Company Advertisements	4.6	(145)	4.5	(102)	4.6	(97)	4.5	(95)	0.223
Herbicide Application									
Measuring and Mixing	4.7	(168)	4.5	(107)	5.3	(100)	5.4	(97)	11.145*
Method of Application	5.0	(168)	4.9	(110)	5.0	(99)	4.4	(100)	4.212*
Label Information	5.3	(169)	5.2	(112)	5.1	(103)	5.1	(98)	0.790
Herbicide Salesmen									
Salesmen Service	4.6	(81)	4.1	(58)	4.6	(60)	4.4	(54)	1.289
Salesmen Knowledge	4.8	(85)	4.7	(64)	4.9	(64)	4.9	(63)	0.519
Weed Control									
Control of Broadleaves	4.8	(167)	4.3	(99)	3.7	(95)	3.4	(93)	21.292*
Control of Grasses	4.0	(167)	4.1	(106)	4.4	(97)	4.7	(93)	6.599*
Control of Perennials	3.7	(157)	3.1	(100)	2.9	(89)	3.3	(84)	5.152*
Cost/Damage									
Cost per Acre	3.7	(164)	2.8	(107)	2.8	(101)	2.5	(95)	17.948*
Damage to Corn Crop	4.9	(166)	4.1	(101)	3.9	(95)	4.6	(90)	9.352*
Carryover or Residue	2.3	(165)	5.4	(104)	5.5	(93)	5.5	(91)	159.231*
Herbicide Dealers									
Dealer Service	5.2	(167)	5.2	(115)	5.3	(107)	5.2	(107)	0.435

[1] The numbers in parentheses show the number of farmers making an evaluation.

[2] * Indicates a level of significance $< .01$.

TABLE 3.15

DUNCAN'S MULTIPLE RANGE TEST OF MEAN EVALUATION SCORES

Company or Product Attributes	Mean Evaluation Scores			
	Aatrex	Bladex	Lasso	Sutan
Herbicide Application				
Measuring and Mixing				
Subset 1	4.7	4.5	-	-
Subset 2	-	-	5.3	5.4
Method of Application				
Subset 1	-	-	-	4.4
Subset 2	5.0	4.9	5.0	-
Weed Control				
Control of Broadleaves				
Subset 1	-	-	3.7	3.4
Subset 2	-	4.3	-	-
Subset 3	4.8	-	-	-
Control of Grasses				
Subset 1	4.0	4.1	-	-
Subset 2	-	4.1	4.4	-
Subset 3	-	-	4.4	4.7
Control of Perennials				
Subset 1	-	3.1	2.9	3.3
Subset 2	3.7	-	-	3.3
Cost/Damage				
Cost per Acre				
Subset 1	-	2.8	2.8	2.5
Subset 2	3.7	-	-	-
Damage to Corn Crop				
Subset 1	-	4.1	3.9	-
Subset 2	4.9	-	-	4.6
Carryover or Residue				
Subset 1	2.3	-	-	-
Subset 2	-	5.4	5.5	5.5

Examination of the results in Table 3.15 leads to the following conclusions regarding farmers' evaluations of the four major brands of corn herbicides. In considering these conclusions, reference can also be made to the graphic illustration in Figure 3.2.

(1) Measuring and mixing - Lasso and Sutan were rated more favourably in terms of their ease of mixing and measuring than Bladex and Aatrex. This finding may be related to the fact that most of the farmers reported applying Lasso and Sutan using the emulsificable concentrate formulation, while they used the wettable powder formulation for Aatrex and Bladex.

(2) Method of application - Sutan was considered by farmers to have the most difficult method of application while the other brands were not perceived to be significantly different on this attribute. This evaluation appears to reflect Sutan's inflexible application requirement of pre-plant incorporation.

(3) Control of broadleaves - Aatrex was judged by farmers to give the most effective control of broadleaves while the second best brand was thought to be Bladex. The difference between evaluation scores for Sutan and Lasso on this attribute was not significant.

(4) Control of grasses - Farmers thought that Sutan gave the most effective control of grasses and Aatrex the least effective control. However, the differences among the brands for this attribute were not perceived to be as large as was the case for broadleaf control.

(5) Control of perennials - Aatrex was perceived by farmers to give the most effective control of perennials. The differences among the other three brands were not statistically significant.

(6) Cost per acre - Aatrex was the most favourably evaluated brand on the attribute cost per acre. The differences among mean evaluation scores

for the other three brands were not statistically significant.

(7) Damage to corn crop - Aatrex and Sutan were considered by farmers to have less chance of damaging the corn crop than Bladex and Lasso.

(8) Carryover or residue - The mean evaluation score for Aatrex on residue was distinctly lower than the scores for the other three brands. Farmers, therefore, perceived Aatrex to have a considerably higher residue effect than the other three brands.

3.3.3 Prediction of Purchase Behaviour

To arrive at a purchase decision, farmers form attitudes toward alternative brands by combining their evaluation criteria with their brand beliefs. The result of this process is an ordering of alternative brands in terms of their relative preference, and the selection of the most preferred brand for purchase.

Although buyers have been found to apply various evaluation procedures to arrive at a purchase decision, the most widely held view of this process is depicted by the expectancy-value model. This model "states that the consumer gives weight to every brand belief and its attribute importance in arriving at a global attitude toward each brand." (Kotler, 1976). The expectancy-value model takes the following general form.

$$A_{jk} = \sum_{i=1}^{n} W_{ik} \; B_{ijk}$$

where A_{jk} = consumer k's attitude score for brand j.

W_{ik} = the importance weight given attribute i by consumer k.

B_{ijk} = consumer k's belief as to the extent to which attribute i is offered by brand j.

n = the number of attributes important in the selection of a given brand.

In order to "test" the applicability of this model to the case of farmers' evaluation and purchase of corn herbicides, data from this research was used to calculate attitude scores for each of the three brands -- Bladex, Lasso, and Sutan.[9] These attitude scores were then compared with actual brand preferences and the degree of correspondence between predicted and actual brand choices was determined.

To calculate a farmer's attitude score for a brand, his importance rating was multiplied by his brand belief for each attribute, and the products summed over the fifteen attributes. This procedure was repeated for each of the three brands under consideration. In situations where the farmer was not able to form a belief for an attribute, a brand belief rating of four was assigned.

To illustrate the method used to calculate attitude scores, an example is provided in Figure 3.3. For simplicity, only five attributes are considered. In this example the farmer's attitude toward Blades (A_B) is determined by multiplying his importance ratings on the five attributes by his brand beliefs for Bladex to get an attitude score of 63. In the case of Lasso and Sutan, the same procedure is followed to arrive at attitude scores or 58 and 61 respectively. For Lasso the brand belief ratings of four for salesman and dealer service indicate that the farmer did not have an opinion on these attributes. The same is true for Sutan in the case of salesman service and company advertisements. Based on the calculated attitude scores, the farmer in the example would be expected to rank Bladex first in his order of preference followed by Sutan and Lasso.

Using the procedure outlined above, attitude scores were calculated

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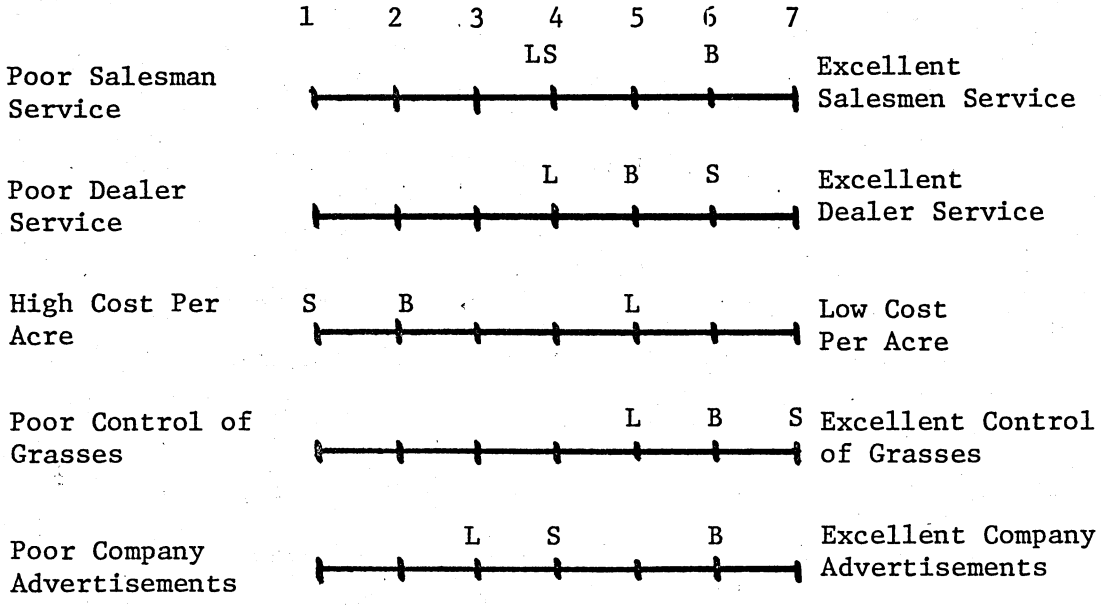
[9] Although brand belief data was collected on Aatrex, it was not included in this analysis because in almost all instances this product is not used alone, but in combination with other products.

Importance of Ratings	Ratings
Salesman Service	2
Dealer Service	3
Cost Per Acre	3
Control of Grasses	4
Company Advertisements	1

Brand Beliefs



Attitude Scores

$$A_B = 2(6) + 3(5) + 3(2) + 4(6) + 1(6) = 63$$

$$A_L = 2(4) + 3(4) + 3(5) + 4(5) + 1(3) = 58$$

$$A_S = 2(4) + 3(6) + 3(1) + 4(7) + 1(4) = 61$$

FIGURE 3.3

CALCULATION OF BRAND ATTITUDE SCORES

for each of the three brands for every farmer in the sample. On the basis of these scores, it was possible to determine each farmer's "most preferred brand," by choosing that brand with the highest overall attitude score. This "most preferred brand" was then compared with the actual brand choice of the farmer to determine the degree of correspondence between the two. Because many of the farmers in the sample used more than one brand of corn herbicide, the brand choice selected for the comparison was that brand used on the largest number of acres. In the few instances where farmers used two or more brands on the same acreage, these farmers were not included in the analysis because there was no objective basis for determining their "actual brand choice." In addition, farmers who used brands other than the three under consideration on their largest acreage were also excluded from the analysis. After these exclusions, 117 farmers (67 percent of the sample) were included in the comparison.

Table 3.16 shows the results of this analysis in terms of what is called a confusion matrix. To interpret the information in this matrix it is useful to consider one column at a time. For example, the first column shows that of the 40 farmers whose "most preferred brand" was Bladex (their highest attitude score was for Bladex), 32 actually used Bladex, three actually used Lasso, and five actually used Sutan. Thus in the case of Bladex, the expectancy-value model was correct in predicting 75 percent of the actual choices of this brand. Over all of the brands, the model correctly predicted the actual brand choices of 97 out of 117 farmers for an accuracy rate of 82.9 percent.

The purpose of the above analysis was to determine whether the expectancy-value model represents a reasonable approximation of the evaluation procedure used by farmers in selecting brands of corn herbicides. Intuitively,

TABLE 3.16

COMPARISON OF "MOST PREFERRED BRAND" WITH ACTUAL BRAND CHOICE

Actual Brand Choices	"Most Preferred Brands"					
	Bladex		Lasso		Sutan	
	No.	%	No.	%	No.	%
Bladex	32	27.4	3	2.6	4	3.4
Lasso	3	2.6	31	26.5	3	2.6
Sutan	5	4.3	2	1.7	34	29.1

results showing an overall accuracy rate of 82.9 percent would seem to indicate that a reasonable approximation exists. However, to be more objective, one can determine whether this agreement is better than that expected from random guessing. This can be done by determining the chance distribution of the number of correct predictions and then testing the chance hypothesis with the normal deviate. Using procedures developed by Mosteller and Bush (1954), the hypothesis was tested and rejected at the .001 level of significance.[10] Thus on both intuitive and statistical grounds, it can be concluded that the expectance-value model closely approximates the evaluation procedure used by farmers in making their corn herbicide purchasing decision, and therefore that attitudes toward alternative brands play a central role in the brand selection decision.

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[10] The procedure developed by Mosteller and Bush consists of calculating the mean and standard deviation of the chance distribution of correct predictions and then testing the chance hypothesis with the normal deviate. The mean and standard deviation of the chance distribution are given by:

$$\bar{m} = \frac{\sum_{i=1}^{s} C_i^2}{n}$$

$$\sigma^2 = \frac{1}{n-1}\left[m\,(m-n) - \frac{2}{b} \sum_{i=1}^{s} C_i^3 \right]$$

where C_i = the number of cases in the i^{th} category.

s = the number of categories

$$n = \sum_{i=1}^{s} C_i$$

The normal deviate is given by:

$$z = \frac{C_r - \bar{m}}{\sigma}$$

where C_1 = the number of correct classifications.

3.3.4 Evaluation of Herbicide Dealers

In addition to selecting a herbicide brand, Ontario corn farmers must also select a particular dealer from whom they will make their purchase. As in the brand selection process, this decision is guided by the use of certain criteria the farmers establish to compare alternatives.

To investigate this area, the farmers were first asked to express agreement or disagreement with a series of statements describing attributes they thought a "good" corn herbicide dealer should possess. Their responses to these statements are presented in the first four columns of Table 3.17 and show that the most important attribute desired in a "good" dealer is a willingness to make on-farm visits if problems develop with the herbicide products the farmer is using. Also considered very important is the related attribute of providing help in contacting company representatives to assist in solving specific problems. In addition to these attributes, other important points brought out in the analysis were the dealer's knowledge concerning weed problems, his willingness to make brand recommendations, and his policy to carry a broad product line.

Next, to assess the extent to which dealers possess these attributes, the respondents were asked to evaluate their present corn herbicide dealer in terms of the same characteristics. Their responses to this evaluation are shown in the second four columns of Table 3.17. Comparing the responses to the two sets of questions reveals that farmers' evaluation of what a "good" dealer should be is very close to what they perceive their present dealer actually is. The only differences of any importance are in terms of dealer knowledge and willingness to make on-farm visits. In both of these areas the sample farmers rated their present dealers slightly lower than their "ideal" dealer.

TABLE 3.17

EVALUATION OF EXPECTED AND ACTUAL DEALER ATTRIBUTES

Dealer Attributes	Percentage of farmers responding that a good herbicide dealer should:				Percentage of farmers responding that their herbicide dealer is:			
	Strongly Disagree	Slightly Disagree	Slightly Agree	Strongly Agree	Strongly Disagree	Slightly Disagree	Slightly Agree	Strongly Agree
Be knowledgeable about my weed problems.	2.3	2.9	19.3	75.4	0.0	4.3	31.1	64.6
Be willing to visit my farm if I have a problem with my herbicide.	0.6	0.6	16.4	82.5	1.2	5.6	21.7	71.4
Carry many different brands of corn herbicides.	2.9	6.4	35.7	55.0	1.8	4.9	22.1	71.2
Make recommendations concerning what brand to use.	1.8	6.5	38.8	52.9	1.2	3.7	31.5	63.6
Contact company salesmen for help with specific problems.	2.3	0.0	19.3	78.4	0.0	2.5	26.1	71.4
Provide credit terms.	19.4	17.1	35.3	28.2	4.4	9.5	27.2	58.9
Be nearby.	2.3	8.6	40.6	46.3	0.6	1.8	23.9	73.6

3.4 The Purchase Decision

The actual herbicide purchase decision is a direct and immediate result of the evaluation process discussed above. This decision has been described in detail by Funk and Vincent (1977) in terms of such factors as the products and quantities purchased, the timing of the purchase decision, and the type of retail outlets used. The purpose of this section is to extend the analysis of the previous paper and integrate the results into the conceptual scheme of the decision process model.

3.4.1 Timing of the Purchase Decision

Seventy-six percent of the sample farmers (133 respondents) reported that they had already made a decision as to which treatments to use in 1977 as of December 1976. Table 3.18 presents the distribution of farmers' responses with respect to the months in which the purchase decision was made. This table indicates that most decisions regarding treatment useage for the coming year are made between the months of June and November. It seems, therefore, that most farmers make their purchase decisions for the coming year after observing the degree of product performance during the current growing season. Also shown in Table 3.18 is the fact that most of the 42 farmers who had not yet made the purchase decision for the next crop year planned to do so in the months of April and May of the coming year.

3.4.2 Treatment Changes

Of the 133 farmers who had definitely decided on next year's treatments, 28 percent indicated an intention to make changes from their 1976 weed control program. The reasons given for these changes and their relative frequency are presented in Table 3.19. A desire for an improved level of weed control was found to be the principal reason causing farmers to introduce changes in their weed control programs. A less dominant, but nonetheless significant factor,

TABLE 3.18

MONTHS WHEN FARMERS DECIDED, OR PLAN TO DECIDE ON NEXT YEAR'S WEED CONTROL TREATMENTS

Months	Number of Farmers	Percentage of Farmers
May (1976)	8	5
June	23	13
July	20	11
August	16	9
September	11	6
October	29	17
November	16	9
December	10	6
	133	
January (1977)	5	3
February	6	3
March	6	3
April	13	7
May	10	6
June	2	1
	42	

TABLE 3.19

REASONS REPORTED BY FARMERS FOR MAKING CHANGES FROM THEIR 1976 WEED CONTROL PROGRAMS

Reasons for Changes	Number of Farmers	Percentage of Farmers
Desire for Improved Weed Control	28	74
Concern for Residue	7	18
Application Considerations	2	6
Mixing Considerations	1	2

was concern for residue build-up or carryover.

3.4.3 Relationship to Problem Recognition

An additional step in the analysis was an investigation of the possibility of a relationship between previous findings in the problem recognition stage of the empirical analysis and farmers' expressed intentions to make changes in their weed control treatments for the coming year. This enquiry was conducted by first classifying the farmers who had already decided on next year's treatments into the four groups shown in Table 3.20. This classification was made possible by the fact that the farmers had been asked to indicate the treatments which they used on their corn in 1976 and the treatments which they planned to use in the next crop year. Table 3.20 shows that 72 percent of the farmers who had already made their corn herbicide purchase decision for 1977, did not intend to make any changes from their 1976 program. Of the remaining 28 percent who indicated an intention to switch treatments, 10 percent planned to switch to a completely new treatment, 7 percent planned to add a new treatment, and 11 percent planned to drop an old treatment.[11]

The next stage in this investigation was to cross-tabulate the categories in Table 3.20 with problem recognition intensity categories established on the basis of failure rates. In constructing these categories, farmers with a failure rate under 20 percent were considered to be in the low problem intensity group, while farmers with a failure rate exceeding 20 percent were classified in the high problem intensity group.

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[11] For example, a farmer who used Atrazine and Bladex this year but planned to switch to Atrazine and Lasso next year was considered to have made a decision to switch treatments. If he decided to continue using Atrazine and Bladex next year while adding Atrazine and Sutan, he was condidered to have added a new treatment. Finally, if the farmer used two or more treatments this year and decided to discontinue the use of one of these treatments, he was considered to have dropped an old treatment.

TABLE 3.20

CLASSIFICATION OF FARMERS ON THE BASIS OF THEIR INTENTIONS TO INTRODUCE CHANGES IN THEIR 1977 WEED CONTROL PROGRAMS

Categories	Number of Farmers	Percentage of Farmers
Farmers who intend to use the same treatments next year as in 1976.	95	72
Farmers who intend to make a change by switching from a treatment used in 1976 to a completely new treatment.	14	10
Farmers who intend to make a change by adding a new treatment to their 1976 weed control program.	9	7
Farmers who intend to make a change by dropping an old treatment from their 1976 weed control program.	15	11
	133	100

TABLE 3.21

CROSS-TABULATION OF NEXT YEAR'S WEED CONTROL PLANS WITH PROBLEM INTENSITY

	Problem Intensity Categories				Total
	High Problem Intensity Group		Low Problem Intensity Group		
Plans for Next Year					
Same Treatments	44	(46%)	51	(54%)	95
Switch Treatments	10	(71%)	4	(29%)	14
Add New Treatments	7	(78%)	2	(22%)	9
Drop Old Treatments	7	(47%)	8	(53%)	15

The results of this cross-tabulation are presented in Table 3.21. These results show that of the 95 farmers who indicated an intention to use the same treatments next year, 54 percent belonged to the low problem intensity group and 46 percent to the high problem intensity group. According to the logic of the decision process model, most farmers who plan to use the same treatments next year should fall in the low problem intensity category. The fact that many of these farmers are actually classified in the high problem intensity group could be either because they have gone through the decision process without discovering a satisfactory alternative herbicide treatment, or because they are very brand loyal farmers for whom the purchase decision has become routine.

Consistent with the postulates of the decision process model, most of the farmers who intended to switch or add new treatments belonged to the high problem intensity group. For these farmers, movement through the decision process resulted in the discovery of a more satisfactory herbicide treatment.

Finally, with respect to the 15 farmers who expressed an intention to drop old treatments, those in the high problem intensity group may consist of corn growers who became intolerant of the performance of a 1976 treatment, but so far have been unsuccessful in finding a suitable alternative. The farmers in the low problem intensity group on the other hand, may consist of those corn growers concerned with various non-weed control issues, or those who may no longer have the need for a specific herbicide treatment.

3.4.4 Brand Loyalty

The final dimension of the herbicide purchasing decision considered in this research is brand loyalty, or the extent to which farmers change brands and/or treatments from year to year. To investigate this behavioural characteristic the farmers in the sample were asked to provide information

on the brands of herbicides they purchased since they first began using chemical weed control products for their corn. Although these purchasing histories were collected over a substantial period,[12] only the data from 1970 through 1976 was used in assessing brand loyalty since it was only during this time that the four major brands (Aatrex, Bladex, Lasso, and Sutan) were all available in the Ontario market.

The results of the analysis of brand switching are shown in Figure 3.3. This illustration shows the percentages of farmers making various numbers of brand and/or treatment changes during the period 1970 through 1976. In this context a change was defined as either the addition or deletion of a brand from a farmer's chemical weed control program from one year to the next. Thus, for example, if a farmer used Atrazine and Bladex in 1970 and changed to Atrazine and Sutan in 1971, this would be considered one change.

The results show that approximately 20 percent of the farmers made no changes during the seven-year period under consideration, while approximately 34 percent, 24 percent, and 20 percent respectively made either one, two, or three changes. Only about three percent of the sample reported making four or five changes during this period.

3.4.5 Farm and Farmer Characteristics Related to Brand Switching

Given the differences in brand switching behaviour shown in Figure 3.3, an attempt was made to relate the extent of brand switching with several farm and farmer characteristics using simple cross-tabulation procedures. The results showed that the eight characteristics listed in Table 3.22 were significantly related to brand switching.

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[12] Atrazine was first available in the Ontario market in 1958. As a result, some respondents could provide purchasing records over the 19-year period, 1958 through 1976. Many producers, however, did not begin growing corn until later, hence their purchasing histories were shorter.

TABLE 3.22

CHARACTERISTICS RELATED TO BRAND LOYALTY

Characteristics	Loyal Farmers	Switchers
Failure Rates*	Low Failure Rates	High Failure Rates
Perceived Brand Differences*	Small Differences	Large Differences
Amount of Searching*	Low	High
Attitude Toward Searching**	Not Routine Searchers	Routine Searchers
Weed and Herbicide Knowledge**	Low Knowledge	High Knowledge
Corn Acreate*	Small Acreage	Large Acreage
Years Corn Growing Experience**	Many Years	Few Years
Age*	Older	Younger

* = Significance .10

** = Significance .05

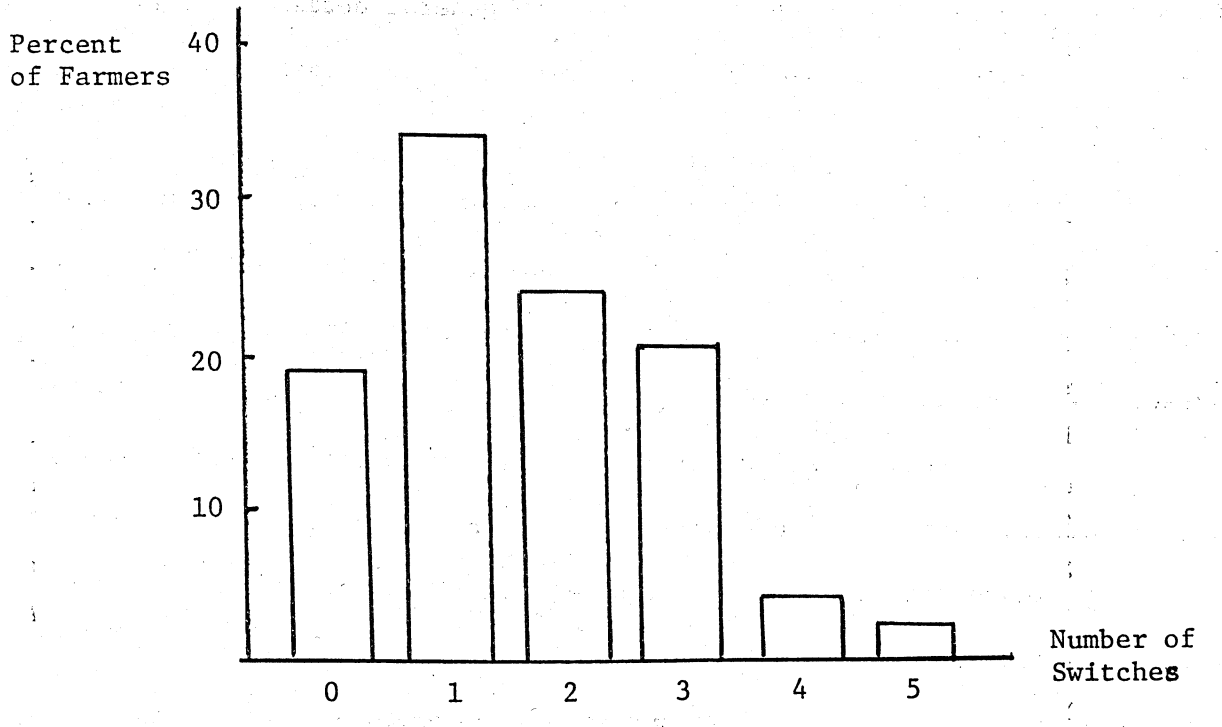

FIGURE 3.4

PERCENTAGE OF FARMERS REPORTING VARIOUS NUMBERS OF TREATMENT SWITCHES, 1970-1976

The more interesting results depicted in this table are first of all that switchers tend to have higher levels of weed and herbicide knowledge, search more, and perceive larger differences among brands than loyal farmers. To some extent these factors are interrelated since farmers who search more widely know more about alternative herbicide brands, and therefore the difference which exist among them.

It is also interesting to observe that switchers tend to engage in habitual or routine searching activities to a larger degree than loyal farmers. As a result of this more or less continuous information gathering, these farmers are more exposed to information on alternative brands, and hence more likely to change from one brand to another.

3.5 Basic Corn Grower Attitudes

For purposes of investigating the farmer decision process model, information was obtained on producer attitudes toward several aspects of corn herbicides. Although not directly related to the general decision process model, analysis of these attitudes can provide some important insights into herbicide buying behaviour.

The attitudes were measured by presenting the farmers with a list of attitude statements and asking them to indicate the extent of their agreement by checking one of four categories ranging from strongly disagree to strongly agree. The tabulation of responses to these statements is shown in Table 3.23.

(1) Attitudes Toward Price. The first group of statements in Table 3.23 relate to basic attitudes toward price. Responses to these statements seem to indicate that producers in general feel that herbicides provide good value for their money, but that herbicide prices in Canada are higher than they should be. Moreover, the responses to statements 2 and 3 indicate that while most producers feel they could save money by looking around for the best

deals, the majority claim that they do not do this, presumably because factors other than price are considerably more important in the product selection decision. Finally, the responses to statement 5 show that total corn herbicide usage is extremely insensitive to changes in the price of corn.

(2) Attitudes Toward Salesmen. Statements 6, 7, and 8 were designed to measure some of the basic attitudes farmers have toward chemical salesmen. Results here show that while most producers feel chemical salesmen can provide useful information, and that they are usually happy to discuss weed control programs with salesmen, the majority of corn growers would not be willing to purchase their herbicide products directly from this source.

(3) Attitudes Toward Advertising. The responses to statements 9 through 13 show some interesting features of farmers' attitudes toward advertising. First, they show that most farmers are not very certain as to the reliability of corn herbicide company advertising, yet they do make it a point to read these ads, but not as a specific activity in the course of their product selection decision. Secondly, the results definitely show that farmers prefer farm magazine advertising over radio advertising, and that they rely much more extensively on package labels than company pamphlets.

(4) Attitudes Toward Dealers. Statements 14 and 15 relate to farmers' attitudes toward chemical dealers. As expected from earlier results, the responses to statement 14 indicate that the vast majority of farmers are always anxious to discuss their herbicide programs with dealers. Furthermore, most farmers expressed strong agreement with the idea that they want to purchase most of their corn production inputs from the same dealer.

(5) Attitudes Toward Brand Differences. Statements 16 through 21 were designed to measure farmer attitudes toward brand differences in terms of cost, crop damage, weed control, and ease of application. In general, the

TABLE 3.23

BASIC CORN GROWER ATTITUDES

Attitude Statements	Strongly Disagree		Slightly Disagree		Slightly Agree		Strongly Agree	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Attitudes Toward Price								
1. I feel corn herbicides provide good value for my money.			11	6.3	55	31.4	109	62.3
2. A farmer can save a lot of money by looking around for the best deals in corn herbicides.	13	7.4	31	17.7	70	40.0	61	34.9
3. I usually look for the lowest possible price when buying corn herbicides.	47	26.9	53	30.3	41	23.4	34	19.4
4. The price of corn herbicides in Canada is unreasonably high.	5	2.9	21	12.0	78	44.6	68	38.9
5. When the price of corn decreases I usually consider using less corn herbicides.	125	71.4	34	19.4	12	6.9	4	2.3
Attitudes Toward Salesmen								
6. Corn herbicide salesmen provide useful information in helping me to decide which corn herbicide to purchase.	31	17.7	30	17.1	83	47.4	31	17.7
7. I will consider buying corn herbicides from any salesman who convinces me that he has a good product.	83	47.4	48	27.4	35	20.0	9	5.1
8. I am always happy to discuss my own corn herbicide program with chemical salesmen.	15	8.6	26	14.9	71	40.6	62	35.4
Attitudes Toward Advertising								
9. Before deciding on my purchase of corn herbicides, I frequently check advertisements in farm magazines.	46	26.3	56	32.0	54	30.9	19	10.9
10. I make it a point to read advertisements for corn herbicides.	11	6.3	21	12.0	86	49.1	57	32.6
11. I find radio advertisements for corn herbicides provide useful information.	61	34.9	60	34.3	46	26.3	8	4.6
12. A lot of advertising done by corn herbicide companies is misleading	26	14.9	64	36.6	57	32.6	24	13.7
13. In using corn herbicides I rely more on company pamphlets than on package labels.	91	52.0	54	30.9	23	13.1	7	4.0
Attitude Toward Dealers								
14. I am always happy to discuss my corn herbicides program with dealers.	6	3.4	5	2.9	63	36.0	101	57.7
15. Whenever possible I like to buy most of the products I need for corn production from the same dealer.	7	4.0	10	5.7	60	34.3	98	56.0

TABLE 3.23 (Contd...)

BASIC CORN GROWER ATTITUDES

Attitude Statements	Strongly Disagree		Slightly Disagree		Slightly Agree		Strongly Agree	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Attitudes Toward Brand Differences								
16. It is fairly easy to judge the performance of different brands of corn herbicides.	26	14.9	61	34.9	58	33.1	27	15.4
17. To me the costs per acre of all corn herbicides are about the same.	97	55.4	45	25.7	22	12.6	8	4.6
18. All brands of corn herbicides can be used without fear of damage to your corn crop.	121	69.1	36	20.6	10	5.7	2	1.1
19. All brands of corn herbicides give good weed control no matter what kind of weed problem you may have.	146	83.4	21	12.0	5	2.9	1	0.6
20. I can use all brands of corn herbicides without fear of damage to succeeding crops.	148	84.6	14	8.0	5	2.9	7	4.0
21. All brands of corn herbicides are easy to mix,measure,and apply to your field.	84	48.0	44	25.1	27	15.4	20	11.4
Attitudes Toward Brand Changes								
22. I feel a lot more comfortable with a brand of corn herbicide that I know and have used before.	8	4.6	7	4.0	38	21.7	122	69.7
23. I would be concerned about what kind of weed control I would get if I were to switch to a new brand of corn herbicide.	5	2.9	10	5.7	60	34.3	100	57.1
Other Attitudes								
24. In Canada it is not difficult to obtain corn herbicides at the right time and place.	11	6.3	22	12.6	56	32.0	85	48.6
25. When buying corn herbicides I usually look for a brand which can also control weeds in my other crops.	60	34.3	43	24.6	44	25.1	27	15.4
26. I can do without any help in planning my weed control program.	104	59.4	41	23.4	21	12.0	9	5.1
27. Storing corn herbicides for any length of time usually causes problems.	26	14.9	51	29.1	56	32.0	37	21.1
28. Good cultural practices are at least as effective as chemicals in controlling weeds.	46	26.3	45	25.7	44	25.1	40	22.9

results show that in all these areas, corn growers perceive major differences among competing brands. However, despite the fact that farmers feel these differences exist, their responses to statement 16 indicate that many of them feel it is difficult to assess the nature and magnitude of these differences for specific herbicide products.

(6) Attitudes Toward Brand Changes. The responses to statements 22 and 23 demonstrate very strong attitudes on the part of producers toward the risks they feel are inherent in changing weed control programs. These attitudes are highly related to the rather high level of treatment loyalty observed in Section 3.4.4.

(7) Other Attitudes. The final group of attitude statements relate to product availability, multi-crop weed control, herbicide storage, the role of cultural practices in weed control, and the farmers' general perception of their own ability to plan weed control programs. Responses to these statements indicate that: (1) Most farmers feel that product availability is not a current problem in Canada, (2) They prefer products which could be used on many different crops, (3) There are problems involved in storing herbicides for any length of time, (4) Good cultural practices are important, and (5) They do need assistance in planning their herbicide programs.

4.0 SUMMARY AND MARKETING IMPLICATIONS

The general objective of this research has been to analyze the corn herbicide market in Ontario by studying farmer buying behaviour within the framework of a model of the corn herbicide purchasing decision process. The previous section presented the results of the empirical analysis of a sample survey of 175 Ontario corn growers. In this final section, these research findings are summarized and some of their marketing implications derived. While the discussion in this section is primarily on results related to each stage of the decision process, an effort is made to examine the interrelationships among findings at different stages of the empirical analysis.

4.1 Problem Recognition

A buying situation with some probability of change in treatments or brands is created when a farmer recognizes a problem. Successful marketing of corn herbicides, therefore, requires that the marketing decision maker develop some awareness and understanding of the ways in which problem recognition occurs. More specifically, the marketer must be aware of the factors which induce problem recognition, the relative importance of these factors, and the times of common occurrence. Equipped with such information, the marketer will be in a better position to design marketing programs aimed at stimulating problems among users of competing products, while at the same time preventing problems from occuring with present customers. In addition, the marketer will also be better able to plan his programs to coincide with the timing of this event.

This study measured the impact of several possible situations thought to be potential sources of problem recognition. Factor analysis was employed to group the situations into the following categories: (1) weed control, (2) other product attributes, (3) availability of product information,

(4) cost considerations, (5) influence of advertising and personal selling, and (6) influence of other information sources. The first four categories relate to problem recognition which results from a perceived decline in some aspect of product performance, quality, or service, while the latter two categories are related to problem recognition induced by new information which causes an increase in farmers' expectations.

The results showed that situations relating to all of the above categories can cause problems among at least some farmers. Availability of product information was found to be the category which has the greatest potential for creating problems, and advertising and personal selling the category with the least potential.[13] Also, there were certain specific situations within some of the above categories which particularly stood out in their potential impact as problem sources. These situations were concern for residue, concern for crop safety, influence of Publication 75 (Guide to Chemical Weed Control), and the influence of neighbors and friends.

Investigation of actual problem recognition in the last crop year revealed that unsatisfactory weed control was the dominant source of problems in 1976. Other circumstances which gave rise to problems in 1976 were mixing problems, unfavourable weather conditions, corn injury, timing of application, carryover or residue, and cost per acre.

Finally, the results showed some important differences among farmers in the types of situations giving rise to problem recognition. For example, broad spectrum weed control, cost considerations, and farmer meetings were

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[13] It was necessary to qualify this result with respect to the influence of advertising and personal selling because the measurement of the impact of this category only reflected the promotion of one dimension of product performance, namely, weed control. Regarding the availability of product information, this category is not in actual fact an important source of problems at the present time because product information is perceived as being readily available.

found to be more important sources of problems for larger producers than for other types of farmers.

4.1.1 Marketing Implications

The empirical results related to this stage of the decision process provide some useful guidelines for the development of marketing strategies aimed at stimulating problem recognition by increasing farmers' expectations. First, the results suggest the key product attributes which should be emphasized in marketing programs. While weed control remains the dominant source of problem recognition, there is strong evidence to support marketing programs which also emphasize certain non-weed control characteristics. These non-weed control characteristics are residue, crop safety, measuring and mixing, cost per acre, and method of application.

Secondly, the potential impact on problem recognition of information in the farmers' social and commercial environment must not be overlooked by corn herbicide marketers. Such information comes from sources such as Publication 75, neighbors and friends, dealers, extension agents, and farmer meetings. It is clear that the marketer must make every effort to have such sources promote or comment favourably on his product. In specific terms, this may entail (1) use of word of mouth advertising through such activities as farmer meetings where customers are given maximum opportunities to share product experiences with other farmers, (2) close liaison and cooperation with government and university research and extension personnel, and (3) organization of dealer meetings designed to equip dealers with adequate knowledge of the product and its uses.

Thirdly, the finding that most problems are actually experienced in the months of May, June, and July suggests that marketers should plan programs to coincide with these times of the year. In this way an opportunity is

embraced to create awareness of an alternative product offering in the farmer's mind at the precise moment when dissatisfaction is being experienced with the product being used. Also, it is during these times that marketers should try to minimize the occurrence of doubts or problems in the minds of their present customers. In practical terms this may require the use of follow-up sales calls to allay any anxieties about the product which may be emerging among farmers at this time.

In addition to the above considerations, the findings of this research provide some useful guidelines for effective market segmentation strategies. For example, the results suggest that segments formed on the basis of farm size offer opportunities to emphasize broad spectrum weed control, low cost, and well-organized farmer meetings to a segment composed of large farmers, while segments formed on the basis of farm type offer opportunities to stress good weed control, dealer service, and farm magazine advertising to the non cash grain farmer.

4.2 Search for Information

Farmer buying behaviour pertaining to the search for information stage of the decision process is also of special significance to the marketer of corn herbicides for it is during this stage that the farmer identifies the alternative products and their characteristics to be considered when making his purchase decision. According to the conceptual framework of this study, two broad kinds of searching activity can be identified. First, information is sought on alternative brands of corn herbicides with respect to specific attributes such as efficacy, residue, cost, measuring and mixing, and so forth. Secondly, for farmers whose buying situation closely approaches one of extensive problem solving, search is geared toward gaining some familiarity with corn herbicides as a general product class.

This study investigated the following three dimensions of the search process: (1) farmers' evaluation of information sources, (2) farmers' degree of participation in searching activities, and (3) the factors related to general searching behaviour.

The Ontario farmer has a large number of commercial and non-commercial information sources at his disposal. This study investigated the relative importance of these sources with respect to seven specific types of information. The results showed that although the most important sources varied somewhat according to the type of information sought, dealers and Publication 75 stood out as particularly important sources for most types of information. Some other sources were regarded as being important for specific uses. For instance, farmer meetings and farm magazine advertisements were rated as important for obtaining information on new herbicide products, and package labels for obtaining information on application methods, safety precautions, and crop damage.

In the course of gathering information on corn herbicides, farmers engage in a variety of shopping activities. These activities range from simply scanning farm magazines and observing herbicide advertisements to spending hours or even days attending farmer meetings or visiting test plots.

The extent of farmer participation in fifteen shopping activities was assessed in this study. The results showed that the more widely used activities were reading Publication 75, reading farm magazine advertisements, attending farmer meetings, and contacting herbicide dealers and other corn growers to discuss weed control programs. Less widely used activities were contacting government extension agents and setting up or visiting various types of corn herbicide test plots.

Finally, this research looked at overall searching behaviour with the objective of determining the factors that influenced the amount of searching

undertaken in 1976. Regression analysis revealed that eight variables were significantly related to overall searching behaviour. More specifically, the results showed that larger, more knowledgeable cash grain farmers who perceived larger differences among brands, had more favourable attitudes toward advertising, and felt that they should always be familiar with herbicide products and brands engaged in a greater number and variety of searching activities than other farmers.

4.2.1 Marketing Implications

One of the more important elements in a firm's marketing program is its communications strategy. Effective communications consists of using the proper communications channel for particular types of messages.

The results of this research provide some important insights into the formulation of an effective communications strategy for herbicide marketers. Specifically, the results showed that two channels, dealers and Publication 75, are very effective in reaching farmers with almost all types of information. Of these two channels, dealers are the most important from a marketing point of view since they represent a more or less controllable element in a firm's marketing program. As a result of their perceived usefulness as a source of many types of herbicide information, they form a critical link in the information flow between the manufacturer and the final purchaser. Because of this important position, herbicide marketers should make every effort to develop effective dealer selection and training programs. In both of these areas, attention should be given to the characteristics farmers desire in an "ideal" herbicide dealer. These include being willing to make on-farm visits, providing help in contacting company representatives to assist in solving specific problems, being willing to make brand recommendations, and being knowledgeable concerning herbicides and weed problems.

In addition to isolating the broad role of dealers in the information flow from manufacturers to purchasers, the results also showed the importance of other controllable channels in providing more specific types of information; for example, personal selling is providing problem solving assistance, and advertising in generating awareness of new products or new product attributes. In designing communication strategies, the marketer should be aware of the rather specific uses of some channels and attempt to maximize communications effectiveness by the proper matching of messages with channels.

In the process of obtaining information, farmers use various shopping or searching activities. It is important for marketers to know which activities are used, and the differences among farmers in the extent to which they use these activities. Such information will allow marketers to concentrate their efforts on those activities used by a large number of buyers or, if following a strategy of market segmentation, to concentrate on the activities used by those farmers in their target markets.

Finally, this research also looked at the factors related to the overall amount of searching done by farmers. From a marketing point of view, the most important result of this analysis is that most searching is not done as a response to a particular problem, but rather on a more or less continuous basis by farmers who feel that they should always be familiar with the various products and brands on the market. Since this is a prevalent attitude among corn farmers, it implies that there is a large and ready audience for herbicide information. Marketers, as a result, should find it desirable to satisfy this need by providing interesting and informative information on their products and how they are used. The fact that these farmers also have favourable attitudes toward advertising implies that this channel might be very appropriate for this purpose.

4.3 Evaluation and Purchase

The process of evaluation involves the formation of attitudes toward alternative brands by comparing certain evaluation criteria with brand beliefs. The result of this process is an ordering of alternative brands in terms of their relative preference, and the selection of the most preferred brand for purchase. Analysis of farmers' ratings of fifteen possible evaluation criteria revealed that good weed control is the most important criterion followed closely by dealer service, cost per acre, potential crop damage, residue, measuring and mixing, method of application, and label information. Factor analysis was employed to group the criteria into the following categories: (1) marketing programs, (2) herbicide application, (3) herbicide salesmen, (4) weed control, (5) cost/damage, and (6) herbicide dealers.

Farmers' perceptions of existing corn herbicide products were investigated in terms of an analysis of the direction and intensity of their attitudes toward the four major brands with respect to the same fifteen product and company attributes. The results of this analysis revealed the following brand beliefs:

(1) Aatrex is the strongest brand in terms of cost per acre, control of broadleaves and control of perennials. It also shares the position with Sutan as the brand with the lowest risk of damaging the corn crop. On the other hand, Aatrex is the weakest brand on control of grasses and residue or carryover. It also shares the position with Bladex as the weakest brand in terms of measuring and mixing.

(2) Bladex is the second strongest brand for broadleaf control. It shares the position with Lasso as the weakest brand on damage to the corn crop, and shares the position with Aatrex as the weakest brand on measuring and mixing.

(3) Sutan is the strongest brand on control of grasses. It shares the

position with Aatrex as the brand with the least chance of damaging the corn crop, and shares the position with Lasso as the strongest brand on measuring and mixing. Sutan is by far the weakest brand on method of application.

(4) Lasso shares the position with Sutan as the strongest brand on measuring and mixing. On the other hand, it is weakest on control of perennials, and shares the position with Bladex as the weakest brand on damage to the corn crop.

After determining the relative importance of the fifteen product and company attributes and the farmers' brand beliefs concerning these attributes, the analysis turned to an examination of the evaluation procedure used by farmers in forming overall attitudes toward brands. The results of this analysis showed that the expectancy-value model represents a close approximation to the actual procedure used by farmers in selecting brands of corn herbicides.[14]

The 1977 corn herbicide purchasing decision was analyzed in terms of (1) the timing of the decision, (2) brand and/or treatment changes, and (3) reasons for brand and/or treatment changes. The results here showed that most purchasing decisions are made immediately after observing the degree of product performance achieved in the current growing season. For most farmers this occurs in the active weed growing months of June, July, and August or in the harvest months of October and November.

Of the 133 farmers who had definitely decided on next year's treatments at the time of the survey (December 1976), 28 percent indicated an intention to change treatments in 1977. The major reasons given for changing were a desire for improved weed control and concern for residue buildup or carryover.

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[14] Further analysis is needed in this area to see if other models of attitude formation are more appropriate. This research only investigated the expectancy-value model. Although this is a widely used model, other approaches have been suggested and should be looked at in future research.

The final step in the analysis of evaluation and purchase was to investigate the extent to which farmers changed brands of herbicides over the seven year period of 1970 through 1976. The results of this analysis showed considerable brand loyalty in the sense that over 50 percent of the farmers made one or fewer changes during this period. An analysis of the farm and farmer characteristics associated with different degrees of loyalty revealed that younger, less experienced farmers with larger corn acreages were likely to switch brands more often than other farmers.

4.3.1 Marketing Implications

It is important for marketers to have some insight into the evaluation criteria or product attributes which farmers consider when evaluating different brands of corn herbicides. Such information provides the marketer with guidelines for improving his product and marketing program in such a way that it can be seen by farmers as possessing salient attributes. Also, by determining the relative importance of different attributes to various target markets, the marketer can attempt to segment the corn herbicide market according to the attributes of common interest to different corn growers.

Marketers must also be concerned about the attitudes and perceptions farmers have toward their brands. The brand belief analysis performed in this research showed some large differences among brands in terms of important product and product-related characteristics. These indicate relative strengths and weaknesses of the four major brands and, as a result, can directly aid the marketer in positioning his brand. If his brand is evaluated relatively high on a particular attribute, he can exploit this finding by orienting his program to emphasize this attribute. On the other hand, if his brand receives a relatively weak evaluation on an attribute, efforts can be made to correct this weakness. In both cases, the result will be an improved image for the company

and brand.

Finally, marketers should be aware of the extent of brand loyalty in the corn herbicide market, and the characteristics of loyal and non-loyal farmers. The results of this study showed that although a substantial proportion of farmers are fairly loyal to herbicide brands, there is a sizeable number that have demonstrated a willingness to make brand changes in the past. This latter group of farmers, the switchers, are an important group to herbicide marketers since they represent the farmers most likely to make brand changes in the future. As a result, marketing programs with sales and/or market share growth objectives must be oriented toward this group. A careful examination of the specific characteristics of this group can aid in designing this type of marketing program.

5.0 APPENDIX A.

MEASUREMENT AND USE OF FARM AND FARMER CHARACTERISTICS IN EVALUATING PURCHASING BEHAVIOUR DIFFERENCES

At various points in the text of this paper, reference is made to an analysis of differences in purchasing behaviour related to various farm and farmer characteristics. This appendix discusses the measurement of these characteristics and how the results of the analysis should be interpreted.

Six major farm and farmer characteristics were employed to investigate differences in purchasing behaviour. These were: (1) farm size, (2) corn yields, (3) farm type, (4) age and experience, (5) education, and (6) herbicide knowledge. In some cases these characteristics were measured using a single variable, while in other cases two or more variables were used. The specific measures used are as follows:

(1) Farm Size

(a) Total Corn Acreage

Less than 50 acres (small)
51 to 200 acres (medium)
201 and 500 acres (large)
Over 500 acres (very large)

(b) Gross Farm Income

$10,000 to $49,000 (small)
$50,000 to $99,999 (medium)
$100,000 to $199,999 (large)
$200,000 and over (very large)

(2) Corn Yields

100 bushels per acre or less (low)
More than 100 bushels per acre (high)

(3) Farm Type

Livestock
Cash Grain
Dairy
Other

(4) Age and Experience

(a) Years of Farming Experience

20 years or less (low)
21 to 30 years (medium)
Over 30 years (high)

(b) Years Corn Growing Experience

10 years or less (low)
11 to 25 years (medium)
Over 25 years (high)

(c) Age of Farm Operator

Under 35 years (young)
35 to 54 years (middle)
55 years and older (old)

(5) Education

Elementary (low)
Secondary (medium)
Some or complete university (high)

(6) Herbicide Knowledge

Low
Medium
High

In using these characteristics to evaluate differences in purchasing behaviour, simple two-way cross-classifications were computed relating each farm and farmer characteristic to the purchasing behaviour variables of interest. For example, in the case of number of brand switches, three categories were cross-tabulated with each of the above characteristics and the number and percentages of farmers in each category were determined for each level of the six farm and farmer characteristics. The results of this type of analysis are indicative of general relationships between the purchasing behaviour variables and the farm and farmer characteristics. This point is illustrated in Table A.1 which shows the cross-tabulation of number of brand switches with years of corn growing experience.

TABLE A.1

CROSS TABULATION OF BRAND SWITCHES WITH YEARS OF CORN GROWING EXPERIENCE

Number of Brand Switches	Years of Corn Growing Experience			
	10 Years or Less	11 to 25 Years	Over 25 Years	Total
No Switches				
Number	5	13	13	31
Row Percentage	16.1	41.9	41.9	17.7
Column Percentage	10.2	15.9	29.5	--
Total Percentage	2.9	7.4	7.4	--
1 to 2 Switches				
Number	30	49	23	102
Row Percentage	29.4	48.0	22.5	58.3
Column Percentage	61.2	59.8	52.3	--
Total Percentage	17.1	28.0	13.1	--
3 or More Switches				
Number	14	20	8	42
Row Percentage	33.3	47.6	19.0	24.0
Column Percentage	28.6	24.4	18.2	--
Total Percentage	8.0	11.4	4.6	--
Column Total	49	82	44	175
	28.0	46.9	25.1	100.0

The results of the analysis in Table A.1 clearly reveal the existence of a relationship between brand switching and years of corn growing experience. This can be readily observed by comparing the column percentages. For example, 10.2 percent of the farmers with 10 years or less of corn growing experience made no switches compared to 15.9 percent with 11 to 25 years of experience, and 29.5 percent with over 25 years of experience. The opposite situation occurs in the case of 3 or more switches. Here 28.6 percent of the farmers with 10 years or less of corn growing experience made 3 or more switches compared to 24.4 percent with 11 to 25 years of experience, and 18.2 percent with over 25 years of experience. Thus in the high switching category there is a greater concentration of less experienced farmers, and a lower concentration of experienced farmers. In the low switching category the opposite situation occurs. As a result, the conclusion clearly is that there is a negative relationship between years of experience and number of brand switches.

There are several limitations involved in using simple two-way cross-classification about which the reader should be aware when interpreting the results. Of these the most important are:

(1) Two-way cross-classification by definition only looks at the relationship between two variables at a time. Introduction of a third variable could significantly change the results of the analysis. For instance, if in the example shown in Table A.1 a third variable was also considered, the results could show little or no relationship between number of brand switches and years of corn growing experience. Although three or multi-way cross-classifications are highly desirable, they require very large sample sizes to be meaningful, hence were not possible in this research.

(2) The results of any cross-classification analysis are obviously influenced by the category definitions. Although great care was taken in this

research to develop meaningful categories both in terms of the purchasing behaviour variables and the farm and farmer characteristics, changes in these categories could change the results.

6.0 APPENDIX B.

DEFINITION AND MEASUREMENT OF VARIABLES

In the analytical work reported earlier in this paper a number of behavioural variables were used in various stages of the analysis. The purpose of this appendix is to specify the exact manner in which each of these variables were defined and measured.

(1) Search Score - the search score was developed on the basis of the extent of farmer participation in the shopping activities listed in Table 3.8. The specific activities considered and the values assigned to each activity are as follows:

(a) Read Publication 75

0 = Did not read
1 = Scanned
2 = Read thoroughly

(b) Number of farmer meetings attended

(c) Discuss weed control program with government extension personnel

0 = No
1 = Yes

(d) Discuss weed control program with neighbors and friends

0 = No
1 = Yes

(e) Discuss weed control program with dealers

0 = No
1 = Yes

(f) Number of dealers you discussed your weed control program with

(g) Discuss weed control program with custom operators

0 = No
1 = Yes

(h) Set up test plot to compare corn herbicide treatments

0 = No
1 = Yes

(i) Visit government test plots

0 = No
1 = Yes

(j) Visit company test plots

0 = No
1 = Yes

(k) Visit university test plots

0 = No
1 = Yes

(l) Visit soils and crops test plots

0 = No
1 = Yes

(m) Read farm magazine ads for herbicides

0 = Did not read
1 = Scanned
2 = Read thoroughly

(n) Discuss weed control program with company salesmen

0 = No
1 = Yes

To compute a search score for each farmer, the scores for the fourteen activities listed above were first standardized and then the standard scores were summed and divided by fourteen.

(2) Weed and Herbicide Knowledge - to measure the extent of weed and herbicide knowledge each farmer was shown a series of 12 photographs containing pictures of common Ontario weeds. For each picture the farmers were asked two questions: (1) What do you call this weed? and (2) What treatment

would best control this weed?

To calculate the knowledge scores the following scale values were used:

(a) Weed identification - a value of one was given for each weed correctly identified and a value of zero for incorrect identification or a don't know response.

(b) Herbicide treatment - the values assigned for each weed were:

4 = excellent
3 = good
2 = fair
1 = poor
0 = don't know

Final scale values were obtained by summing the weed identification scores with the herbicide treatment scores.

(3) Herbicide Failure Rates - to determine herbicide failure rates the sample farmers were shown a list of 26 common Ontario weeds, and for each weed, asked to indicate whether they treated for the weed in 1976, and if so, whether they achieved control. A herbicide failure rate was computed for each farmer by dividing the number of weeds not controlled by the total number treated.

(4) Perceived Brand Difference - to measure a farmer's perception of the differences among brands,a series of five attitude statements were evaluated by each respondent. These statements were:

(a) I can use all brands of corn herbicides without fear of damage to succeeding crops.

(b) To me the cost per acre of all brands of corn herbicides are about the same.

(c) All brands of corn herbicides give good weed control no matter what kind of weed problem you may have.

(d) All brands of corn herbicides are easy to mix, measure, and apply to your field.

(e) All brands of corn herbicides can be used without fear of damage to your corn crop.

Responses to these statements were recorded on a four point scale ranging from (1) Strongly Disagree to (4) Strongly Agree. Perceived difference scores were computed for each respondent by reversing the values assigned to the scale and summing the responses to each statement. Using this procedure, higher scale scores indicate greater perceived brand differences.

(5) Risk Attitude - the variable risk attitude was measured using the following three attitude statements:

(a) Uncertainty about the future always makes me hesitate before doing anything new on my farm.

(b) I feel a lot more comfortable with a brand of corn herbicide that I know and have used before.

(c) I would be concerned about what kind of weed control I would get if I were to switch to a new brand of corn herbicide.

Responses to these statements were recorded on a four point scale ranging from (1) Strongly Disagree to (4) Strongly Agree. Risk attitude scores were computed for each respondent by reversing the values assigned to the scale and summing the responses to each statement. Using this procedure, higher scale scores indicate a higher level of risk acceptance.

(6) Self Confidence - this variable was measured using the following series of three attitude statements:

(a) I can do without any help in planning my weed control program.

(b) I believe I know as much about corn growing as any farmer in Ontario.

(c) There is very little about weed control that I do not know.

Responses to these statements were recorded on a four point scale ranging from (1) Strongly Disagree to (4) Strongly Agree. Scale scores were computed for each respondent by summing the responses to each statement. As a result, higher scores indicate a greater degree of self confidence.

(7) Attitude Toward Advertising - the variable attitude toward advertising was measured using the following four attitude statements:

(a) I make it a point to read advertisements for corn herbicides.

(b) A lot of advertising done by corn herbicide companies is misleading.

(c) Before deciding on my purchase of corn herbicides, I frequently check advertisements in farm magazines.

(d) I find radio advertisements for corn herbicides provide useful information.

Responses to these statements were recorded on a four point scale ranging from (1) Strongly Disagree to (4) Strongly Agree. Attitude toward advertising scores were computed for each respondent by reversing the values assigned to statement (b) and then summing the responses to each statement. Using this procedure, higher scores represent more favourable attitudes toward advertising.

(8) Attitude Toward Salesmen and Dealers - to measure this attitude, a series of four statements were evaluated by each respondent. These statements were:

(a) Corn herbicide salesmen provide useful information in helping me to decide which corn herbicide to purchase.

(b) I am always happy to discuss my corn herbicide program with dealers.

(c) I will consider buying corn herbicides from any salesman who convinces me that he has a good product.

(d) I am always happy to discuss my corn herbicide program with chemical salesmen.

Responses to these statements were recorded on a four point scale ranging from (1) Strongly Disagree to (4) Strongly Agree. Scale scores were computed for each respondent by summing the responses to each statement. As a result, higher scores are associated with a more favourable attitude toward salesmen and dealers.

(9) Attitude Toward Price - this variable was measured using the following three statements:

(a) A farmer can save a lot of money by looking around for the best deals in corn herbicides.

(b) I usually look for the lowest possible price when buying corn herbicides.

(c) I feel corn herbicides provide good value for my money.

Responses to these statements were recorded on a four point scale ranging from (1) Strongly Disagree to (4) Strongly Agree. Attitude toward price scores were computed for each respondent by reversing the values assigned to statement (c) and then summing the responses to each statement, using this procedure, higher scores represent greater price sensitivity.

(10) Attitude Toward Searching - this variable was measured by the following three statements:

(a) Other farmers seek my advice about their weed problems so I must always be knowledgeable about all corn herbicides.

(b) I always make it my business to be familiar with all corn herbicides.

(c) I only make it my business to be familiar with corn herbicides when I am considering changing brands.

Responses to these statements were recorded on a four point scale ranging from (1) Strongly Disagree to (4) Strongly Agree. Scale scores were computed for each respondent by reversing the values assigned to Statement (c) and then summing the responses to each statement so that higher scores represent a greater degree of routine search.

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