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IMPLICATIONS OF SOYBEAN PRODUCER PERCEPTIONS

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IMPLICATIONS OF SOYBEAN PRODUCER PERCEPTIONS FOR PUBLIC VARIETY DEVELOPMENT AND DISTRIBUTION POLICY

By

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ABSTRACT

IMPLICATIONS OF SOYBEAN PRODUCER PERCEPTIONS FOR PUBLIC VARIETY DEVELOPMENT AND DISTRIBUTION POLICY

By

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Several recent developments and trends have greatly affected the seed industry. The participants, their relationships, their goals, and the "rules of the game" have changed, or been pressured to change. This restructuring of the institutions, and the environment within with they operate, presents possibilities, raises concerns, spurs debate, and necessitates choice.

This study seeks to inform some of the policy choices that will be made. Specifically, through an examination of farmer perceptions with regard to soybean varieties, the study explains some of the observed trends, and provides support for policy selection.

Results indicate that public varieties are frequently viewed as inferior, not necessarily based on actual performance, but on some commonly held perceptions that distinguish public varieties from private varieties. These negative perceptions (i.e. "older," "less information and service available") frame all variety comparisons, and hurt the evaluation and ultimately the use of public varieties. Conversely, positive orientations for private varieties (i.e. "new and improved," "more information and service available") indicate that these varieties are favorably framed, supporting their evaluation and use.

ACKNOWLEDGEMENTS

This thesis is the result of a great deal of effort on the part of many. First, I would like to express my gratitude to Allan Schmid, my major professor, whose guidance, insight and inspiration helped me to take a "fresh look," challenging some of my own assumptions, as well as those of our profession. His contributions are reflected throughout the thesis, and will undoubtedly go with me beyond this work. Further thanks are extended to Jack McEowen and Dale Wilson, committee members, who also provided valuable comments and generally improved the value of this effort. Also my thanks to Tom Isleib, Randy Judd, and the many other people, from Cooperative Extension agents to farmers, who taught a "dairy farmer by birth" a lot about growing soybeans. Particular thanks are also extended to the soybean growers interviewed. Their experience, and willingness to share, taught me much, provided needed information, and proved to be one of the most enjoyable parts of the study.

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CHAPTER I

INTRODUCTION

Need for Research

Over the past two decades the environment surrounding and enveloping the seed industry has changed greatly. These changes have created opportunities and challenges for the seed industry, and in particular the public portion of that industry. In response to these challenges, changes in the organization of the industry, most often public programs, have been proposed, and in some cases implemented. Along with changes in policy, influence and ideas, a great deal of debate and conflict over the appropriate role of the land grant system (public breeding programs) in the seed industry have erupted. Essentially the debate is over how public plant breeding and distribution programs can best serve the land grant mission of "the public good."

It is evident that the changes in the environment, and the changes in policy to date, mean that the old ways will never be, and probably should never be, totally returned to. But this leaves the public system and the entire industry in a state of flux, with debate and conflict abounding. Decisions are being made and must be made. These decisions must not be based on emotional argument and the lines that

are often drawn between "the private sector serving the profit motive and the land grant system protecting the public welfare." The decisions must be more fully informed.

A better understanding of the current situation and, in particular, the force that drives the entire industry, the consumer of seeds - the commercial producer - is a necessity to informing these decisions. It is this later issue, the perceptions of commercial producers and their effects on policy, that have perhaps been ignored or belittled by many in the public sector. The manner in which commercial producers behave and ultimately determine the fate of breeding programs has been relegated to lower status. The emphasis has been placed on development of seeds based on traditional notions. For instance, better seed, as defined by researchers, will sell, especially if it it's offered at a lower price. But it has become evident through recent trends that this is not the case. The traditional view of many plant breeders, economists, seedsmen and administrators, that more at a lower price is better, does not hold.

Policy makers are in need of information concerning their options and the effects of their choices. Knowledge of producer perceptions is an essential element for review of the options, and this information has been lacking. Leaders need to know what producers think, how they behave, and how this will affect the outcome of policy choices made.

In light of such information, strategies for action and service of producers and their ultimate audience, the public as consumers of agricultural goods, can be more appropriately selected and designed. And in this manner the land grant mission of "serving the public good" can be more fully achieved.

Background and Problem Statement

In the United States, soybean varieties (as well as other crop varieties) are generally classified as private or public by their source of release. Private varieties are those varieties which are developed and released by private seed companies. Public varieties are those varieties which are bred by public institutions such as land grant universities and the state agricultural experiment stations associated with them. These varieties are most often freely released to any interest wishing to grow out and/or sell them. In general, the production and distribution system for public varieties is much less integrated and controlled by the initial source of the variety when compared to private varieties.

In addition to the differences in mode of operation, the goals of the two sectors of the seed industry differ. In general, the private sector is interested in putting out a product that will reap benefits in the form of financial returns to the firm (and its stockholders if it is a publicly held interest). This does not imply less noble

goals: it is simply the reality of business life. The goals of the public sector are much more complex. In general, the goal of this sector is to serve the "public good." Determination of what exactly is the public good is difficult at best, and may involve competing interests. In any case, the goals of this portion of the seed industry are somewhat less obvious and are constantly being defined and redefined.

Relatively recent developments have altered the rules of the game for the seed industry. In the 1970's biotechnology entered the scene. New opportunities now exist for plant research and development; but it must be noted that these opportunities are costly. At the same time that these costly but great potentials have evolved, public funds have become increasingly tight. Decisions at the federal level[1] now allow for the protection of plant varieties and have created an environment where variety release can legally be restricted and variety use charged. All of this has meant that public research programs have faced new challenges and come under greater scrutiny. Choices concerning research emphasis have been made, and program directors have looked for alternative means of financial support.

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[1] In 1970, the Plant Variety Protection Act granted patent-type protection to sexually-propagated plant varieties. In 1985, the general Patent Act was extended to provide utility patent protection to all plant materials. (Lesser 1987; Stallman and Schmid 1987)

These changes in the seed industry environment have been accompanied by other trends. Private investment in agricultural and food research has increased tremendously since the 1970's. In the soybean seed industry, private varieties have grown in importance and are close to dominating the market in several areas. Privately owned plant breeding companies have developed and are selling their genetic material to those willing and able to purchase it. Whether these trends are simply correlated with the above noted changes or caused by them is difficult to determine, but they do interact to create new challenges for the seed industry, in particular the public seed sector.

These challenges faced by the public seed industry involve some of those most basic and fundamental goals or missions noted above. In particular, they concern the provision of a continued supply of high-quality seed and/or propagating material, the maintenance and exchange of quality plant germplasm, the fostering of support for research programs, the education and training of the industry's future professionals, or more generally how to "serve the greater public good."

The changes and trends, combined with the numerous and varied interpretation of "the greater public good," has lead to conflict, controversy and the need for choice. Plans for addressing these challenges have developed. New public sector roles, release policies, marketing and distribution

modes and the like have been proposed, and in some cases implemented. And a great deal of discussion of, and debate over, these plans for action has resulted.

At the center of this conflict is the question of how to serve the public good. The options are many and, state experiment station directors, department chairs, plant breeders, certification agencies, legislators, seedsmen, commercial producers, and others involved in shaping the policies of the public seed industry, are faced with choices at many levels. What should be the research emphasis? Basic plant research or variety development? What combination? Which commodities? Once new varieties are developed should they be protected? What sort of protection should be sought? How should they be released? Open, limited or exclusive release? To whom? Should royalties, user fees be sought? How do these decisions affect public support? How do these decisions affect seedsmen and producer perceptions of public programs and seed? In essence, what is the appropriate strategy for achieving the goals of the land grant system as defined by that institution?

Although many have offered opinions, and the pros and cons of many of the issues have been debated, little, or no, research has been conducted specifically to provide supporting information. This is especially true for producer perceptions and behaviors that affect the outcomes

of policy choice. Thus, this study specifically seeks to examine soybean producer perceptions, and the link of these perceptions to behavior (variety selection). In light of this information, passed trends can be explained, policy options can be evaluated and strategies can be developed to utilize the perceptions to serve the public good, however that may be defined.

Study Objectives

As noted above, there are many issues involved in the decisions facing the seed industry. In addition, there are many factors affecting the outcome of these decisions. This study focusses on soybeans as a commodity where many of the changes and challenges are currently being strongly felt. By bringing forth and discussing some of the issues facing the soybean seed industry the challenges facing this particular commodity group as well as others may be more fully understood. Specifically, this study examines the situation, the options, the nature of demand for soybean seed, and finally, their effects on the current situation and policy choice.

It is the basic premise of the study that the perceptions of commercial soybean producers regarding seed, are the essential building blocks for understanding the industry and its options. The manner in which producers view seed determines their choices and ultimately the success or failure of public (and private) varieties and the

programs from which they originate. It is this study's hypothesis that public programs have not been as "in tune" with producer perceptions as have private firms. Thus, the successes of the private sector, and the differences seen between private and public programs, can be explained by examining public and private program structure and producer views. Futhermore, the study emphasizes that public programs and policy decision makers need to be more aware of these producer perceptions as they make decisions. It isn't enough to continue on with what has traditionally been considered "good" seed. What producers think, not necessarily what "is" by some scientific standard, affects choice and ultimately the success of breeding programs.

Thus, the basic objective of the study is to explain some of the past and inform future choice. And this can be done through a better understanding of the current situation, the many policy options, and the perceptions of soybean producers. By getting at what attributes producers feel are important, what these attributes really mean, and how these are linked together, policy selection and strategy planning can be more appropriately conducted. In addition, it is essential to find out where the programs are now. What is currently happening? How are public programs and private programs viewed by growers? And how does this affect the choices that will be made?

The specific objectives of this study are to:

1. Review the soybean seed industry situation as a means for providing a better understanding of the current debate.

2. Develop a framework for analyzing consumer perceptions regarding a product and its characteristics, and the relation of these to behavior.

3. Apply the framework to commercial soybean producers and their perceptions regarding soybean seed.

4. Use the analysis of this application to explain current trends, review policy options, and demonstrate opportunities for strategy development.

Overview of the Study

This study evaluates some of the alternatives and choices facing the public soybean seed industry through a review of the industry situation and an analysis of the nature of demand for soybean varieties. Through the use of the means-end chain model of consumer behavior and accompanying research methods, the variety attributes, use consequences, and personal values of importance in soybean variety selection are uncovered. A Hierarchical Value Map (HVM) or perceptual map for soybean producers reveals perceptions of soybean varieties (in particular public and private varieties) and links these to variety choice. Finally, the current situation and some policy options are reviewed in light of the findings.

The thesis is divided into seven chapters, yielding insight into the industry situation, the nature of consumer behavior, the perceptions of soybean producers in Michigan,

and the impact of these upon the seed industry and public choice.

Chapter II sets the stage by examining the soybean seed industry. The organization of the industry is first examined. Next, the goals of the private and public sector are reviewed. This discussion includes an overview of the role or mission of the land grant institution. It is this mission that is the foundation for much of the discussion and debate surrounding public breeding programs. Current market trends and some of the differences between public and private programs and varieties are also discussed.

The specifics of policy alternatives, and proposed changes are reviewed in Chapter III. This chapter also seeks to shed some light on the nature and extent of the debate by discussing some of the many reactions to, and concerns with, specific policies and changes.

Chapter IV deals exclusively with consumer behavior. It seeks to provide some background for viewing the driving force behind the seed industry; the behavior of the seed consumer, commercial producers. First, traditional economic approaches and their implications are discussed. Next, a behavioral approach to choice is examined, and some additional questions and concerns point to the need for some market/choice research.

In Chapter V, the specific model, the means-end chain model, used in this study is introduced and developed for

this market. The implications of this model for pubic policy choice and strategy formulation in the public seed industry are examined. And the specific procedures used in this study for researching soybean grower perceptions and choice are developed and explained in depth in this section.

The results and analysis of the market research are presented in Chapter VI. Specific variety attributes, use consequences and personal values of pertinence to the growers surveyed are presented, along with a perceptual map demonstrating the manner in which these are linked to affect choice. Also, perceptions regarding the split between public and private varieties are put forth.

Chapter VI also uses the above noted findings to review and explain some of the current trends and private/public program differences in the industry. In addition, some proposed changes and other issues facing public sector decision makers are discussed in light of the findings. Possible "plans of attack" are also discussed, not as "the" solutions, but as examples of the manner in which data from this study can be utilized to form strategies for variety development, distribution and marketing.

Chapter VII summarizes the study and results obtained. A brief review of the situation, study efforts and some results are presented. Also the implications of the results and methods for the soybean seed industry and for future research are examined.

CHAPTER II

INDUSTRY SITUATION

The current situation facing the seed industry, in particular the soybean seed industry, is a complex one. As a first step to weighing the options and informing choice, a better understanding of the industry situation is essential. In this chapter several facets of the situation are examined in greater depth. The organization of the industry with regard to the functional roles and institutional nature of participants is presented. The goals of both the private and public sectors of the industry are then examined. Next, the environment that the industry works within, including the nature of technology, research funding, patent rights, and some trends concerning the players and their roles is presented. All of this discussion makes up the backdrop for change and proposed change. And it is this change, proposed change, and the surrounding debate that is discussed in Chapter III.

The Seed Industry

As commonly perceived, the U.S. seed industry includes all of those interests that breed, produce, condition, market and distribute seeds of all kinds (Butler and Marion

1985). Many of these interests operate only in certain geographic areas and do not compete with those interests in other regions. "In addition, different species of seed (e.g. corn, wheat, alfalfa, peas) are not close substitutes. Thus, the loose collection of firms that are commonly considered the 'seed industry' are actually in several economic industries or markets."[1] (Butler and Marion, p.15). This loose collection, across and within regions and commodities, makes for a complex set of interrelationships between interests involved as competitors, suppliers and/or customers.

In Figure 2.1, the vertical organization of the seed industry, as laid out by Butler and Marion (1985), displays the majority of those above noted interrelationships. This organization of the industry revolves around four basic functions: 1) plant breeding, 2) seed production/growing, 3) seed conditioning/processing, and 4) seed distribution. In simplified form: following variety development, foundation seed is grown-out to provide registered seed, which is grown-out to provide certified seed, which is then

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[1] "An economic definition of an industry is a group of firms which produce a group of products which are close substitutes for each other, are available to a common group of buyers, and are relatively distant substitutes for other products." (Butler and Marion 1985, p. 14) Joseph Bain defined a market as all sellers in any individual industry, and all buyers to whom they sell. (Caves 1980)

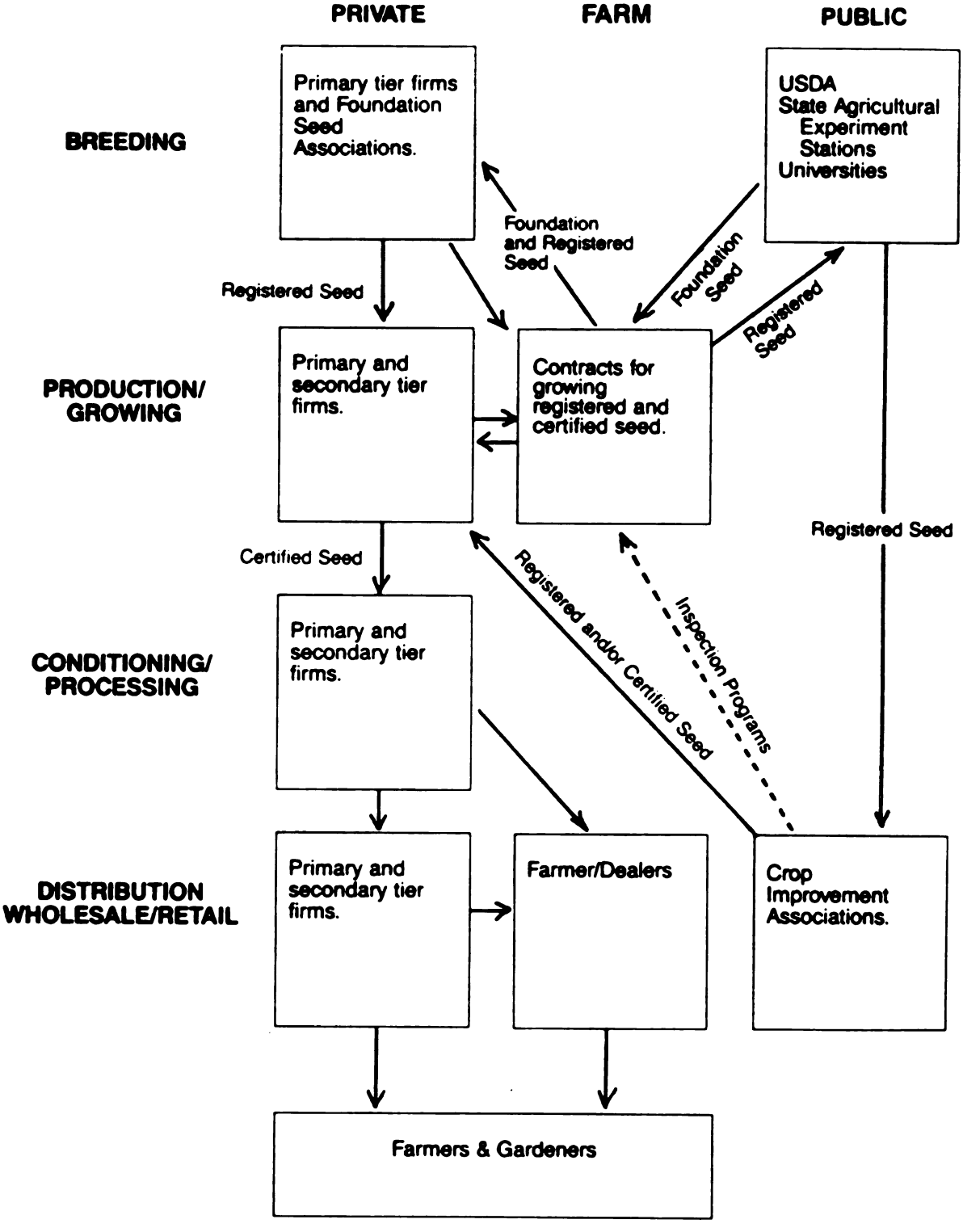

Figure 2.1 Vertical Organization of the Seed Industry

Source: Butler and Marion 1985

sold to farmers[2].

Butler and Marion (1985) classify the industry participants into two tiers based on the functions performed. "Secondary tier firms are primarily engaged in production of certified seed, conditioning and distribution. Primary tier firms usually perform these functions but also are involved in breeding and releasing new varieties" (p.16). Outside of these two general tiers are the farmers who grow out registered and/or certified seed and sell it to firms, and the many farmer-dealers who serve as seed company retailers.

As noted in Chapter I, another organizational split in the United States seed industry is the "private/public" classification as delineated by the source of variety release. Private seeds are those varieties which are developed and released by private seed companies. As previously noted, these private varieties are often grown out, wholesaled and retailed through the firm's own production and distribution system (a primary tier firm). In some cases, other private interests take up parts of this chain, most often at the retail end (secondary tier firms). In general, the manner in which secondary tier firms carry out these functions is heavily mandated or controlled by the

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[2] In Michigan and Wisconsin, the registered seed class is not used, reducing the multiplication steps by one. Following variety development, foundation seed is grown out to provide saleable certified seed (equivalent to registered seed in many states).

initial source of release. The private seed firm actively seeks to control the marketing and distribution channels traveled by their varieties.

Public varieties are those varieties which are bred by public institutions such as land grant universities and the state agricultural experiment stations associated with them. Traditionally, most of the production, conditioning and distribution of these varieties occurred through a network of public variety handlers made up of certification agencies, crop improvement associations and farmer seedsmen. But these varieties have also been freely released, and any private interest wishing to grow out and sell them, or utilize them in their own breeding programs has been free to do so. In general, the production and distribution system for public varieties is much less integrated and controlled by the initial source of the variety when compared to private varieties.

Industry Goals - Private and Public

Although the vertical organization based on functions performed is essential to understanding the seed industry, the private/public organizational split is the one of concern and interest to this study. It is the interdependency of these two sectors, and the conflict in emphases and interests, that fuels much of the debate over the appropriate roles for each. In further examining the situation, a closer look at the goals of the private and the

public sectors may be of help.

In general, it must be stated that the goals of the private portion of the seed industry must first, and foremost, be to reap benefits in the form of financial returns to the firm. This is the reality facing private interests dependent on the marketplace. They must produce a product acceptable to the market, and then realize that acceptance through sales. As noted by one seed company executive, "We must make a profit in order to stay in business." (State Agricultural Experiment Station Plant Variety Workshop Proceedings, p.109) This necessity for financial success does not suggest that the farmer consumer is being ripped off by "profit-hungry" seed companies, but emphasizes that all other goals must be thought of as secondary to, or necessary for, financial viability. Likewise, the reaction of the private sector to changes in the industry environment and the options before the public sector, must be evaluated in light of a private sector necessity for commercial success. Finally, it should be noted that this profit motive may result in benefit to the public by bringing new products to market.

The goals of the public sector of the seed industry revolve around the more general land grant mission of "serving the public good." (Seed Policy Subcommittee of the Experiment Station Committee on Organization and Policy, 1989) Defining and reaching agreement on the specifics of

that mission are difficult at best. As is apparent from examining the vertical organization of the seed industry (Figure 2.1), and considering some of the different publics to be served, the needs and desires of public sector dependents are complex and not always compatible. Suppliers and dependent customers become competitors, and interests and goals conflict.

With respect to variety development, release and distribution, some more specific goals have been put forth by the State Agricultural Experiment Stations (SAES's), and in Michigan, by the Michigan Agricultural Experiment Station (MAES) in conjunction with the larger University (Michigan State University). Policy statements from these organizations indicate that procedures should strive to encourage rapid and widespread use of a new variety, with special consideration to:

> -protecting a variety's genetic purity
> -assuring a continued supply of high-quality, and competitively priced seed or propagating material
> -encouraging the free exchange of germplasm
> -fostering increased support for research programs
> -educating and training the industry's future professionals
> -and providing the greatest net positive impact for the state's economy
>
> (Michigan Agricultural Experiment Station 1988; Seed Policy Subcommittee of the Experiment Station Committee on Organization and Policy 1989)

It is the above set of considerations, the overarching public service goal, and their relationship to the private sector's goals and dependency, that are at the heart of the

debate over appropriate policies. Again, the complexity of industry interrelationships means that these considerations (goals) facing the public sector are not always compatible. Conflicting emphases and interests arise. And, as will be seen, recent changes in the industry environment have altered priorities, changing program emphases, policies and procedures, and ultimately the relationships throughout the seed industry.

Industry Environment

In reviewing the seed industry environment, it is necessary to review four different yet closely related issues, namely biotechnology, research funding, the legal framework of patent rights in biological inventions, and the trends in private and public research, market and philosophy. These issues and trends have altered the nature of the "seed industry game." In this section some of the general implications of these issues will be explored, as background for a review of the specific implications for, and proposed changes in, the seed industry.

Biotechnology

As noted by A. Allan Schmid (1988), the quickening pace of biological change suggests the possibility of significant change in the many institutions related to agriculture. New demands will be placed on traditional services. Substitutes will be created for traditional roles. Change will occur. This change in institutions stems in part from one of the

"greatest scientific breakthroughs of our time - the discovery of that remarkable double helix string of life that carries the genetic messengers with instructions for all living cells." (Agricultural Biotechnology and the Public, p.6) Biotechnology is essentially the many ways that this discovery is put to use. And it involves the ability to control and utilize this string of information to create or modify living organisms and biological material. It is evident that the results of such processes, and the use of these results have potentially far reaching effects (Symposium on the Protection of Biotechnological Inventions 1987).

Biotechnology is expected to lead to important breakthroughs in such areas as medicines, pollution control, and food and energy production. In the area of plant research and development, some scientists predict near miracles resulting from genetic engineering. Examples include the elimination of diseases, development of bioherbicides and bioinsecticides, and creation of salt and drought resistent varieties (Agricultural Biotechnology and the Public 1988).

While the extent to which these visions will be realized is debatable, biotechnology has opened new doors of possibility. These doors include potentially profitable investments in plant research and development by private interests. In response, the private sector has opened its

eyes, ears and pocketbooks to plant research and development. In addition, biotechnology has impacted on public sector resource allocation, bringing new focus to different aspects of plant science. Thus, biotechnology has increased interest in the seed industry, changed some of its research agenda, and altered the "line up" for the industry. Like other changes, it has brought new emphases to the forefront, created new possibilities, and in general, spurred on change.

Research Funding

While biotechnology potentials loom great, the cost of discovery and development may be somewhat inhibitive. Relative to traditional plant breeding methods, genetic engineering requires large sums of money. The process of gene splicing for instance requires highly specialized equipment, and often produces results at such a basic level that bringing these to commercial use requires a great deal of additional time, effort and money (from discussions with plant breeders). These costs of research and development are realities and obstacles to progress, and they must be recovered via public support or market returns.

In addition to the inhibitive costs of biotechnology, public research programs have seen their budgets frozen, and, in many cases, shrink in real terms (Schmid 1988). The availability of federal dollars has decreased, and "state funding" has had to take up the slack. Butler and Marion

(1985) defined this "state funding" as state appropriations, product sales, industry research grants, and other non-federal funds. And recently with state budget constraints, the state appropriations portion of that funding has become increasingly tight. So, public programs have had to rely on still other sources of support, often from industry.

This latest trend of increased public program dependence on private interests brings forth new issues. There are many concerns over dependency on, and control by, the private sector. Does this increased private role give industry control over genetic resources, and place too great an emphasis on genetic manipulation of food crops for profit rather than for the public good? Is the integrity of the public plant breeding system being sacrificed? (Butler and Marion 1985) Partially in response to these concerns, agricultural experiment stations are searching for ways to capture revenue in markets. And this possibility has potentially been made real (for public and private programs) by changes in the legal framework of patent rights (Schmid 1988).

Legal Framework

In 1970 passage of the Plant Variety Protection Act (PVPA) granted patent-like protection for sexually-propagated plant varieties, such as traditional field crops, for the first time. Prior to that time only asexually propagated plants were covered under any form of patent

protection (via the 1930 extension of the Patent Act - Stallman and Schmid 1987). In 1980 the general Patent Act was extended to micro-organisms, and in 1985 the U. S. Patent and Trademark Office (PTO) appeals decision, in Ex parte Hibberd, extended that protection by declaring that all seeds are patentable (in the form of a utility patent). This extension of patentability to all plant and animal life, in principle, provides inventors the exclusive rights to sell the invention. As traditionally viewed, this exclusivity allows for the recovery of research costs which would otherwise be difficult. Without exclusive use rights, competitors bearing no such research costs could freely utilize the invention. No costs of inventing would be recovered, and no incentives to invent would exist (Schmid 1988). Thus, in principle at least, protection provides the means for realizing the return on investment[3].

While the objective of intellectual property rights is to stimulate investment in research and development through the granting of an exclusive use right, exclusion costs limit the ability to enforce these patent rights. And these costs tend to be high for most plants (Schmid 1988). Plants differ from most other "inventions" in that they reproduce themselves and carry the "invention blueprint." "This means

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[3] For a more thorough discussion of plant and biotechnological patent protection see Lesser (1987), Schmid (1985) and the Symposium on the Protection of Biotechnological Invention (1987).

that the total market for repeated purchases is not available to the patent holder. Buyers buy one unit and then have the blueprint and 'factory' for making more." (Stallman and Schmid, 1988 p.432). In theory the right can be granted, and patents should help to realize investment returns. But in practice, the right may not be easily applied, and the returns not realized.

In her study of fruit breeding investment, Stallman (1987) developed a framework for predicting investment in fruits. This framework was also used in predicting investment and effort in other areas. As noted by Stallman and Schmid (1987), because of enforcement difficulties, patent rights on widely distributed plants will probably require additional means of protection. An example of such a means of protection is the use of hybrids which eliminate the farmer as a competitor (bin run seed use is not possible). Mechanisms which scramble the genetic code of a plant in the second generation may also be considered. And firms may seek a broad "product space" in patent definition so that the protection provided is wide enough to include more than a single variety or group of them. The hope of gaining such patent definitions is to include several related varieties or even all varieties carrying a certain gene or trait. The central idea of the additional efforts, and the purpose of such patent protection is to achieve/grant a monopoly, and thus, recover the investment

costs and extract "due" rents (Schmid 1985; Lesser 1987; Stallman and Schmid 1987). "But the proof of its application is not yet available." (Schmid 1988, p. 3) How much real control ownership actually affords is still highly debatable.

Trends

As noted above, the outcome of the application of patents to plant-life is not yet available, but trends in research, product development and market share have been observed. Whether these trends are the result of patent protection possibilities, and/or research funding difficulties, and/or biotechnology opportunities is difficult to determine at best. But the trends, and perceptions regarding these trends, are real and make up part of the environment facing the industry, and public sector decision makers in particular.

a. Research and Development

Butler and Marion (1985) closely examined the trends in plant breeding research and development in both the private and public sectors. They examined breeding research and development (R&D) in two major ways: 1) expenditures on R&D reflecting inputs to innovative efforts, and 2) new variety releases reflecting output of innovative efforts.

While much of the study revolved around the impacts of the Plant Variety Protection Act, it was concluded that private plant breeding R&D, especially for soybeans and

Table 2.1 Distribution of R&D Expenditures Across Five Species, 1970-1980, 14 Seed Companies

	Percent of Total R&D Expense for Each Crop				
Year	Corn	Alfalfa	Wheat	Soybeans	Cotton
1970	79	9	7	1	4
1972	77	8	9	2	5
1974	75	7	8	6	4
1976	73	6	11	7	3
1977	68	7	11	10	4
1978	71	6	9	10	4
1979	70	6	8	11	4
1980	71	7	9	11	3

Source: Butler and Marion 1985

Table 2.2 Number of New Private Varieties Released by Species 1970-1980

No. of Firms	Corn (12)	Alfalfa (6)	Wheat (12)	Soybeans (11)	Cotton (8)
1970	57	6	2	1	7
1972	40	3	4	3	3
1974	43	5	3	4	6
1976	52	4	7	6	9
1977	35	1	6	10	2
1978	24	7	7	15	4
1979	24	4	6	11	5
1980	35	6	11	25	6

Source: Butler and Marion 1985

wheat, had greatly increased. R&D expenditures per firm sharply increased from 1960-1980.(p.27) The number of plant breeders employed per firm also more than doubled over that period.(p.29) In addition, R&D expenditures shifted slightly, away from corn with expenditures in soybeans increasing (Table 2.1). The result of this shift may be seen in a decline in the number of corn varieties released from 1970-1980, while the number of soybean varieties released increased dramatically (Table 2.2). In sum, both the inputs to, and outputs from private sector investment in plant breeding research and development have increased.

Table 2.3 Plant Breeding and Genetic (PB & G) Research Expenditures at Public Institutions 1970-1979

Yr.	PB&G Res. Exp. ($M)	% PB & G Res. Exp. of Total	Source of PB & G Genetic Research USDA ($M)	Source of PB & G Genetic Research State ($M)	USDA as % of Total PB & G
'70	32.2	11.63	12.8	19.3	40
'71	34.1	11.37	13.4	20.6	39
'72	36.3	10.20	13.7	22.4	38
'73	40.3	10.48	15.1	25.1	37
'74	43.9	10.36	15.6	28.2	36
'75	49.1	10.18	17.4	31.6	35
'76	57.6	11.14	19.9	37.3	35
'77	63.7	10.72	22.1	41.1	35
'78	70.9	10.93	23.9	46.4	34
'79	79.8	10.64	26.3	52.5	33

Source: Current Research Information Service, USDA via Butler and Marion 1985

In the public sector, the total plant breeding and genetic research expenditures have increased as well. But as a percentage of total research expenditures they have

remained relatively constant (Table 2.3). Butler and Marion (1985) also found that the federal funds utilized since 1970 have represented a declining percentage of plant breeding and genetic research support. This decline has been offset by "state funding" increases (Table 2.3) especially private sector support.

In addition to funding changes, research emphases may have changed. A survey of Agricultural Experiment Station directors (Hanway 1978) indicated that many noticed a shift in Agricultural Experiment Station emphasis toward more basic research. V. L. Lechtenberg also noted this shift to "basic plant science, that research fundamental enough in nature that it can't be assigned to any specific commodity." (State Agricultural Experiment Station (SAES) Plant Variety Release Workshop Proceedings 1987, p. 57) Nationally basic plant research at SAES's increased by 40 percent, as compared to a .3 percent increase in field crops research effort from 1975 - 1985.(p.57)

The shift in research emphasis is also reflected in research output. Relative to the private sector, public sector variety release numbers have been dwarfed. While specific numbers are not available, it is readily apparent that the flood of private brand soybean varieties far surpasses the number of public releases. Although not a direct measure, a look at the dramatic increase in private varieties relative to publics in state soybean performance

reports over the past three years supports the release number differences. The number of private varieties voluntarily entered in the Michigan Soybean Performance Trials has increased by more than 33 percent since 1986 while public numbers have remained virtually unchanged. Thus, it appears that public sector plant breeding input and output have declined relative to the efforts of the private sector.

b. Market Share

In order to extend the examination of the "output" end of R&D, as defined by Butler and Marion (1985), an effort was made to estimate market shares in the soybean seed industry. What is happening to those varieties being released? As noted by Butler and Marion (1985), this process is particulary difficult since varieties may be grown and marketed by many companies, and even sold under different brand names. In addition, there is virtually no data available on the percentage of total acreage planted to different varieties. And finally, bin run seed is a significant factor for soybeans, and estimates of the amount of farmer-saved seed which is planted vary form 25% to more than 60% of a state's total soybean acreage.

It was felt that discussions with the Crop Improvement Associations that oversee the certification of public seeds would provide some general sense of the relative market shares of public and private varieties. Seven Crop

Improvement Associations in the North Central Region were contacted and issues of market share, price, variety characteristics, and other trends were discussed. Cooperative Extension agents and several farmer seedsmen were also contacted to gain their perspective.

Through these discussions it was found that all Crop Improvement Associations, and all of the extension agents and seedsmen feel that public varieties have lost significant market shares to private varieties. Most also indicated that while many private varieties are superior, they are not that much better if evaluated by state performance trials. And it was repeatedly stated that the marginally better private varieties cost "half again as much as publics." In general, there exists a perception that private varieties are getting an increased market share that is only partially deserved if one examines variety performance.

Again, because of a lack of data available on acreage planted to different varieties, no direct estimation of market share is possible. But in an effort to gain some sense of market share trends in Michigan, approved certified seed acreage and state totals for soybean acreage were investigated. It was found that since 1983 the total acreage of public soybean varieties certified by the Michigan Crop Improvement Association increased by 14.2 percent. Because of the three class seed system in

Michigan, and other certification standards and regulations, virtually all of this certified seed is sold within Michigan. And except for yearly carry-over (non-sales), this certified seed is grown commercially in the following year. Finally, because all public variety seed must be certified and tagged, the approved acreage for certification, is essentially that seed which is grown for commercial production. And so, the soybean acreage certified by Michigan Crop Improvement Association has a direct relationship to the amount of public variety soybeans grown out, essentially their market share.

In examining the percent change in total soybean acreage for Michigan since 1983, it was found that the acreage has increased by 19.0 percent. The fact that the percent increase in total acreage is larger than that for public variety certified seed (19.0% vs. 14.2%) indicates that public varieties must be making up a smaller portion of the total. More of the increased acreage is being planted to private varieties or bin run seed. In addition, as previously noted, a portion of the public seed certified will not be sold (carry-over). Thus, the public market share appears to be shrinking even more. Again, these are only rough indicators, but if combined with the perceptions of the Crop Improvement Associations, Cooperative Extension agents, and seedsmen, it does seem to indicate that public varieties are losing market share.

c. Price

In addition to the market share trends, there are other trends and characteristics of the private/public split that were revealed through the discussions. As mentioned previously, virtually all of those contacted noted a strong price difference between public and private varieties. Estimates of how much more private varieties cost varied, but the most commonly cited difference was "$4-5 more for a 50 pound bag as compared to a 60 pound bag for publics."

A great deal of range in opinion existed as to whether the price differences are important to growers, or even should be important to growers. Some felt that farmers are cheated; the more expensive varieties are not worth it. Others stated that it is not that big a difference when spread across a farmer's acreage. Relative to other costs it should not matter.

d. Variety Lifespan and Program Philosophy

In addition to price variation, "lifespan differences" between public and private varieties were noted. As a general proposition, it was felt that 3-4 years is the maximum time that a private variety remains on the market, while public varieties "hang around for 7-8 years or even more." Several Crop Improvement Association officials stated that private companies use this as a marketing tool, and they have a different definition of significantly better. "An experiment station wouldn't release it, but

they release it as 'new and improved,' and yank the old variety." On the other side, many of these officials noted that public breeders are slow to release new varieties[4], and fail to remove old ones from performance trials.

As previously mentioned, it was felt that private interests develop and release more varieties. In part this was attributed to differences in definition of "significantly different," but development time differences were also sighted. It was generally perceived that private companies have the resources for such efforts as "shipping a variety south so that two generations can be achieved in one year," speeding up the development time. Public programs were not noted for doing this, and it was felt that even given equal time to variety development, public varieties take longer to get to commercial use. Lengthy testing, approval and certification procedures were sighted as causes.

All of these trends in research and development, market share, price, breeding program philosophy, along with the effects of biotechnology, program funding challenges and patent options, make up the industry situation. They are the factors and issues that have brought about change, proposed change and the debate surrounding change. With

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[4] Stallman (1986) noted this private/public difference in time in testing. In her study she also found that private interests test less than do publicly supported interests. Stallman attributed this to differences in time preferences.

this background in mind the following chapter will discuss the specific proposals for change, particularly in the public sector, and the debate they have created.

CHAPTER III

PROPOSED CHANGES, POLICY OPTIONS AND THE DEBATE

The seed industry situation reviewed in Chapter II is one of concern to many in the industry. The changes being faced, proposed and adopted raise many a red flag among a variety of interests. The observed market trends for public varieties and the programs from which they originate are disheartening. As mentioned previously, research monies are drastically needed and yet in increasingly short supply. In some circles, the increased private sector role implies problems in terms of the direction of plant research, the quality of plant material, the supply of seed, and the price at which these can be acquired. The increased use of patents raises concerns of "germplasm protectionism," damaging a tradition of open research and free exchange of germplasm. In general, the institutions are changing and needing change, and life has been made more difficult.

As previously noted, most of the changes and proposed changes concern the public sector and the way it "does business." This is largely due to some of the issues just discussed. In the face of new technologies, new demands are being placed on traditional research programs. The tightening screw of research budget constraints is

pressuring programs to cut and/or change traditional research emphases, and examine marketable options. The patentability of plant materials is, in theory, enhancing the potential for gaining market rewards, and altering the norm of open research and free germplasm exchange. And the trends in terms of decreasing market share are exacerbating the pressures. A "put up or shut up" attitude in terms of variety development support prevails, and pressures exist to move away from this "failing" effort or make it work.

These pressures are the main forces driving the proposed changes and policy options that will be examined in this chapter. These options fall into three general categories: 1) public program roles and research emphases; 2) release policies and procedures; and 3) marketing and distribution modes. Each of these categories and some specific options will be discussed, along with some of the concerns relating to each. This effort should provide a better understanding of the options and debate, and a final "situation setting" for an in depth look at soybean grower behavior and its effects on some of the trends being seen and options being considered.

Public Sector Role and Research Emphasis

As pointed out in Chapter Two, the role of the public sector of the seed industry is a complex one. The land grant mission, and its definition with regard to conducting plant research and development, has far reaching effects on

the seed industry and its many participants. The functions that university plant breeders, State Agricultural Experiment Stations (SAES's), and certification agencies are called on to perform are many. In addition to the heavy burden of service placed on the public sector, the functions required are often at odds with each other making for conflicts between roles and publics to be served. This is especially true in the area of program roles and research emphases.

Since they began 125 years ago, land grant universities have sought to bring research efforts to bear on solving the problems of agriculture and rural America. Traditionally, a large part of this effort for the plant breeder has been the development of useful plant varieties with increased disease resistance or stress tolerance for example. The resulting varieties have been essential to increasing yields and farm productivity in the United States and throughout the world.

In addition to their variety development role, SAES's greatly contribute to the understanding of plant genetics through basic research. Experiment Station's also play a major role in the acquisition, preservation and exchange of germplasm. They undertake long-term risky research, which may not be attempted by the private sector. And SAES's are essential to the production of trained scientists. Thus, through their broad spectrum of role and research emphases, Experiment Stations serve as suppliers of developed

varieties, basic knowledge, germplasm and trained professionals.

Finally, the public sector has always played a role in testing variety performance. Public and private varieties have been tested under a range of conditions by public breeders. The resulting state performance reports allow evaluation and comparison of varieties.

But three factors are resulting in calls for a change in public sector role and research emphasis: 1) decreased state and federal research support; 2) increased research input costs; and 3) the trends of decreased public variety releases and market share. Many feel that these factors indicate that Experiment Stations are spreading themselves too thin. There isn't enough money to do everything that has traditionally been done. In addition, some sight the decreased public variety releases and market share relative to the private sector as a sign that private interests simply can perform this function better. Private seed companies have the resources to more effectively develop and distribute those varieties of use to U.S. agriculture. And so, there is some pressure for the public sector to discontinue variety development, especially for major commodities where private seed companies are active. Viewed from this perspective, the research emphases and roles of the private sector should be basic supporting research, specialty item development, and the maintenance of an

available source of plant germplasm. Not only have there been calls for a reduced variety development role for the public sector, but, as noted in Chapter II, many Experiment Stations have already redirected research efforts somewhat toward more basic research.

Despite the trends facing public varieties and programs, and the difficulty of maintaining a broad research agenda, many in the seed industry fear the outcome of not continuing these efforts. F. E. Hutchinson, noted some of these fears in a presentation at the State Agricultural Experiment Station Plant Variety Release Workshop (Feb. 1987). Without variety development further erosion of support for research may occur. Constituents (i.e. commodity groups and taxpayers) not seeing research results in the form of variety output may fail to see the usefulness of the research and their support. Reduced research support and basic research may result. The production of new breeders may be reduced. Genetic diversity may also be lost.

Others, from plant breeder to farmer seedsmen, are also concerned about the private sector control that may result should public breeders exit variety development. They feel too great an emphasis would be placed on development for profit rather than the public good. Monopolies in plant variety development and acquisition may occur. Fees may be charged by private interests for variety and germplasm use

even in basic research. A reduction in the diversity and availability of germplasm may result. Information on the genetic background of varieties may be kept secret, and other farmer information may be clouded by the increased private role. In sum, a fear for the long run productivity of U.S. agriculture exits should Experiment Stations not continue in the manner in which the land grant mission has traditionally been defined.

Release Policies and Procedures

While calls for a major change in the public sector's role and research emphases do exist, these proposals are dwarfed by those relating to the release policies and procedures for public varieties. Until alternatives such a limited release and royalty fees are attempted, few are willing to make a major overhaul in the public sector's role. Therefore, as is evident by past and current efforts such as the SAES Plant Variety Release Workshop (Feb. 1987), the Symposium on the Protection of Biotechnological Inventions (June 1987), and the revision of the release policies and procedures of several Experiment Stations, the options involving variety release mechanisms are currently of great interest.

These options are being proposed, explored and applied in the hope that they will allow the public sector to continue to perform many of the traditional functions, from variety development to basic research. In particular, such

proposals seek to increase financial support through the market, and help "good" public varieties get into the market. In this manner, public programs may become more viable "plant producing units."

Organization of a discussion of variety release policies is difficult at best. The specific options are many, and each can be applied under a range of conditions, and in different combinations.

In a presentation on alternative release policies at the SAES Plant Variety Release Workshop (1987), V. L. Lechtenberg organized his discussion around five major elements that Experiment Station policies must address:

1. property rights
2. accessibility
3. licenses
4. research fees and royalty
5. labeling

This discussion of release alternatives will follow Lechtenberg's pattern, and emphasize that each issue must be addressed independently. "A decision on one element does not necessarily restrict options with regard to decisions on other elements." (p. 58) In addition, as Lechtenberg points out, differences need to be drawn between "variety" and "germplasm." Here "varieties" are defined as plant materials that are market ready and used in crop production, and "germplasm" is that plant material used in research and development. While a clear distinction can not always be drawn between the two, the end-use should be considered in

setting policies, and different options may be appropriate for each.

Property Rights

Nearly all of the release policy options rely heavily on the acquisition and use of property rights in plant material. The legal framework provided through the Plant Variety Protection Act and extension of the general Patent Act, in theory at least, lays the basis for the specific proposals that will be discussed under other elements. In addition, this element of property rights on its own demands choice.

As has been noted, there are options with respect to protection. William Lesser (1987) reviewed these options and described some of the differences between them. Each form of protection is unique and may serve different goals. Some of the basic conclusions of Lesser's discussion follow.

In general, the Plant Variety Protection Act (PVPA) provides very narrow protection. The protection granted is for a specific variety, and then only for the entire variety (plant), not its components. PVPA certificates do not protect germplasm. In addition, there is a research exemption in the PVPA. Thus, plant variety certificates are not the approach to use if one is interested in gaining a "wide product space," such as protection for a specific gene, gene combination or even a trait. On the other hand, PVPA protection is relatively easy to acquire.

A utility patent differs from a plant variety certificate in that it provides much broader protection. Genes, linkages and traits can theoretically be patented. In addition, germplasm use, even for research purposes, can technically be restricted. Although there is limited experience with utility patents as applied to plant materials, it is believed that a general utility patent may be harder to acquire. A greater "distance from prior art" must be established to gain such broad protection.

As noted by Lechtenberg, "disposition of patent rights should be a major concern to both public and private organizations. Experiment Station policies with respect to patent protection are generally not well developed." (SAES Plant Variety Release Workshop Proceedings, p. 59) And these ownership issues are central to other decisions on release. They provide the potential means for controlling plant material use in order to gain returns to investment, and/or provide incentives to commercialize research findings.

On the other hand, many fear the protection of plant materials especially utility patents. Patents have already been granted for plant traits (i.e. Iowa State University has a patent on low linolenic acid soybeans) and many feel this protection is far too broad. There may be many ways to get to a trait, some of which are yet to be found. Should the new "routes" be under the scope of the old patent? Many

traits, genes, and gene combinations occur in nature. Who invented these? In general, many feel that patent protection limits the exchange and use of germplasm, and thus, the scientific process may be inhibited.

While plant variety and germplasm ownership and protection through patent-type mechanisms are issues needing to be addressed, most discussions fail to examine them in a realistic light. As has been noted in Chapter II, the granting of an exclusive use right does not necessitate its realization (e.g. Schmid 1985; Stallman 1986, Stallman and Schmid 1987; and Schmid 1988). This is especially true for plants where exclusion costs, the costs of policing and enforcing the right, are high. With each plant carrying the blueprint for making more, and the technologies for utilizing that blueprint readily available, the protection of rights becomes difficult at best. This difficulty is pronounced where the granted protection is narrow as is the case with plant variety certificates. Again, as previously noted, alternative means of protection will likely be sought. With the ready reproducability of plants, hybridization and trade secrets are likely to be coupled with patent protection. And other efforts to ensure returns to investment and commercialization will be needed.

Whatever the choice of protection, it should be realized that patent-type protection for plants and plant materials is not likely to be the panacea (or demise) that

many view it as. It is probable that some protection will be provided though such a legal framework, but the loop holes and opportunities to "go around the fence of protection" are many. This reality must be kept in mind in the discussion to follow, and when considering the effects of specific policy options. In general, the effectiveness of all options relying on ownership will be diminished, but not eliminated, by the exclusion problem.

Accessibility

There are several possibilities relating to access to varieties and germplasm that run a continuum from unrestricted to exclusive access. Traditionally, Experiment Stations have provided nearly unrestricted access to varieties and germplasm. The only restriction traditionally utilized has been a certification requirement. Such an unrestricted access policy was employed to foster use and exchange of varieties and germplasm.

Increased restriction options also exist and are being proposed to meet other goals. Access could be limited to particular groups, Michigan-based seed companies for example. Time restrictions on access may also be applied. Access restricted by use, such as for research only, are also common. And totally exclusive releases can limit access to a single user.

Alternative accessibility policies and combinations of these may help to meet different goals. For instance,

exclusive access with a time limit (i.e. three years) provides the incentives for commercialization, without forever limiting access. Regional restrictions may allow different interests to be involved in the distribution of varieties, and these can be targeted (i.e. Michigan groups supporting M.S.U. research efforts).

Different levels of accessibility may also be applied to different materials. Variety release may be exclusive to foster commercialization, while germplasm for research purposes may be released without restriction. Different uses of materials may have different goals and require different accessibility policies. But again this differentiation may be limited by the ability to clearly define and control end-use (variety vs. germplasm).

Again, all of the options that limit access rely on the ability to enforce property rights. In light of the realistic difficulties of exclusion, it should be realized that the control over access may be partial. Thus, the policy effectiveness may be reduced.

In addition, while limited access may serve certain interests and goals such as rapidly getting a variety into the market, it may be in conflict with other interests. For example, many are concerned with the impact of such policies on germplasm exchange. Richard Lower (SAES Plant Variety Release Workshop Proceedings 1987) noted that any limits on access fly in the face of the need to promote germplasm

usage and create diversity in germplasm pools. Likewise, private interests are concerned that the strong public-private partnership will be hurt by restrictions on access to publicly developed plant materials. In sum, limited access is a departure from the tradition of open research and free germplasm exchange, and thus, it is in conflict with a long held definition of the land grant mission.

Licenses

Licenses are the actual mechanisms by which policies are implemented. They are essentially the contract terms for variety and germplasm use. Licenses define the policy and convey the intent with respect to use of the technology. As such, they determine what access to varieties will be.

For instance, an exclusive license means that there is a single licensee, and it is a manner in which exclusive access could be implemented. But it should be noted that use of such an exclusive license is not limited to an exclusive access policy. Mandatory sub-license clauses could require the single licensee to sub-license to anyone wishing to use the technology.

On the other hand, non-exclusive licenses imply more than one licensee, and are a manner in which unrestricted access may be implemented. But the terms of such a non-exclusive license may actually work to restrict access to a certain group (i.e. an association of growers).

The essential point is that the terms of the license

are all important. They convey the policy decisions that are made: who owns, who uses, for how much, and under what terms. As such, licenses per se are not a matter for debate and choice. They are a necessity and can take any form and convey any policy (i.e. restricted or unrestricted access). The terms of the license are what need to be examined and debated in light of the desired outcomes for the individual organization and the industry.

Fees and Royalty

Fees and royalty are the manner in which licensees, in some way, pay for the right to use materials. In general, license fees are thought of as up-front, one-time (or yearly) payments, while royalty payments are based on the number of units sold.

Again, these payment options can run a wide spectrum in their level and combined application with accessibility. For instance, traditional inventions (i.e. electrical components) are often exclusively licensed with restricted access for a royalty payment based on 2.5% of sales for example. In the plant breeding arena, a possibility is to license to a group of seedsmen or companies (restricted access) with payment in the form of research support based on the volume of sales of each interest. In addition, royalty bearing varieties may be employed while germplasm used in research and development may go royalty free. All of these access and payment combinations must be formulated

in the terms of the license.

These fee and royalty options have raised a great deal of interest in the public sector. Many Experiment Stations are looking to these as ways to capture revenue in markets and generate research dollars. And several efforts have already been employed. Iowa State University, for example, is collecting 20 cent per bushel royalty payments on some varieties. I.S.U. is also charging a $10 per 100 beans royalty for Iowa materials used in research.

Agricultural Genetic Research Association (AGRA) is a slightly different example of the use of royalty bearing release. AGRA, an Ohio-based organization of seed companies with no internal breeding programs, was established to bring sister lines of public varieties (or specialty items) developed at Ohio State University to market. In the release to AGRA, O.S.U. employs exclusive royalty bearing releases as a means for bringing back funding for university research. This desire to assist with funding difficulties was one of the major reasons for the foundation of AGRA, and Ohio State University's use of exclusive royalty bearing releases.

Opponents of fee and royalty policies raise the issue of double taxation. In essence, some feel that they have already paid for the research through tax dollars, check-off programs and the like, and being made to pay a royalty on top of that support is unfair. Not only are there concerns

with the fairness of such a policy, but there are fears that exchange and use of germplasm may be limited. While the royalty raises money for the "owner," it is an additional cost for others. This may be an added cost that just can not be born by some programs. And if royalty rates and use are determined by a bid procedure, many will be unable to compete.

Another concern with fee and royalty payments is over who actually gets the returns. Should any of the money go back to the "inventor?" This raises difficulties over determining who the inventor(s) is(are). Is the technician and other support staff given a share along with the primary researcher? It also may change the research emphases of public researchers making them more profit oriented. Certain department staff simply are not working in an area where "invention," and thus royalty income, is possible. Is this fair, and does it discourage the necessary supportive research that is conducted in such areas? The return of royalties to the researcher may alter their traditional objective position, and concern sponsors of their efforts. But without such returns to efforts, incentives to remain in a public sector with lower pay scales may be lost. And is it fair for plant breeders to waive royalty income possibilities when peers in microbiology, biochemistry and the like widely use and receive royalty payments?

The exclusion cost problem, noted previously, should

also be raised in the fee and royalty context. It is technically possible to charge other researchers $10 per 100 beans, or seed companies 40 cents a bag, but will they pay it? And how many times will they pay it? The ability to reproduce it may mean that users will only purchase it once. And if too high will they purchase it at all? Exclusion costs again reduce the effectiveness of ownership, and thus, any royalty bearing option.

Labeling

The last element needing to be addressed is the labeling of plant varieties. Traditionally, Experiment Stations have released materials with the understanding that they be certified, and this requires designation of variety name. This policy was designed to ensure genetic purity and to provide information on genetic background.

Recently, it has become increasingly common to release varieties without a certification or variety name listing requirement. Brand name, variety-not-stated has been proposed as a means for encouraging individual seedsmen and companies to utilize public varieties. By allowing individual interests to brand without stating the variety, fears of others free riding on promotion efforts are reduced. It provides the incentives for bringing privately branded public varieties to market, and if coupled with a royalty, brand name, variety-not-stated may raise funds. In addition, such a branding option means that access need not

be restricted for the purpose of encouraging promotion. The brand name can be differentiated and promoted, and hence variety access need not be restricted.

On the other hand, brand name, variety-not-stated raises some real concerns regarding genetic purity and farmer information. Without a certification process, the genetic purity of the variety can not be guaranteed. In addition, without knowledge of the variety and its genetic background, a farmer may end up planting the same variety under different brand names.

Again, labeling requirements can and should be stated in the terms of the license. Different results will be obtained from different policies, and these must be reviewed and selected.

Summary of Release Policy Issues

The discussion of these elements of release policies and procedures makes it apparent that many opportunities exist. Different levels of ownership, access, use payment, and labeling may be applied, in different combinations with each other, for plant materials of different end-use. Pros and cons exist for each option with regard to its ability to aid commercialization, research support, the exchange and use of germplasm, and in the long term, the productivity of U.S. agriculture.

Finally, it must be repeated that these options rely on the first element of property rights. These rights are

easily granted but not so easily realized because of the ready reproducability of plants. Even if options utilizing control over accessibility, payment and labeling are desired, the potential for these options must be realistically evaluated. How much control will plant material ownership realistically provide? To what extent can access be limited? How much royalty can be charged and collected before interested parties simply produce their own? And can all the users and potential users be policed to ensure that they follow the rules?

It is likely that some control will be afforded through property rights, and some benefits will result from a few of the above noted release policies. But realistically, the extent of control and benefit may be greatly reduced by the nature of the beast (plant materials). And other options and changes in the system may be needed.

Marketing and Distribution Modes

Another set of options facing the public sector of the seed industry concerns the manner in which public varieties and seed are marketed and distributed. The decreasing market share of public varieties, and some differences between public and private varieties and practices highlight this issue. In addition, the shortfalls of the options just discussed (those relying on property rights enforcement) point to the need for additional efforts, particularly in the marketing and distribution channels. Perhaps the root

of the problem lies in this process. What may be needed is an overhaul of the marketing and distribution philosophy and effort.

Marketing and Distribution Problems

Lawrence Copeland, a Michigan State University plant breeder, states,

> "I believe that the certified seed industry of publicly released field crop varieties is facing difficult times. We might say they are in trouble, and this trouble is caused by two basic factors. Number one, competition from increasing numbers of private varieties where supply and price can be controlled. Secondly, from what I call the self-destructive nature of competition among certified seed producers."
> (SAES Plant Variety Release Workshop Proceedings, p.69)

In sum, private seed companies have a distribution system that markets for success, while the public sector does not even control or utilize its distribution system. Instead public varieties compete solely on "production laurels" with little attention paid to price, service, farmer awareness, and other marketing issues.

As noted by Copeland, and in this study's initial discussion of the private/public seed industry split, private seed companies actively control the distribution channels for their varieties. Supply, price, information, promotion and service are all generally closely guided by the "parent firm." A farmer dealer may be the exclusive retail source in an area. Price may be set without fear of being under-cut. Information and promotion is readily

supplied. The functions performed and services offered through the marketing channel are orchestrated by the seed company.

In the public sector this is not the norm. While certification seeks to ensure a standard and quality product, little else in the public arena is standardized or controlled. Certified seedsmen are free to market as they see fit, or not market at all. As noted by Copeland and others, "the price of certified seed is neither standardized nor stable, and promotional programs are, for the most part, poorly planned and carried out." (p. 70)

Many sight the lack of a stable price as the main reason for a decreasing market share. Retailers can not be assured of a price or profit when "the guy down the road undercuts him." Without standardized prices for certified varieties, price cutting wars often result, and this has lead to a lack of enthusiasm among retailers to handle public varieties. As one farmer-dealer stated, "I can maybe make $1.00 on a bag of Corsoy 79's (a public variety), or an assured $1.50 on a bag of Golden Harvest beans. Which would you choose?"

In addition to price, promotional efforts are generally lacking and/or poorly conducted for public varieties. "As compared to private varieties, publics simply are not pushed. You don't hear or see as much about them." (discussion with a farmer seedsman) While there are

examples of good public growers who hold the line on price and offer good services, there is great variability in their practices. One seedsmen indicated that many of his peers simply use price cuts as their sole marketing effort. "Little attention is paid to maintaining an image of quality in both the product and service." Standard promotional efforts, including information, brochures, roadside plots, and the like are not prominent, or if in existence, not highly visible.

In general, it can be said that little control of the marketing and distribution channel for public varieties exists. Those handling these varieties most often go it on their own, with only a limited marketing effort. The result is a marketing and distribution mode for public varieties that is disjointed and perhaps self-destructive.

Possible Changes in Marketing and Distribution

In response to these concerns, calls are being made for a change in marketing and distribution modes. The proposals range from simply getting seedsmen to stop cutting price, to utilizing the exclusive release policies previously noted so that private interests essentially handle the marketing and distribution of publicly developed materials. The general idea, is that the public sector needs to, at least in part, emulate the efforts of private firms (i.e. stabilize price, provide information and services), or let private firms do it.

The most basic proposal is to simply educate and train public seedsmen in marketing. There needs to be a realization among public seedsmen that price cutting is not the only, or maybe even an appropriate, marketing strategy. They also need to make an effort to provide quality seeds and quality service. The seed will not sell itself.

An extension of this marketing effort is to develop a public variety marketing organization and program. Minnesota, Indiana and Iowa have developed such promotional efforts. The realization is that seed varieties will not sell themselves. Knowledge of varieties, services associated with varieties, and perceptions regarding varieties are critical. The public distribution system needs to provide and control these factors as does the private sector, and perhaps this can be done through a public seed marketing effort.

Minnesota Public Seeds (MPS) began fifteen years ago, and it has been the most successful of these marketing programs. MPS is essentially a statewide aggregation of public seedsmen working to coordinate their distribution and marketing efforts. Established as a separate entity from Minnesota Crop Improvement Association, MPS is funded by a 10 cent per bushel check-off for seedsmen on certified seed sales. These funds support a number of efforts. For instance Minnesota Public Seeds (MPS) is promoted via print, radio, billboards, bumper stickers, hats, etc. as "Good seed

talking better." (This campaign was developed by a contracted advertising agency.) Seeds are provided to farmers for test plots. MPS seed books provide specific variety information and recommendations. Marketing consultants work with public seedsmen. And variety development through the Minnesota Agricultural Experiment Station is supported.

Officials at Minnesota Crop Improvement and members of Minnesota Public Seeds attribute the "better situation for public varieties in Minnesota" to MPS efforts. Even though private variety numbers have increased, Minnesota now has the largest public certified acreage in the United States. In addition, some feel that MPS has greatly reduced the amount of bin run seed planted.

While Minnesota officials claim success, efforts in Indiana and Iowa have been slower to show returns. In addition, some breeders are concerned that any further check-offs will, in sum, reduce the check-offs already supporting plant research.

Rather than forming one statewide group, some support the organization of separate aggregations of seedsmen. AGRA is one such effort, although the primary purpose for its organization was to help fund university research, as opposed to bringing public materials to market. Other organizations have been formed by innovative seedsmen with the primary purpose of getting money behind additional

public materials in hopes of profitably bringing them to market.

Lakeside States, Incorporated (LSI) is a Michigan-based corporation of approximately 25 producer, grower and seed processor shareholders. LSI negotiates for exclusive royalty bearing rights to varieties in their area of operation. As stated by William Byrum, LSI shareholder, this organization of public seedsmen has "achieved an orderly marketing system that's maintaining some price stability. We monitor quality and there's a reasonable margin for the seed grower and processor, and the commercial farmer who's buying our product is benefiting from what we're supplying."(SAES Plant Variety Release Workshop Proceedings, p.68) In addition, royalty payments paid by LSI return to the university and support research efforts.

Proponents of such efforts feel that they are able to address many of the distributional problems of public varieties. Quality variability can be monitored. Variety promotion and information can be provided. Industry coordination can be facilitated. And research funding can be acquired.

Opponents of these aggregations of seedsmen raise several concerns. Some opponents feel that the release of closely related varieties (i.e. sister lines) to the aggregations of seedsmen may reduce genetic diversity and cloud farmer information. "More varieties that aren't

really any better certainly aren't needed." Will the licensee(s) gain undue control of the research agenda through their close relationship to the university? Some of the opponents depend on plant material from Experiment Stations. These interests are concerned that the relationship between groups such as LSI and Experiment Stations, and the use of restricted release, will limit their opportunities to gain plant materials. Again, any restricted release policy runs counter to the tradition of open release. And some are concerned that such a policy will strain industry partnerships, and result in limiting germplasm exchange and research cooperation.

These three efforts are examples of how the mode of marketing and distribution for public materials and varieties can be altered. The traditional distribution philosophy and process has proven to be disjointed and maybe even self-destructive. By trying to gain increased control, or coordination over the manner in which public materials are marketed, many hope to increase public variety market share, public material commercialization, and public program support. As mentioned before, options utilizing property rights and exclusivity may help in some of the above concerns, but they have limitations. Thus, some of the other efforts to more effectively market public materials may also be needed.

Summary of Proposed Changes, Policy Options and Debate

All of the proposed changes, and policy options discussed in this chapter do have some potential for addressing the trends of concern and needs of the changing soybean seed industry. Each set of options for the public sector (a new role and research emphasis, a change in release policies, and an altered mode of marketing and distribution) has pros and cons. These options, and combinations of these options, are currently being experimented with, and are a part of the menu for policy choice facing decision makers. In coming to decisions, several concerns and goals, all relating to the land grant mission, must be weighed: 1) the exchange and use of genetic materials in research; 2) the commercialization of intellectual property whenever possible; 3) the funding and support of research and development, and 4) the long term gain and benefit of farmers.

While some of the previous discussion will help those in decision positions simply by laying out the options and their effect on alternate goals, additional information is needed. This is especially true for the possible changes in marketing and distribution efforts. The manner in which the consumers of seed (farmers) behave will undoubtedly affect the outcome of policies. What soybean growers desire, what their perceptions are, essentially how they select varieties ultimately determines the fate of breeding programs. In

light of this, the varieties developed, and any breeding program policies, especially distribution strategies, must mesh with or influence the nature of soybean grower behavior. Varieties must bear the appropriate attributes, seedsmen must provide the appropriate services, and these must be distributed and marketed in coordination with producer perceptions.

The following chapters will examine these issues. In particular, the nature of consumer behavior will be explored. A means for researching behavior will be reviewed. And then the results and implications of this study's findings regarding soybean grower behavior will be presented.

CHAPTER IV

CONSUMER CHOICE THEORY

In examining the concerns of public plant breeders, and evaluating the reasons for, and some possible solutions to, these issues, it may be most helpful to first examine in greater detail a traditional view of consumer/producer choice. After this introductory discussion, additional and alternative views of choice based on behavioral emphases may help shed some light, raise some additional questions and point to some research needs.

Traditional Approaches

The predominant view of the situation facing the seed industry is a traditional approach that embraces a theory of consumer demand based on the characteristics that goods possess. This "characteristics approach" to demand was formally stated by Kelvin Lancaster (1971), and has since been the basis of much effort in demand theory (Lea, Tarpy, Webley 1988). The central notion of Lancaster's consumer choice model is that consumers are not wanting commodities for the commodities sake, but for the characteristics they possess. The trade-offs being made are between levels of key characteristics, and in the soybean seed example the

characteristics are commonly believed to be yield, disease resistance and price. Producers are seen as choosing seed by examining its bundling of attributes.

Lancaster formulated the consumer's utility-maximization problem by suggesting that utility depends upon the total amount of product characteristics. Lancaster made three important assumptions. First, linear consumption technology was assumed, or increasing consumption by a given percent increases the amount of each characteristic obtained from the product by the same percent. Secondly, utility is independent of the distribution of characteristics among products. It depends on the total amount of characteristics obtained not their source. Thirdly, every characteristic has non-negative marginal utility. No characteristic or level of characteristic takes away from total utility.

Such a consumer choice model, a "compensatory model," (Earl 1983) assumes a producer that determines a summed value or score for a good based on the existence and level of yield and disease resistance in a variety for example. This score is a utility weight from which a bid price or willingness to pay is derived, or it is measured against the market price to arrive at a purchase decision. In essence, this is the traditional notion of maximizing utility subject to a price constraint, or minimizing total cost subject to a utility constraint.

As derived by Kehong Jeong (1988) in his study of southeastern U.S. soybean demand:

$$\min TC = \sum_{i=1}^{m} w_i q_i$$

$$\text{subject to } \sum_{i=1}^{m} x_{ji} q_{ji} \geq X_j$$

where w_i = price of a unit of variety i;

q_i = amount of variety i used;

i = 1,2,...,m varieties;

j = 1,2,...,n characteristics;

x_{ji} = amount of characteristic j in a unit of soybean seed variety i, and

X_j = a parametric value of characteristic j of soybean

Using the Lagrangian, and assuming (due to a lack of price discrimination by variety) that w_i of a unit of each variety remains equal and constant, w_i drops out. Working through the Lagrangian and taking the partial derivatives, it is evident that the derived demand for an individual variety is based upon those characteristics embodied in its own product:

$$q_i = f(x_{1i}, x_{2i},...,x_{ni}).$$

where q_i = amount of variety i demanded.

As can be seen from such a demand function, possession of high levels of key attributes such as yield is essential to variety demand. As traditionally viewed by economists

and public plant breeders, the higher the absolute level of yield and disease resistance, the better the variety/the greater the variety's score, and thus, the greater the demand. If the attribute levels are lower, as is the case with some varieties, the score should be lower, and these should not be selected. Or if the overall scores of varieties are equal, the lower priced variety should be selected. A producer should select the variety that gives the same utility at a lower price (minimize TC subject to a utility constraint). In addition, even if some "insignificant" attribute is totally lacking or exists at a low level, as long as another attribute such as yield is big enough, the difference can be made up. The total score could still be higher because no characteristic or level of characteristic existence within a variety reduces the utility score.

This general notion of the nature of demand for products and their characteristics has been central to research estimating the demand for products and the value of product characteristics (e.g. Ladd and Martin 1976; Carl, Kilmer and Kenny 1983). Sherwin Rosen's hedonic framework (1974) derives from this line of reasoning and has served as a base for research on characteristic valuation or implicit prices. Like Lancaster, Rosen hypothesized that goods are valued for their utility-bearing characteristics. Furthermore, the price at which the product sells depends

upon the amount of each characteristic within the product. Thus, price reflects the value of a good's characteristic-bundle, and price differences reflect the differentiation between goods based on relative amounts of characteristics possessed.

$$P(q_i) = P(q_{i1}, q_{i2}, \ldots, q_{ij})$$

where: $P(q_i)$ = observed market price of commodity i;

q_{ij} = amount or presence of the j_{th} characteristic per unit of commodity i.

(Jeong 1988, p.20)

Rosen's hedonic prices are defined as the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them. (Rosen 1974, p. 34). Thus, studies based on this theoretical framework use first-step regression analysis (observed product price regressed on product quality characteristics) to estimate the hedonic indexes or characteristic values. Ladd and Savannunt (1976) determined meat, dairy and poultry product attribute indexes via retail prices. Neville, et al. (1976) regressed boar prices on size of litter, final age, average daily gain, feed efficiency, and backfat thickness to determine values for these attributes. Numerous other studies have also employed such hedonic methodologies for estimating the implicit value

of outputs and their characteristics (e.g. Brorsen et al. 1984, Jordon et al. 1985).

As noted previously, such a study was conducted for certified soybean sales in the southeastern United States (Jeong 1988). Slight alterations were made in the standard hedonic model due to an assumed lack of price discrimination by varieties in the local markets for soybean seed. Under this assumption, quality of seed is associated with expenditures on seed, and ultimately market sales. Therefore, volume of seed sold within a region was regressed on varietal quality characteristics as observed in experiment stations trials. Results indicated that experimental yield was the most highly valued soybean characteristic followed by nematode, parasite and disease resistance, especially in susceptible locations.

All of these hedonic methodologies are based on the assumption of a consumer that calculates a product utility using the levels of characteristics within a product to be purchased. These characteristics are measurable, standardizable and transparent to the calculating consumer. Based on the calculated utility score a bid (willingness to pay) is offered determining product price. In a perfect market with many consumers this utility score is compared against the market price to arrive at a purchase decision. Or, working backwards, price reflects product worth or utility, as derived from product characteristics. Thus,

regressing price on product characteristics provides a measure of individual characteristic value or derived demand.

Viewed from the traditional perspectives outlined above, demand, sales and thus market share simply hinge on having the valued attributes at higher levels to give the product a higher total utility score. If a variety possesses those valued attributes (i.e. yield, nematode, parasite and disease resistance - Jeong 1988) at higher levels, it will sell. Thus, the decreasing market share of "good" public varieties containing these attributes, can not be attributable to the variety itself, but to a lack of knowledge of public variety attributes. "Better" seeds with more complete information will sell. In addition, if the "quality variety" is offered at a lower price, it will sell. From such a perspective little attention need be paid to additional attributes, "threshold" attribute levels, what these attributes, including price, really mean, or how they are measured. The emphasis is still on building a better mousetrap, a variety with these attributes, and offering it at a lower price.

Behavioral Approaches

Behavioral economists would suggest that producer purchasing behavior does not follow a compensatory model of choice. As Herbert Simon (1986) argues, humans have a limited ability to know and process information - a bounded

rationality. In essence, brain resources are scarce, and calculating every decision via a compensatory model is too taxing on these resources. In addition, perceptions, meaning of variety attributes, habits and norms may play a large role in decisions, demand and ultimately market share. Thus, a more realistic view of producer choice is needed to discover how seed is selected, and what really is important to producers. Knowledge of this may shed light on what private firms are doing (and public breeders and distributors are not doing) successfully in their breeding, production and distribution systems. And such knowledge can inform policy choice for public variety development and distribution in the public sector.

Lexicographic Choice

The lexicographic model of consumer choice (e.g. Fishburn 1974; Earl 1983) is an example of an approach that proposes a much less calculating individual. Rather than evaluating goods separately and in regard to all their characteristics, the lexicographic model proposes that choosers consider all goods, "still on their agendas of possibilities, with regard to a single attribute at a time." (Earl 1983, p. 87) Thus, people are assumed to set targets for attributes, as well as ranking these according to their priorities. Choice is viewed as a filtering process. Goods must pass "attribute filters." They must fall above a minimum, below a maximum, or within a range, in order for

the goods to remain on the agenda of possibilities. Consecutive filters are applied to "weed out" possibilities and arrive at a choice.

In the lexicographic model price is seen as one of a good's attributes that is central to determining what will be put through later filters. Price is not a value measure to be traded off with utility, but the predominant filter. The good must first fall within the "appropriate" price range in order to be considered further. Price may later reenter the choice situation as the ultimate tie-breaker should more than one good "pass" all the important filters.

Figure 4.1 graphically displays an example of the lexicographic view of choice along with the traditional compensatory view. In this figure, A represents a Ford purchased, and B a Fiat not purchased. The horizontal dotted line represents an economy aspiration, and the vertical dotted line a performance aspiration. These are two filters. Lines I_0 and I_1 are indifference curves of the usual kind for a Lancaster model, which represent preferences and trade-offs. The choice of A over B is consistent with both theories.

Examining the choice from a lexicographic model: Both A and B offer adequate performance, but B is insufficiently economical. It doesn't pass this filter.

While both models are consistent with observed choice, only the lexicographic model "makes no great demand on human

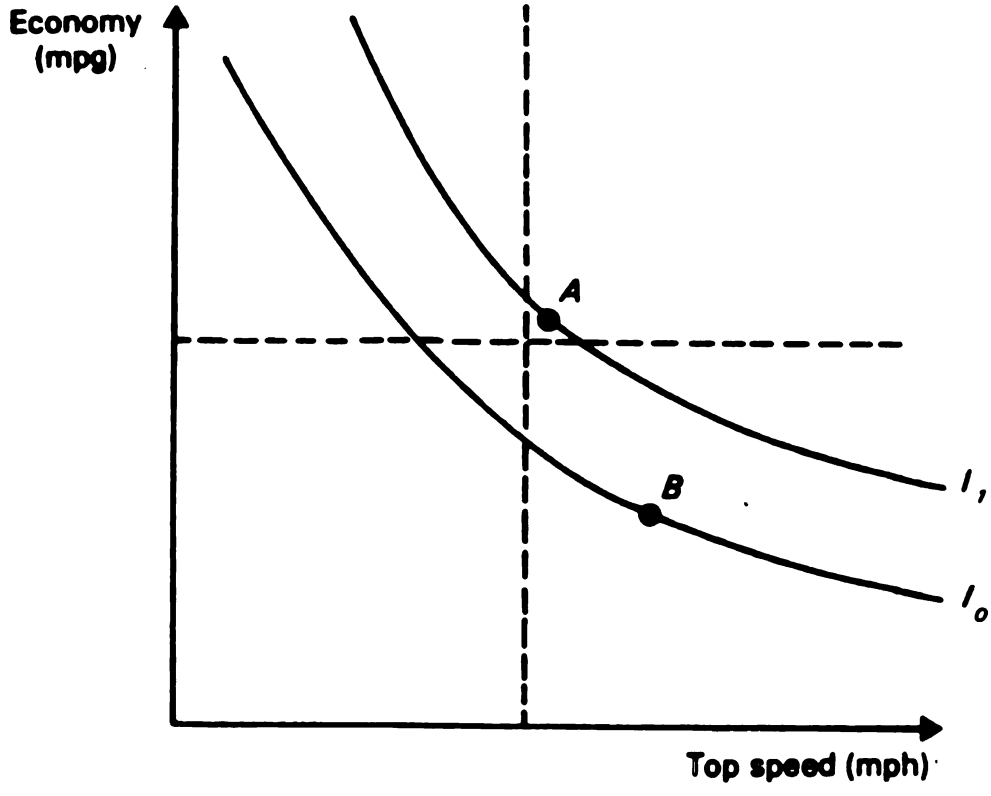

Figure 4.1 Graphic Representation of Lexicographic and Compensatory Choice

Source: Earl, Peter E. 1983. The Economic Imagination

information processing." (Earl 1983, p.114) Only this model is consistent with realistic human abilities.

The lexicographic model, in particular its role for price, alters the traditional notion of substitution and income effects. In this model income effects occur only when price changes alter the number of people whose price range now "fits." It is conceivable that a price change could have no income effect. Some consumers would drop the good from their list while others would add it; resulting in no net change. And substitution effects occur only when goods are considered satisfactory in all non-price dimensions, and price becomes the ultimate tie-breaker.

In light of the lexicographic choice model, the current belief that the best variety is defined by highest yield and greatest disease resistance is questionable. When choice is not a matter of calculating a summed value based on amounts of attributes, but a matter of passing filters, or threshold levels, for certain key attributes, one's thinking changes greatly. In short, the traditional emphases of the breeding and distribution system for public varieties may be inadequate. Maximum attribute levels become less important when thresholds are all that are necessary. Maybe cheap, higher yielding, more disease resistent soybean varieties aren't as important as just adequately yielding, disease resistent varieties that fall within the appropriate price range. Perhaps the price filter has a range such that the

higher priced private varieties still fall within the range. Perhaps seed companies have discovered that not as much yield improvement is needed to pass the "new and improved filter." Given equal performance, perhaps the addition of an "insignificant" attribute allows a variety to pass the next filter that public varieties with higher yield but none of this attribute fail.

The lexicographic model, based on a realistic behavioral assumption of bounds on rationality, indicates that "better" as traditionally seen may not be better to the purchaser. Some other attributes may be of importance even at a minuscule level. Perhaps a variety is superior on attributes B, C and D, but it fails because it doesn't have enough of "A." Characteristics, their presence or non-presence, and/or their levels may have negative marginal utility. Also maybe "not as good" is still good enough. A variety may be inferior if a summed compensatory weight is calculated, but if it has enough to get past the filters, it is still good enough.

Viewed from this perspective, the public seed system may need to emphasize additional attributes and activities, because just having more of some attributes (even with producers knowing it) is not enough to ensure sales. And as will be shown in the following sections, perhaps the perceptions and deeper meanings of these attributes are more important than any "absolute," physical measurement.

Typing, SOP's, Ideology, Constructs

a. Typing and SOP's

An important part of the picture of choice and resulting market share may be to determine what producers actually see when they examine different varieties. The idea that the perceptions and meanings of "things" are important (not just a researcher's perception of reality) is central to many authors in behavioral economics. In Ronald Heiner's terms (1983), the way we type an event, a person, a product is the most important step. Like Simon, Heiner does not assume human awareness of all potential actions and information. Instead humans have limitations and the world uncertainty. Calculation and investigation of each situation is not possible. Even with information, uncertainty as to the role of a good in satisfying preferences exists.

In the face of this uncertainty human behavior is rule governed. Rules of thumb, or Standard Operating Procedures (SOP's), are developed to deal with the limitations and uncertainty, and reduce the frequency of costly mistakes. Uncertainty means "mistake potential" to humans, and thus, old stand-by procedures are employed to reach decisions. In fact, instead of calculating and optimizing based on all information and options, humans may limit themselves to what they have known, and thus "underachieve" (Heiner, 1983). As Robert Frank (1988) notes, "we often make poor use of the

information right at our fingertips." Furthermore, Frank argues that computational mistakes are not the only problem in predicting behavior. Instead, "errors" are systematic due to the use of "proximate goals," norms, standards and passion.

These authors, and behavioral economists in general, argue that the consumer is not a rational calculating optimizer, but an approximator. The consumer uses rules based on what has been personally experienced, and is subject to "passionate mistakes." This results, not in calculation of summed utilities, but in the more general typing or categorization of situations, and the application of SOP's that correspond to the type.

In the soybean variety selection process, a producer may be faced with a choice between a previously used public variety that they've had good experience with and a new private variety reported to be higher yielding. Without full review of the varieties' characteristics, the older public one may still be chosen. In this case the producer might have an SOP that says, "Buy what you know, especially if you've had no problems with it." The actual attribute values are of little, or no, importance in such a situation. Or perhaps the SOP is "Buy the latest variety. Its recent release must mean that it is new and improved." In this way new releases have an advantage, and firms may desire to release new varieties more often, not based on

"significantly" enhanced performance, but in order to take advantage of the latter SOP. In either of these cases it is not a calculating consumer measuring out and summing the amounts and values of specific attributes that is acting. Instead it is a consumer with limitations who does "the best he can" by utilizing past experiences and a rule of thumb which may be largely independent of the actual product attributes possessed.

b. Ideologies

Randall Bartlett's emphasis (1973) on ideology is essentially the same as Heiner's typing (1983). Broad ideologies, notions, or upheld beliefs help simplify the world. They are needed to deal with bounded rationality, to reduce the tax on brain resources. They help consumers make sense out of the unknown, or that which is not readily transparent. Perhaps a producer has an ideology about Michigan State University or Asgrow: "M.S.U. (Asgrow) is a good organization producing good products. Therefore, their variety must be good." The purchasing decision is never broken down into performance criteria, or the variety into the attributes it possesses. Instead, an ideology is accepted, and an SOP that has worked before is applied. This may not result in the selection of the "best" variety, but "best" requires more calculating than is possible. The producer uses the information he/she can handle in the best possible manner, and that is based on an ideology and SOP

formed to repeat past success and avoid past failure.

c. Constructs

Earl (1983) uses a more calculating lexicographic choice model, but the way a product is typed, or in his language the construct seen, is still essential to choice. The central theme of Earl's construct theory is that the way people make sense of the world, the patterns seen, the constructs applied, influence the filters utilized and the evaluation of a situation relative to that filter.

The way a producer makes sense of a higher price is such an example. Given equal yield and disease resistance, a grower may construe the higher price of one variety as an attempt to weasel more money out of him/her. Or the producer may construe the higher price as an indicator of some hidden quality (e.g. Stiglitz 1987). In this way, a higher price (but still within the price filter) may actually increase sales. In either case, the producer can not, and does not, know to what the higher price is actually attributable. And that reality is unimportant. The only reality that affects choice is the producer's means for construing that higher price. The central idea is that the constructs, or the means by which producers view the varieties and variety attributes is critical to the purchasing decision. It is essentially the same notion as Heiner's typing, or Bartlett's ideology.

Earl (1983) also advances construct theory to tie

product attributes to some deeper core constructs that are actually the action-driving points. Some of the current literature calls the idea laddering (Easterby-Smith 1981; Gutman 1982 and Earl 1988) in that a concrete attribute such as price ladders to (it elicits cognition of) "increasingly imponderable" constructs. A producer ladder might be: higher price --> higher quality --> increased yields --> increased returns --> financial stability --> success. This last node is a terminal value or core construct. Such constructs are essential values that are the center of who we are and what we believe, and as such they drive behavior. The notion is that measurable attributes really mean something deeper, and it is this deeper meaning that is important to choice.

These three ideas of typing, ideology and constructs utilize the fact that rules of thumb are necessary because of the bounded rationality of people. Heiner's and Bartlett's theories, if taken to extreme, may oversimplify the situation. It is likely that producers do look, at least to some extent, at variety attributes and their levels. But the ideas of Heiner, Bartlett and Earl seem very probable as one examines the way people make sense of product attributes (i.e. brand names, higher prices, and recent release) and deal with the multitude of options facing them. All of this means that the way a variety is evaluated is highly subject to the patterns seen in world,

the way attributes are construed, the ideologies possessed, the way characteristics are typed, or what prospect theory (Kahneman and Tversky, 1979) calls the frame.

Framing

a. Prospect Theory

As seen above, it is not enough to look at what are believed to be essential attributes and seek to supply them. It is not sufficient to examine some absolute measure of attribute levels, and their contribution to utility, or ultimate goals/objectives. Breeders and distributors need to examine what producers are thinking. They need to know the constructs, types and ideologies that producers apply to varieties and variety attributes as they make selection. And as prospect theory (Tversky and Kahneman 1986) points out, they may need to provide the frame so that variety attributes are construed, typed in a beneficial way (or bad attributes are construed negatively).

Prospect theory distinguishes two phases in the choice process: a phase of framing, followed by a phase of evaluation (Tversky and Kahneman 1986). The first framing phase is a preliminary analysis of the decision problem. This process is controlled by the way in which the problem is presented, and by norms, habits and decision maker expectancies (Tversky and Kahneman 1986). This appears to closely match the previously discussed ideas of constructs, ideologies and SOP's. In the second phase, "the framed

prospects are evaluated, and the prospect of highest value is selected." (Tversky and Kahneman 1986)

In observing human behavior concerning time preferences, alternate labels, and simple gambling games (e.g. the Allais Paradox), Tversky and Kahneman (1986) have discovered some common means of evaluation and selection. Gains are valued less than the actual values, while losses are valued more heavily. Risk seeking behavior occurs in the face of loss, while behavior is risk averse in the face of gains. In addition, certain outcomes are over-weighted relative to uncertain outcomes.

The main point of these particular observations is that behavior does not always follow measurable probabilities, expected utility, and notions of rationality. While a "dollar is always a dollar in accounting, a dollar is not always a dollar in other situations." Like the previously discussed authors, Tversky and Kahneman emphasize that humans have limitations, and the manner in which the situation is perceived by the chooser (not another's view of reality) is essential in determining behavior. Tversky and Kahneman (1986) emphasize that the way consumers see a situation (and particularly losses, gains and risk) is dependent upon how the situation is presented to them, how it is framed. The frame affects how the dollar is perceived and valued. And those that can, and do, control the frame wield power, and influence behavior.

Richard Thaler (1980) described behavior in response to labeling a difference between two prices as a surcharge or a discount, and Tversky and Kahneman (1986) use this as a demonstration of framing effects. "It is easier for consumers to forgo a discount than to accept a surcharge because the same price difference is valued as a gain in the former case and as a loss in the latter." (Tversky and Kahneman 1986) As noted by the authors, the credit card lobby realizes this framing effect, and has insisted that cash and card purchase price differences be labeled cash discounts rather than credit surcharges.

Thus, the frame is all important to the outcome. There really is no normative means for presenting a situation (Tversky and Kahneman 1986). All manners of presentation affect perceptions and ultimately choice, and control and use of the frame can greatly alter the outcome of the choice situation. All gains, losses, yields, resistances, prices, etc. are not equal. Instead, they are dependent on the frame.

b. Implications of Prospect Theory

The use of the framing concept by seed companies is a likely explanation for some of the market share differences that are being noted. It appears that seed companies, through their own distribution system, and control over those they contract with, are able to use the behavioral assumptions noted above to achieve increased market shares

(while public programs have not). Because the way products and attributes are typed is subject to the way a situation is framed, private companies work to affect the way producers construe attributes. As previously stated, advertising and promotion may have influenced the way price and brand name are seen, so that they become indicators of hidden value. Marketers may work to ladder an attribute possessed by their seed, such as very specific soil-type responsiveness (which some public breeders feel has very limited effects) to a terminal value that drives choice. Another example of the use of framing is the manner in which private seed companies have approached the use of plant patents.

With the change in patent law, plant patents have actually become a variety attribute that seed companies may have used to their advantage. The way this "patent attribute" is construed can affect the demand for a patented variety and ultimately the return on the patent. A traditional approach to increasing sales and returns from ownership rights would be to actively enforce the patent through use of policing activity and infringement fines. In this way farmers and seedsmen would calculate expected utilities using probabilities for getting caught, and determine that it is not to their advantage to use or sell bin run seed. Such an approach emphasizes efforts to more effectively police and severely penalize. But the results

of this activity may be to frame patents and protected varieties in a negative manner. A patent may be seen as a regulation, not as a beneficial attribute of a variety, and this may cause a negative SOP to be applied. Or in Earl's language, the variety may fail to pass a filter for regulation or "strings attached," and a different variety will be purchased despite any performance advantages of the patented variety. Or the strict policing effort may affect the ideology applied to that firm changing it from "a company working with me" to "a company hounding me and out to make a buck on me." The end result being low sales, collection of royalties and returns on the patent.

In view of the above scenario, and the previously cited exclusion problems[1], an alternative frame can be provided in hopes of increasing sales and returns. The idea is to influence the construct applied to a patented variety. Such an effort could be to promote patents as a sign of superior quality. This frames patents as indicators of quality. In a different language, patents are being laddered back to the terminal value of success so that the variety is purchased. Or, for Heiner, an SOP may be, "The seal of the U.S. Patent Office is on this variety so it must be good, and worth purchasing." These efforts may increase the use and

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[1] Control of patented plant materials is limited due to their ready reproducability, and the shear number of potential users. Thus, policing efforts, along with creating a bad frame, are not likely to be successful.

repurchase of patented varieties. And the end result may be greater returns on the patent, than if enforcement is attempted, resulting in the application of negative constructs.

Implications of a Behavioral Approach

The behavioral approach to variety purchase decisions indicates that it is first necessary to find out what producers actually think. It simply is not enough to develop a "good" variety. Research is needed to dig out behavioral information. A better understanding of important attributes and their deeper meaning is necessary. What do producers actually see as important and why?

This knowledge can then be used in light of goals to decide what the policy for the breeding and distribution of public varieties is to be. If the foremost goal is to get better varieties (as defined by test plot performance) to producers, public breeders must control and coordinate their marketing and distribution system to utilize constructs, typing, framing, laddering, etc. as private seed companies do in order to ensure that producers get the "better" varieties. They must design the frame that producers perceive when they examine their varieties. If the goal is to increase revenue from those varieties which are developed, perhaps levels of yield and disease resistance need not be as high as traditionally believed. Price may not need to be as low, and in fact may need to be higher to

indicate quality. What ever the goal, agricultural experiment stations, foundation and certification agencies, and seedsmen need to be more aware of the behavioral aspects of choice that have traditionally been ignored.

CHAPTER V

RESEARCH MODEL AND METHODS

Conceptual Framework

As noted in the previous chapter, the behavioral approach to consumer choice and seed purchase decisions indicates that if public breeding programs are to be designed to meet the goals of the public sector, it is necessary to find out what producers actually think. It simply is not enough to develop a "good" variety and put it out there. Or as one plant breeder stated, "I never believed that all we have to do is build what we consider to be a better mousetrap. It just isn't that simple." Research is needed to dig out behavioral information. What do people think and why? How are varieties typed? What are the essential constructs? What Standard Operating Procedures (SOP's) are applied? What is the best frame for decisions?

A view of consumer perceptions, their cognitive structures, or perceptual maps is needed. Researches have widely recognized that these structures are what govern behavior to a large extent. In the area of interest of this study, such structures, with regard to soybean varieties, guide seed choice, variety success or failure, and

ultimately breeding program success or failure.

In this chapter, a model for viewing consumers' cognitive structures using a behavioral approach consistent with those issues discussed in Chapter IV is presented. Some of the implications of such a perspective for product distribution strategies and policy choice are discussed. Next, a number of methodologies for identifying the elements of cognitive structure are presented and reviewed. Finally, the actual procedures used in this study of soybean seed demand are presented in depth.

Means-End Chain Model

Researchers have developed numerous schemes to describe the content and organization of consumers' cognitive structures. For instance, the Grey benefit chain (Young and Feigin 1975) describes a path in which a product is linked to a concept, the emotional payoff, through a chain of benefits:

Product ===> Functional Benefit ===> Practical Benefit ===> Emotional Payoff

Other models begin with product attributes and end with terminal or essential personal values (Rokeach 1973):

Product Attributes ==> Choice Criteria ==> Instrumental Values ==> Terminal Values

The later type of representation is generally termed a means-end chain model, and its general form serves as the conceptual framework for this study.

The "means-end chain" concept (Gutman 1982), based on

consumer processes and behavior, is a model that links product attributes to values that guide behavior. It is a means for examining what people think and why, and how this relates to behavior. Just as Kelly (1955) and Earl (1983) noted the centrality of core constructs, this model first assumes and emphasizes the dominant role of values in guiding choice. These values are desired end states of being such as happiness, security, accomplishment. And it is these end states, or the continual striving to achieve them, that drive choice/behavior.

The means-end model seeks to explain how means, or products and their attributes, are perceived by consumers in regard to the achievement of the desired ends. The model consists of elements that represent the major consumer processes that link values to behavior (Gutman 1982). Through such links, values are applied to all situations, to all products. These linkages are the way sense is made out of things, and the means by which decisions on action are achieved. As the foundation for these associations, values or end states play the central role in consumer behavior.

A second assumption of the Gutman means-end chain model is that people categorize. As noted by Simon (1986) the diversity and complexity of the world, and human limitations in terms of brain capacity, puts bounds on human ability to know and process information. Thus, to deal with the complexity and save on limited brain resources, people group

or categorize. People need to and do, type, group or frame products and situations, and then apply SOP's, rules of thumb, or best approximations (Heiner 1983; Bartlett 1973; Tversky and Kahneman 1986). For the means-end chain model this indicates that the attribute-value linkage is not "traveled" or worked through each time choice is necessary. Instead products and/or attributes are categorized by their relationship to values.

In addition to these two major assumptions, there are two more general propositions of this model. First, all consumer actions have consequences that are given meaning and importance by values, although not all consumers perceive these in the same manner. Secondly, consumers learn to associate particular consequences, or their perceptions of these, with particular actions (i.e. product use), specific products and/or product attributes.

Thus, in the means-end chain model consumers are seen as creatures with values that drive their actions including choice. They are bounded by the complexity of the world and the limitations of their brain and therefore, they are forced to categorize issues. This categorization is done based on the associations that are made between perceived consequences and particular actions (i.e. product use), specific products and product attributes. In essence, learned associations and human bounded rationality means that actions, products and attributes are categorized by

their consequences or affects on values. Again, the association, or chain, is not "travelled" each time decisions are necessary. Instead, a product or attribute is perceived in a certain way and categorized by its association with consequences and eventually the way it relates to values. In this way, the means-end chain provides the conceptual framework that displays the network between product attributes and the personal values that direct action.

Product Attributes ======>(Perceived) Consequences ======>Values/Desired End States

The chain, as described by Gutman, follows a path of increasing abstraction and definition of choice. Product attributes are concrete and relatively superficial, but have limited direct affect on choice. It is their deeper meaning or the way that they are linked to consequences and values that affect choice. Thus, the next step in the chain's path is consequences. These result from product use or situation action. They are less absolute and move farther up the path of abstraction. They are perceptual elements that differ between individuals, but are believed to be similar within a relatively homogenous group. These perceived consequences have effects on personal self, and values. And it is these value elements that are the ultimate behavior determining step. Via the chain or association to less abstract elements, values drive choice. It should be noted that this path may not be a simple three step one. Several perceived

distinctions or construed elements of importance may exist at each or any level, but these are the essential components that bring consumers to choice. Thus the product, via the attribute-consequence-value linkage (the consumer's cognitive structure) is typed and behavior with regard to that product is determined (choice/non-choice).

Implications

Knowledge of such a linkage between product attributes and values can be a very useful tool, and may be an essential component for product success. First of all, it is not enough to produce what is generally felt to be the appropriate attributes. The attributes of pertinence to consumers, not developers or researchers, are the necessity.

While the provision of pertinent attributes is essential, it is not sufficient. The attributes' relation to consequences and values also needs to be considered. This association provides the key to successful marketing and distribution of products with the "appropriate characteristics." Marketers must plug into the means-end chain and make it the marketing strategy path. Likewise, policy makers seeking public program success must make sure that their program fits in with, and utilizes the chain. Are the attributes the right ones? Are the programs, their products and attributes perceived as being tied to the desired ends of consumers? If not, can a new strategy be designed to tie them together? If a new strategy is put

forth as a policy option, how does it relate to the chain? Does it work with it or against it? Essentially the means-end chain offers marketers, policy planners and the like, a way to position their product, in this case their variety, by tying the means (the physical attributes) to the achievement of the desired ends (the valued end states). This can be done through advertising and promotion, by institutional organization, by pricing strategies, and more.

An illustration of consumer perceptions of gums and lozenges (Reynolds and Gutman 1984b) may prove useful. Knowledge that consumers like to use mint chewing gum doesn't tell much. But if it is known that they prefer mint gum, because of its lasting fresh taste, which gives fresh breath, preventing social rejection, promoting self-confidence and enhancing one's self esteem, strategies can be tailored to mesh with or utilize this means-end chain. Chewing gum producers can tap into the values or desired end states of consumers through the provision of attributes that link with these. Promotion and marketing channels can display this link, demonstrating that the product contains the means for value satisfaction.

In this study of policy options for soybean variety distribution, the attributes of pertinence to commercial soybean producers must be found. The manner in which varieties and their attributes are perceived, their deeper meaning, must also be discovered. Policies must work with,

not against, these perceptions, and/or these policies must be developed to favorably effect perceptions. Finally, the manner in which these elements of importance link to personal values must be revealed so that appropriate distribution strategies, including demonstration of product worth, can be developed.

Research Methodologies

The methodologies used to uncover important attributes and their deeper meaning or relation to behavior directing values must identify both content and linkages. The pertinent elements, from attributes to values, must be uncovered and these must be mapped out to show their association, and thus, affect on choice. This is essentially an examination of consumers' perceptual maps or cognitive structures. Several methodologies have been employed, in a variety of fields of study, in attempts to identify all or part of the content and linkages of cognitive structures. Three of these are reviewed in the following sections.

Repertory Grid Procedure

The repertory grid technique (Kelly 1955) is a procedure that allows identification of the constructs or distinctions that people use to define their world. It was originally designed for use in psychotherapy settings as a means of determining how a person views the world.

Utilizing such a procedure a patient's perception of reality is the focus, not some other sense of reality that society, a counselor, or a researcher deems appropriate. Through use of the repertory grid the different perceptions or world views can be revealed, and in a counselling setting any difficulties that such perceptions create are examined.

The Kelly repertory grid procedure has since been applied to numerous other fields including training evaluation (Smith 1978), performance appraisals (Jolly, Reynolds and Slocum 1988), political attitude measurement (Fransella and Bannister 1967) and market analysis (e.g. Olson and Reynolds 1983; Reynolds and Gutman 1984b; Walker, Celsi and Olson 1986).

In market analysis uses, a triadic sorting process reveals individuals' categorization of products. The constructs or distinctions used by consumers in product choice decisions are elicited in this process. In general, triadic sorting uses the following steps to elicit product distinctions. First, the stimuli, in this case similar commodities or different brands of a single commodity, are divided into sets of three, called triads. Subjects are then presented with a triad and asked to "tell all the ways that two of these are alike and yet different from the third." The responses to these instructions yield bi-polar distinctions used by the subject to categorize the stimuli. The process continues for each triad, and thus, a number of

distinctions used by consumers are revealed.

Past use of the repertory grid procedure in market research has revealed that the process identifies mainly lower-level distinctions, more concrete attributes (Gutman and Reynolds 1979; Walker, Celsi and Olson 1986). Few distinctions are made at the consequence or value level. Those experienced with repertory grid use indicate that this may be due to a lesser-degree of involvement with the stimuli in a market setting as compared to the counseling interview (i.e. seed varieties as compared to problem relationships) (Reynolds and Gutman 1984b).

While deeper meanings are not often revealed, these lower-level distinctions are the starting point for building a consumer cognitive structure for a product or product group. They are the pertinent attributes as perceived by consumers. The procedure allows consumers to demonstrate what they see as important. As such, the repertory grid is a departure from many techniques in which subjects respond to elements provided and deemed important by researchers. And the deeper meanings of these concrete attributes which ties them to behavior-guiding values can be revealed by building upon the repertory grid procedure.

Free Elicitation Procedure

In order to expand the content of the revealed attributes, a free elicitation approach (Olson and Muderrisoglu 1979) could be combined with the repertory grid

procedure. This procedure, also known as thought verbalization (e.g. Wright 1980) or protocol analysis (e.g. Bettman 1980), calls for the subject to talk though the choice situation. Subjects are presented with the situation and can respond freely in their own words. The assumption is that in talking through the decision, "thinking aloud," a subject will freely elicit distinctions, constructs, attributes, consequences, etc. of importance. The fact that this process is less structured may encourage elicitation of a wider range of salient distinctions, distinctions not revealed in a triadic sort.

Again, past experience has shown that the distinctions revealed using such procedures are often at a lower-level of abstraction (Olson and Reynolds 1983; Walker, Celsi and Olson 1986). But free elicitation allows consumers the opportunity to verbalize other perceptions of importance not revealed through structured procedures. This expansion of the base of pertinent attribute-level distinctions may prove helpful, but an additional procedure is necessary to delve into salient consequences and values and their associations.

Laddering Procedure

The laddering procedure as described by Easterby-Smith (1981) and Gutman (1982), can be applied to the distinctions uncovered through the repertory grid and free elicitation procedures in order to uncover their deeper meanings, reasons for importance and relation to the personal values

that drive behavior. This is a process that encourages subjects to ladder, or step along the path of the means-end chain, and elicit the consequences perceived and the values deemed important. Such a technique allows researchers to move beyond the surface properties and attributes to the consequences and values that give meaning to the superficial (Gutman 1982). And the procedure reveals the links or hierarchical means-end chain that associates the elements at each level.

The laddering procedure begins with a concrete attribute of pertinence elicited from a prior procedure. The interviewer says something like, "You mentioned that _____ (a distinction) was important to you. Why is it important?" When the subject responds a new, more abstract distinction has been elicited. The researcher then repeats the "why question" for the new distinction. The process continues in this manner until the subject can no longer proceed. This in-depth probing "forces the respondent up the ladder of abstraction to see how individuals link salient attributes to higher level consequences and, ultimately, to personal values (Jolly, Reynolds and Slocum 1988). It demonstrates how the desired endstates are measured. It provides the deeper meanings and associations needed for construction of a cognitive structure.

When combined, these three procedures can serve to

encourage comparison of soybean varieties and their attributes, allowing for an array of distinctions of pertinence to be elicited. The combined processes enable researchers to delve into the more concrete-level distinctions, uncovering their importance and linkage to the behavior-guiding values or desired end states of consumers.

Data Analysis

Repertory grids alone provide a great deal of data for analysis, and when combined with free elicitation and laddering procedures, the range and depth of data generated is greatly extended. Likewise, there are a number of possibilities for data analysis, from in-depth individual-level analyses detailing each respondent's idiosyncratic cognitive structure to cumulative analyses of combined responses from many subjects that provide an overview of a segment of the population's cognitive structure (Olson and Reynolds 1983). For this study a group's (soybean growers) cognitive structure was desired, and so, cumulative analyses are reviewed. Two such procedures are overviewed below. The first is a correlation-type analysis that seeks to identify the importance of distinctions elicited. The second is a three step process to construct a map of the subject group's cognitive structure.

a. Correlation-type Analysis

By adding procedures in which subjects rate stimuli with regard to constructs elicited and some "overall best"

attribute, a correlation-type analysis can be conducted. This procedure provides a simple correlation measure between the construct/attribute elicited and some overarching construct of importance. In this way a notion of attribute importance is achieved.

This process is illustrated in Table 5.1 using an example of salesperson effectiveness ratings (Easterby-Smith 1981). The difference between the construct rating and most effective rating for each salesmen is summed to arrive at difference scores. For example, Salesmen #1 is rated a two with respect to Construct 2 and three overall. Thus, the difference is one. For Salesman #2 the difference between the construct rating and most effective rating is zero. Continuing on and summing for each salesmen, the difference score for Construct 2 becomes four. Construct 2 has the lowest difference score, and thus, to this subject it is the closest to the "most effective" construct.

Table 5.1 Difference Scores Between Elicited and Supplied Constructs

	Salesmen						Difference
	1	2	3	4	5	6	Score
			Rating				
Construct 1	4	3	2	1	1	5	10
Construct 2	2	5	1	3	2	5	4
Construct 3	1	4	4	1	3	4	11
"Most Effective"	3	5	1	4	2	3	

Source: Easterby-Smith 1981

b. Cognitive Structure Analysis

To begin a cognitive structure analysis of data from an interview process a content analysis is necessary. Researchers need to review the idiosyncratic responses from subjects and convert these into some standardized form that expresses their essential meanings. Categories, or concept codes, are developed to capture the key aspects of thoughts expressed by the subjects interviewed. Then the distinctions and verbalizations of each individual are assigned a concept code corresponding to the response's essential meaning[1]. The concept codes elicited can also be categorized by their level of abstraction. In essence, the objective is to match the concepts to the components of the means-end chain model - attribute, consequence or value.

These two categorization procedures transform all responses from the interview process into a set of standard concepts classified by the level of abstraction. It summarizes the distinctions consumers perceive as important and corresponds them to the components of the means-end chain model of consumer choice.

Following the content analysis a structural analysis is often conducted to identify the linkages between the concepts. This analysis involves constructing a square matrix using the concept codes to denote rows and columns.

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[1] For a free elicitation technique this means that each tape recorded response must first be segmented into short phrases which are then coded.

Entries are made in a cell each time the row concept preceded the column concept in the ladder responses. Whenever the row concept was the "probe distinction" that elicited the column concept, an entry is made in the cell.

The resulting matrix, an asymmetrical dominance matrix represents the aggregated cognitive structure for the group of subjects (Olson and Reynolds 1983). It displays the frequency with which concept links were mentioned by all subjects. This procedure does not provide any information about the strength of the links between concepts, only the frequency of their mention.

The next step in cumulative analyses is to construct a Hierarchical Value Map (HVM), a perceptual map. The linkages displayed in the structural analysis are used to develop such a map. First the significant linkages must be selected. Previous studies have considered all linkages mentioned more than six times across all subjects as significant. As noted by Olson and Reynolds (1983), this is a somewhat arbitrary cut-off, leaving out many links. But the aim of cumulative analysis is to identify the key features of most of the subjects' perceptual map not the idiosyncratic maps of individuals.

By using the significant linkages determined by the dominance matrix, the perceptual map can be constructed. In constructing the map the value-level concepts are positioned at the top and the more concrete attributes are positioned

toward the bottom. Lines are then drawn between concepts that were direct probes/elicitations in the laddering process. Figure 5.1 is a hypothetical example of such a map.

As can be seen in Figure 5.1, the resulting map represents the cognitive structure of the subjects for the stimuli presented to them for comparison. It identifies not only the concepts that are salient across most subjects, but also the most frequent interconnections between concepts. Thus, the subject group's cognitive structure, or means-end chain, that directs choice is revealed. In essence, the map describes how this group perceives the stimuli and their attributes, and the manner in which selections are made. For example, the concrete attributes of "advanced seat reservations," "aircraft type," and "first class cabin," all lead to "more space," which in turn leads to "physical comfort." This concept then leads to "status," "getting more done, " and "reducing tension." These consequences are essentially the gateways to higher-level consequences and values, such as "safety," "accomplishment," "security," and "self-esteem." And these are the concepts that drive choice.

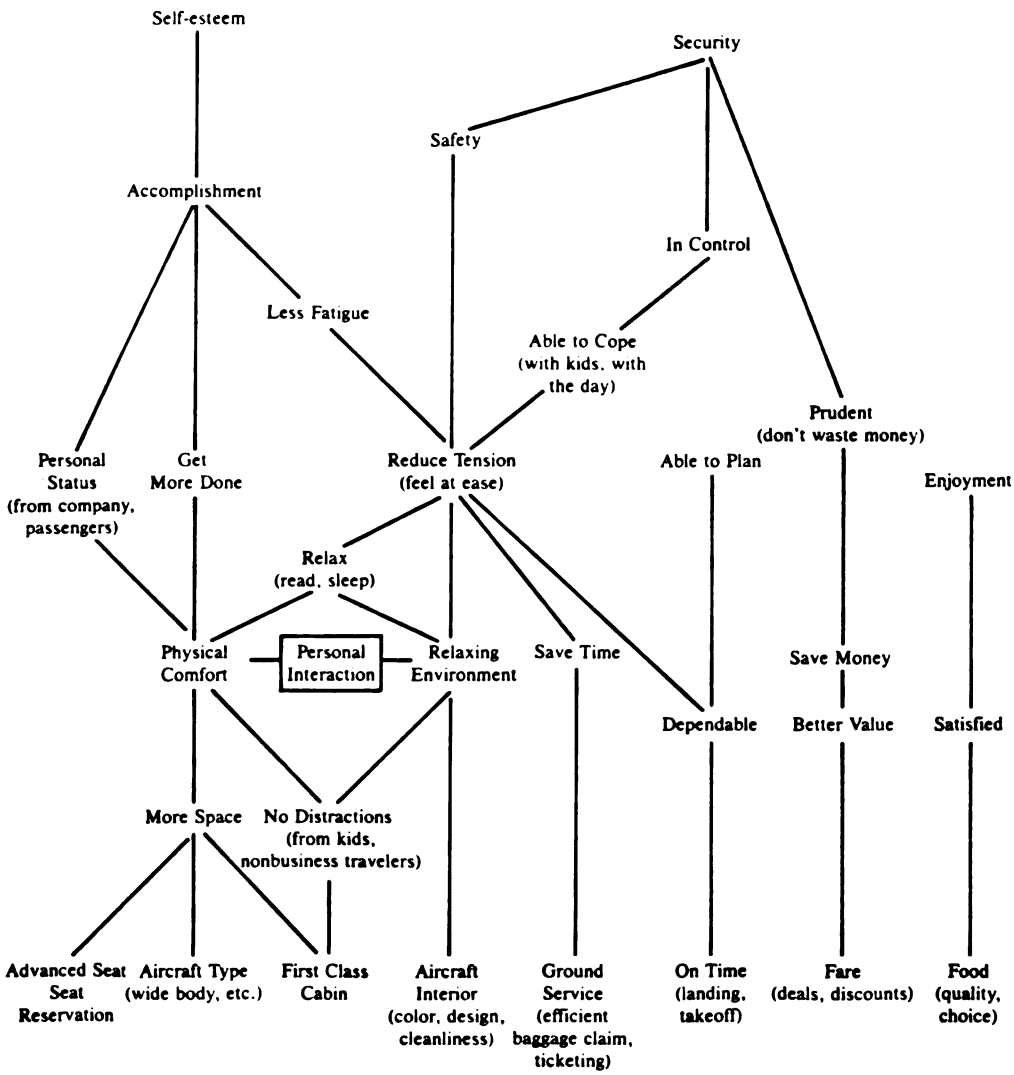

Figure 5.1 Perceptual Map for Hypothetical Airline Study

Source: Reynolds and Gutman 1984a

Procedures Used in this Study

The procedures utilized in this study sought to combine the three techniques previously reviewed. This was done in hopes of combining the strengths of a somewhat directed procedure with a free elicitation and a second directed probe driving at deeper meanings. However, following four pretest interviews some alterations were made in the procedure, the primary being the elimination of the free elicitation procedure. During the pretests the farmers did not openly talk through the variety selection process, and there was some hesitation regarding the tape recorder. So, it was decided that the free elicitation would be eliminated due to these difficulties. The following sections review the data collection and analysis procedures employed.

Data Collection

A total of twenty eight commercial soybean producers were selected for the interview process. These producers were randomly selected from soybean producer lists provided by Cooperative Extension offices in six of the top soybean producing counties in Michigan.

An initial contact-call to the selected growers explained the general nature and purpose of the study, and on-farm interviews were then requested and set up. These interviews were conducted over a three week period in late March and early April of 1989.

As noted previously, four of the interviews constituted

a pretest where alternate methods were explored. In addition, these pretests generated the concept codes for content analysis.

The remaining twenty four interviews served as the data source for this study. Review of the procedures utilized in these interviews follows.

Data were collected from each producer in an individual interview lasting from 1 to 2 hours. Each interview consisted of the following parts.

a. Warm-Up

The first part of the interview session was an informal discussion of farming, soybeans and ratings. It was designed to get the subject thinking seriously about soybean seeds and to relax both the interviewer and the subject.

b. Stimuli/Variety Elicitation

Because of the large number of soybean varieties available in the market, it was uncertain whether all subjects would be familiar with any set of varieties produced by the researcher. Thus, the researcher "defined a pool", and the subject was asked to "fill the pool" (Easterby-Smith 1981). Specifically, each producer was asked to name eight varieties with which they were familiar. In as much as possible, growers were asked to create a list of public and private varieties. Each variety was written on its own index card, and five triads were randomly formed.

c. Triadic Sorting

Each triad was presented, one at a time, to the subject. The subject was asked to group two varieties together as similar and different from the third. They were then asked to "name a way that these two were alike and yet different the third." The grouping and distinction made was recorded, and the subject was asked if "there are any other ways that these two are alike and yet different from the third." The process continued for each triad, and the interviewer recorded the groupings and distinctions.

d. Distinction and "Overall Best" Rating

Subjects were next presented with all of the cards (varieties), and asked to rate them on a four point scale with regard to seven distinctions[2] they had previously elicited (or been provided). In addition, a rating for "overall best" was obtained. For instance, ratings (1-4) for yield potential, consistency, standability and others were obtained, followed by a 1-4 rating for overall best. These ratings were recorded for later analysis.

e. Ranking

Next, all of these distinctions were presented to the subjects, and they were asked to directly rank these with respect to importance. These rankings were recorded.

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[2] These seven distinctions had been elicited in all pretest interviews. In an effort to obtain a set of ratings for a standard set of variety attributes, it was determined that all future subjects would rate varieties with regard to these.

f. Laddering

For the top six distinctions, the growers were asked which pole of the distinction was preferred. Next the interviewer asked why that pole was preferred. The newly elicited distinction served as the basis for another "why question." The process continued until the subject could no longer answer.

Additional distinctions that appeared to be important to the subject were also supplied for laddering. In addition, some particular distinctions of interest in the study were supplied for laddering if they had not been elicited in the triadic sort[3]. Such distinctions included "newness" (how old the variety is), price, place of purchase (elevator, dealer, farmer grower), and the actual distinction of public and private varieties. These last two were of special interest to formulating perceptual maps for each of these "classes" of varieties. All responses were recorded for later coding.

g. Demographic Information

A short form was given to the producers surveyed to collect information on farm size, farm enterprises, years farming and soybean varieties planted.

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[3] Such procedures have proven useful when perceptions regarding particular attributes which are commonly understood are of particular interest to the researcher (Easterby-Smith 1981).

Data Analysis

As noted before, a number of possibilities for data analysis exist, from in-depth analysis of an individual's cognitive structure, to cumulative analysis of a group's structure. For the purpose of informing policy choice and strategy formation for the public seed system, the later approach was taken.

a. Correlation-Type Analysis

The first analysis conducted was to identify the closeness of each distinction to an "overall best" variety dimension. The procedure is a correlation-type analysis and is similar to that previously outlined. The four point ratings of all varieties for each distinction were compared to the four point rating for overall best. The difference between each pair of numbers was totalled for the full row, giving a difference score for that construct. The lower that score, the closer the distinction to the overall best notion.

An example of the difference score calculations for one subject is presented in Table 5.2. The differences between the distinction rating and "overall best" were calculated and then summed across all varieties to arrive at that distinction's difference score. For this soybean grower the yield potential distinction had the lowest difference score, and thus, for this grower, yield potential is closest to (is most important in determining) the "overall best" variety.

Table 5.2 Difference Scores Between Seven Variety Distinctions and "Overall Best" Distinction For One Grower Interviewed

Distinction[a]	Varieties 1	2	3	4	5	6	7	8	Diff Score
				Rating					
PRR Resist.	3	1	3	4	3	3	2	3	9
Standability	4	2	2	1	3	1	2	2	11
Ease of Comb.	3	3	3	1	2	1	1	2	10
Consistency	3	2	3	1	1	3	3	3	5
New Variety	3	3	3	2	1	1	2	1	6
Yield Potent.	3	3	4	2	1	2	3	1	3
Seed Price	1	1	1	3	3	3	3	3	12
Overall Best	3	2	4	2	1	3	4	1	

[a] PRR Resist. = phytophthora root rot resistance
Standability = plant standability/lodging
Ease of Comb. = ease of combine/harvest ease
Consistency = yield consistency
New Variety = relative "age" of variety
Yield Potent. = yield potential
Seed Price
"Overall Best" = an overall assessment of "best"

This procedure was the manner in which difference scores were calculated for this study. Because not all subjects mentioned the same distinctions, only the seven distinctions mentioned (and shown above) were rated by all subjects, and combined to formulate difference scores for the group interviewed.

b. Cognitive Structure Analysis

The first step in formulating a cognitive structure from the large number of distinctions elicited in the triadic sort and laddering procedures was to perform a thorough content analysis. Categories, or concept codes, were developed to capture the essential aspects of the thoughts expressed by subjects in response to the triadic

sorting, verbalization and laddering tasks. Then each thought/response/distinction from each subject was assigned a category or concept code. In this manner all responses were expressed in a set of standard concepts.

The categories or codes were then classified as attributes, consequences or values, the main components of the means-end chain model. This provided a summary of distinctions coded in a standard form, and classified by level of abstraction.

It should be noted that the two steps of categorization and classification are obviously highly subjective. Identifying the meaning of elicited responses is open to coder judgement and biases. In an effort to address this issue two coders conducted the content analysis independently, and then compared analyses. Where disagreement in coding occurred agreement through negotiation was achieved.

The next step in the data analysis procedure was to conduct a structural analysis. The objective of this procedure was to identify the linkages among the concepts. First a square matrix was constructed in which the rows and columns were denoted by the concept codes developed in the content analysis. Next, entries were made in a row/column cell each time the row concept preceded the column concept in the ladder responses. The total entries in any individual cell indicated the number of times, across all

respondents, that a particular row concept directly elicited the column concept. This structural analysis provided a dominance matrix displaying the frequency with which concept links were mentioned by the producers surveyed. In essence, it demonstrated the commonly perceived linkages between important distinctions.

The final step of the data analysis was to construct a Hierarchical Value Map (HVM) or perceptual map. The first procedure was to determine the significant elements and linkages. In this study, all linkages that were mentioned more than five times were considered significant. These significant linkages and the elements contained in them became the nodes and pathways of the perceptual map. The value-level concepts contained in the linkages were positioned at the top of the map, while the concrete, or attribute-level, concepts were positioned at the bottom. It should be noted that clear distinctions can not be made between attributes and consequences or the concrete and the abstract. But the general notion of increasing abstraction and personal definition from bottom to top is useful.

Lines were next drawn between concepts that were direct probes/elicitations in the laddering process. The result was a mapping of the most important distinctions (at a number of levels of abstraction) between soybean varieties as perceived by the soybean producers surveyed. This mapping provided not only the important elements but also the links between them. In essence, a perceptual map,

consisting of the means-end orientations of the soybean growers interviewed for soybean varieties, complete with elements and structure was constructed.

CHAPTER VI

RESULTS AND IMPLICATIONS

This chapter presents summaries of the twenty four interviews of soybean growers conducted to examine the manner in which growers view soybean varieties. The chapter profiles the growers interviewed, discusses the importance of several soybean attributes as rated by growers, and lists the distinctions between soybean varieties elicited by the growers. In addition, the perceptual maps regarding seed attributes and the public/private split, essentially what these constructs mean and how they affect choice, are presented.

Results

Subject Characteristics

As noted before, the sample for interview was drawn from six of the top soybean producing counties in Michigan, namely Saginaw, Lenawee, Monroe, Clinton, Gratiot and Shiawasee counties. Together soybean growers in these six counties accounted for approximately 45% of Michigan's total soybean acreage and production in 1987 (Michigan Agricultural Statistics, 1988).

The soybean growers interviewed are involved in a

number of enterprises in addition to soybeans. All interviewees raise corn, and nearly all included wheat in their farm enterprise. In addition, to these three predominant enterprises, most growers included at least one more enterprise in their business. A listing of the enterprises included, and the number of growers involved in these can be seen in Table 6.1.

Table 6.1 Subject Group Farm Enterprises

Farm Enterprise	Subjects Involved In Enterprise
Soybeans	24
Corn	24
Wheat	20
Oats	9
Alfalfa/Hay	7
Dry Beans	6
Beef/Steers	4
Hogs	4
Sugar Beets	3
Vegetables	3
Dairy	3

The total tillable acreage for the subject group ranged from 60 acres to just over 1900 acres, while the average farm size was 790 acres. This compares to a 1982 average of 213 acres for Michigan cash grain farmers (1982 Census of Agriculture), and a 1987 average of 202 acres for all Michigan farms (1987 Census of Agriculture - Advanced County Reports).

In addition to total farm acreage, soybean acreage over the past four years was recorded. Again, there was a large

range among the subject group in their soybean acreage. The smallest, largest and average soybean acreage for the group in each of the past four years can be seen in Table 6.2.

Table 6.2 Soybean Acreage for the Subject Group 1986-1989, Smallest, Largest and Average Acreage

	Acreage		
Year	Smallest	Largest	Average
1986	30	800	284
1987	30	800	303
1988	30	1000	315
1989(projected)	30	1000	353

Over the past four years the average soybean acreage for the group increased by nearly 25 percent. When individuals were asked their reason for increasing soybean acreage, "favorable soybean markets" were most commonly cited.

Again, this group's soybean acreage was much greater than a 1987 statewide average of 80 acres of soybeans per farm for Michigan soybean growers (1987 Census of Agriculture - Advance County Reports). While the 1987 average for the six counties represented was larger than the state figures (just over 100 acres of soybeans per farm), this average was still substantially smaller than the group average.

When asked how many years they had grown soybeans, the answers ranged from five to forty years. The group average

was just under twenty years.

Nine of the twenty four growers held degrees beyond high school. But it should be noted that four of these nine advanced degrees were in fields outside of agriculture. In addition, seven of the twenty four growers held off-farm jobs from which they gained "significant" income.

Because the initial source of the list (Cooperative Extension membership lists), and the limited sample size, the subject group is obviously not totally random and unbiased. It also appears from the above noted characteristics that the growers interviewed represent larger than average farms. Despite this drawback, a range in enterprises, acreage, experience and education is represented in the sample. In addition, the objective of the study is not to represent and characterize all soybean growers, but to describe this subject group's perceptions and their implications.

Measures of Attribute Importance

Two measures seeking to get at attribute importance were employed in the study. First, a distinction and "overall best" rating and correlation-type analysis examined the closeness of elicited attributes to perceptions of overall best varieties. As noted previously, through these simple correlations a sense of attribute importance was desired.

Because not all growers elicited the same attributes,

there were difficulties in conducting this analysis. As noted, seven distinctions/attributes were selected for correlation-type analysis based on pretest results. In all but four of the remaining interviews[1], these seven attributes were either elicited or provided, and varieties were then rated (1-4) with regard to these along with the "overall best" construct.

The cumulative results are presented in Table 6.3 and Table 6.4. In Table 6.3, the difference score frequencies are presented for each soybean attribute. For example, 4 of 20 farmers had a difference score of 2 or less for yield, while the other 16 had a difference score of between 3 and 5. Again, low difference scores for an attribute indicate closeness to "overall best," while higher scores indicate distance. Easterby-Smith (1981) refers to these as simple correlations, and as can be seen in Table 6.3, the number of people that more closely correlate "yield potential" to "overall best" is greater than for any other variety attribute. On the other hand, few people gave a close correlation between "ease of combine" and "overall best." And as can be seen, the difference scores for "new variety," "seed price," and "PRR resistance" were relatively spread out. A great deal of variation among individuals exists in their perception of the closeness of these attributes to

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[1] In four of the interviews recording errors or subject inability to name eight varieties prevented use of ratings in the analysis.

Table 6.3 Difference Score Frequencies (Number of Farmers) Between Soybean Attributes and "Overall Best"

Soybean Attribute	Frequency of Difference Score				
	0-2	3-5	6-8	9-11	12-14
Yield Potential	4	16			
Consist-ency	2	10	8		
Standa-bility		2	12	6	
New Variety	2	2	8	4	4
Seed Price		8	4	4	4
PRR Resist.		4	6	8	2
Ease of Combine			2	14	4

Table 6.4 Median and Mean Difference Scores Between Soybean Attributes and "Overall Best"

Soybean Attribute	Difference Scores	
	Median	Mean
Yield Potential	4.0	3.6
Consistency	6.0	5.8
Standability	8.0	8.0
New Variety	8.0	8.1
Seed Price	8.0	8.1
PRR Resist.	8.5	8.2
Ease of Combine	8.5	9.1

determining "overall best."

In Table 6.4, median and mean difference scores are presented[2]. These medians and means also indicate that "yield potential" is most closely correlated with "overall best," followed by "consistency."

In addition to rating varieties with regard to the seven attributes, all twenty growers directly ranked the attributes as to their overall importance. Table 6.5 and Table 6.6 present the results of these rankings. In Table 6.6, the frequencies with which each of the seven variety attributes were ranked 1,2,3,4,5,6,or 7 across the twenty growers is displayed. As can be seen, "yield potential" and "consistency" were ranked in the same manner, most often at the important end of the scale, followed by "standability." For most of the remaining attributes there was a relatively large amount of variability in rank. This was especially true for "seed price," which ranged in importance from second to last.

Table 6.6 presents the median ranks for each attribute. Again, "yield potential" and "consistency" rank high followed by "standability," with "seed price," "PRR

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[2] Both statistics are provided because of concerns over whether the rating scale was ordinal or interval. If ordinal, no information as to differences between scores can be surmised, and thus, the use of a mean is not appropriate. If interval, the ratings represent equal increments, differences can be compared, and means are appropriate measures. It is likely that the rating was interpreted in different manners by different subject. And this is a point that future interview design should address.

Table 6.5 Frequency of Importance Rankings for Soybean Attributes

Soybean Attribute	Frequency of Importance Ranking						
	1	2	3	4	5	6	7
Yield Potential	10	8	2				
Consist-ency	10	8	2				
Standa-bility		2	12	6			
Seed Price		2		4	6	2	6
PRR Resist.			4		8	6	2
New Variety				8	2	2	8
Ease of Combine				2	4	10	4

Table 6.6 Medians for Importance Rankings of Soybean Attributes

Soybean Attribute	Median Rank
Yield Potential	1.5
Consistency	1.5
Standability	3.0
Seed Price	5.0
PRR Resist.	5.0
New Variety	5.5
Ease of Combine	6.0

resistance," and "new variety" somewhere in the middle. "Ease of combine" appears to be the least important attribute for this group.

The two importance measures appear to indicate that "yield potential" and "consistency" are the most important, and "ease of combine" the least important, of these seven soybean variety attributes. The remaining four attributes fall somewhere in the middle, most often with a large amount of variation in importance across the group.

While the rating and ranking scores give some sense of attribute importance, there are flaws in the procedure. First, later interviews revealed additional attributes that were repeatedly elicited by growers (e.g. bean size, bushiness of bean, plant height). Because these were not elicited in the pretests they were not included in the ratings or rankings. Thus, important attributes may not have been included in the correlation-type analysis and ranking scales, and their importance not measured.

Along these same lines, the process of providing the attributes, when not elicited is flawed. While the majority of growers elicited most of these seven attributes, some did not elicit all seven. Forcing growers to rate and rank attributes not freely elicited, moves away from examining their behavior and perceptions. For some, "seed price" or "newness of variety" was not an issue, It was not a part of their cognitive structure. And any ratings and rankings

resulting from their interview may simply be to appease the interviewer, and/or justify their actions and perceptions.

In sum, the rating and ranking procedures and their analysis may have provided some sense of relative attribute importance, but it leaves much to be desired. In hopes of standardizing the process across subjects, attributes that may be of importance were left out, and subjects were forced to consider attributes that may not be important. In essence, this portion of the study fell into the common trap of dictating what is to be considered, instead of relying on subject perceptions. In this way, researcher interests are examined while consumers' behavior-directing interests may be ignored.

Summary of "Significant" Elicited Distinctions

While the preceding analysis and results examined seven of the many soybean variety attributes elicited, the remainder of the study sought to examine all "significant" distinctions, and their linkages. This was the emphasis of both the triadic sort and laddering procedures employed. At this point some findings regarding the procedures themselves should be noted.

First, as suggested by Gutman and Reynolds (1974), the triadic sort resulted in elicitation of distinctions that were predominantly soybean variety attributes. Consequences of attributes were occasionally mentioned, but no value-level distinctions were revealed. Thus, the laddering

procedure that followed the triadic sort was essential in encouraging subjects to elicit perceived consequences (i.e. "combining ease"), and the values they affect ("tension/in control"). With the "why" prompts, soybean growers revealed deeper meanings and desired endstates (or undesired endstates), such as "making a living," which result from links to product attributes and consequences such as "standability" and "realizing the stand."

Although the laddering process revealed these distinctions, it proved somewhat frustrating to some of the growers interviewed. For some, it seemed "obvious why standability is important. I end up with higher yields and that means I can make some money." Thus, "how," "in what way," and "what do you mean" questions were often necessary prompts. For instance, "How does standability result in higher yields?" Or "In what way are newer varieties riskier?" Such prompts helped the growers verbalize some specific distinctions between varieties that they perceived.

It should be noted that nearly all ladders led to the same desired endstate, namely "the need to make a living." The only other value-level concept elicited was a concern over frustration, tension, "being in control," and security. This result is most likely due to the nature of the stimuli.

Soybean varieties greatly differ from consumer goods such as breath fresheners. The reasons for their use have less to do with psycho-social consequences and values (i.e.

not standing out, self-esteem, independence) than for consumer goods. Soybeans are generally grown for more functional reasons (business purposes). Social consequences, such as neighbor acceptance or peer recognition, may exist, but they are likely smaller factors. In addition, soybean growers may not want to admit that such nonfunctional/"unpractical" concerns enter their decisions. Thus, consciously, or subconsciously, they rationalize their perceptions in terms of functional attributes, consequences and desired endstates. The result a common desired endstate of "making a living off of farm production" is elicited. Despite this nearly single endpoint for all ladders, the methodology proved useful. A large number of variety distinctions at a number of levels were revealed.

As previously noted, the first step in examining these results was to conduct a thorough content analysis. By sorting distinctions into concepts, the essential meanings were captured, and all responses were standardized. The results of this analysis are broken down into three sections representing distinctions for 1) soybean varieties in general; 2) public soybean varieties; and 3) private soybean varieties. Only those distinctions mentioned by six or more growers were considered "significant" and included in the content summaries presented in Table 6.7, Table 6.8 and Table 6.9. Each summary table lists the distinctions or standardized concepts, along with the level of abstraction

or corresponding element of the means-end chain model. Where illustrative, examples of the actual distinctions elicited are also provided.

It should be noted, that not all distinctions are easily classified by level of abstraction. For example, "yield potential" was elicited as a consequence of other factors such as "progressive," as well as a variety attribute itself. The same is true for "standability," "consistent yields" and others. Thus, a distinction's level of abstraction is not absolute. But, as noted by Gutman (1984), level of abstraction as a general concept is informative in thinking about a distinction's direct effect on choice, and centrality to consumer thought.

In Table 6.7, it can be seen that a total of twenty four distinctions pertained to soybean varieties in general. Again, there is a great deal of grey area, but approximately eight of these are relatively "concrete variety attributes" (the first eight in Table 6.7). Fourteen distinctions are of a higher level of abstraction, either more "abstract attributes" or "perceived consequences" of the attributes. The two remaining distinctions are of a value or desired endstate nature. These two endstates, "tension/in control" and "making a living," are the only two value-level concepts revealed in the study. And the later of the two was far more frequently mentioned.

Table 6.7 Summary of Elicited Distinctions for Soybean Varieties In General

Level of Abstraction	Distinction/ Concept	Examples
Variety Attributes	Seed Price	
	Big Bean	
	Bushy Bean	
	Tall Bean	
	Upright Bean	
	PRR Resist.	
	Not a Tough Stalk	
	Standability	
	Too Expensive/ Costs Less	
	"Cheap"	
Perceived Consequences	Germ/Emerg/Vigor	
	Weed Control	
	Getting A Stand	
	Combining Ease	
	Lower/Higher Yield Potential	
	Timeliness/Time Constraint	-slows me down, move right along,get done
	Cash Flow/Money Constraint	-need to watch the expenses, haven't got money to waste
Valued and Desired Endstates	Lower/Higher Actual Yield	
	Tension/ "In Control"	-really had to push, not sure I'd finish
	Making A Living/ Financial Success	-earn a living, turn a profit, it's a business

Table 6.8 and Table 6.9 present the distinctions elicited as a result of laddering the public and private distinction between varieties. As such, these tables reveal the list of perceptions that this group of growers has for public (Table 6.8) and private (Table 6.9) varieties. Many of the distinctions elicited for these two variety groups are the same or concerned with the same issue (i.e. "seed quality"), and they are often bipolar or monopolar opposites (i.e. "variable dealer quality"/"reliable dealers"; "less information and service from dealers"/"more information and service from dealers").

As seen in Table 6.8, a total of sixteen of the distinction elicited relate to public varieties, compared to nineteen for private varieties (Table 6.9). All distinctions for both variety groups (except the two endpoints) are actually "abstract attributes" or "perceived consequences" as they are perceptions regarding public or private varieties. Again, it proved difficult to classify these distinctions as attribute or consequence, because of differences between the manner in which subjects elicited them. For example, some growers indicated that "more visible/good reputation" resulted from "having more info and service from dealers," while others elicited the former distinction directly.

Table 6.8 Summary of Elicited Distinctions for Public Soybean Varieties

Level of Abstraction	Distinction/ Concept	Examples
	Var. Dealer Qual.	-a lot of difference btwn public dealers
Public Variety Attributes	Variable Seed Quality.	-some years good, some bad, germ lower than my own
	Less Info and Service	-dealers don't have as much info, no recommendations
	"Older" Varieties	-been around for yrs
	Unbiased	-objective info, scientific trials
	Germ/Emerg/Vigor Problems	
	Not as Visible	-don't see much about them, not pushed
Perceived Consequences	Consistent Yields	-dependable across conditions and yrs, count on descent Y
	Not Progressive	-less research, not competitive in tests "fading"
	More Search Time	-have to search for info, run my own test plots
	Timeliness	-took time to find what I want
	Low Yield Potential	
	Low Actual Yield	
Valued and Desired Endstates	Low Risk	-reliable,dependable
	Tension/In Control Security	-hate not knowing, less pressure, can control the outcome
	Making A Living/ Financial Success	-earn a living, feed family, make $

Table 6.9 Summary of Elicited Distinctions for Private Soybean Varieties

Level of Abstraction	Distinction/ Concept	Examples
	Reliable Dealers	-can count on them, have what I need
Private Variety Attributes	Poor Seed Qual.	-cracked seed, junk in bag, poor germ
	More Info and Services	-lots of info, recommendations, give me a bag to try
	"Newer" Varieties	-recent releases, experimentals
	Biased	-not objective info, take with a grain of salt
	Germ/Emerg/Vigor Problems	
Perceived Consequences	More Visible/ Good Reputation	-see alot about them farmer experience
	"Race Horse" Var.	-needs specific conditions
	Progressive/"New and Improved"	-researched improvements, cutting edge, better
	Personal Attention	-work w/ me, walk fields, farm visits
	"Proven Out"	-lots of trials, on-farm experience
	"Match to My Sit."	-recommendations for my soils, my needs
	High Yield Potential	
	High Actual Yield	
Valued and Desired	High/Low Risk	-unreliable,can(not) depend on them
	Tension/In Control Security	-pressure, just don't know,control
	Make a Living	-livelihood, make $

In sum, the content analysis identified the main categories used by the subject group to make distinctions. These categories/distinctions represent components of their means-end chains, or the nodes of their perceptual maps concerning soybean varieties, in particular public and private varieties.

Perceptual Maps

a. Summary of Maps

Utilizing the "significant" distinctions noted above, a structural analysis was conducted. A square matrix of the distinctions identified the most commonly perceived linkages between these. This recording procedure resulted in an asymmetrical dominance matrix that also identified the direction of the links, which distinction preceded (prompted elicitation of) which.

Using this matrix, Hierarchical Value Maps (HVM's) or perceptual maps for soybean varieties in general, and public/private varieties were constructed (Figure 6.1 and Figure 6.2). These perceptual maps diagrammatically represent the cognitive structures of the subject group. They are their cumulative means-end chains or ladders. The "significant" linkages[3] and the possible pathways or orientations are mapped out. Essentially, these perceptual

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[3] As noted in Chapter V, "significant" links are those connections between distinctions that were mentioned five or more times by the growers interviewed.

maps display the ways that soybean varieties, public varieties, and private varieties are perceived. As discussed in the previous section, the distinctions closer to the bottom of the map represent the less abstract, while those nearer the top of the map are the more abstract consequences and values/desired endstates that drive behavior with regard to soybean variety selection.

Figure 6.1 and Figure 6.2 illustrate that there are a large number of possible pathways. Attributes mean different things to different growers. The perceived consequences of the attributes differ. And the way subjects perceive that they can achieve the desired endstates varies.

For instance, Figure 6.1 shows that perceptions regarding "seed price" differ greatly. Some growers feel it is "not an issue." Others see price in a "too expensive" (privates) or "costing less" manner, and this has the consequence of hurting or helping "cash flow," and in the end, the ability to "make a living." Still others see "seed price" of publics as "cheap," meaning "lower yield potentials," "lower actual yield," and eventually the inability to "make a living."

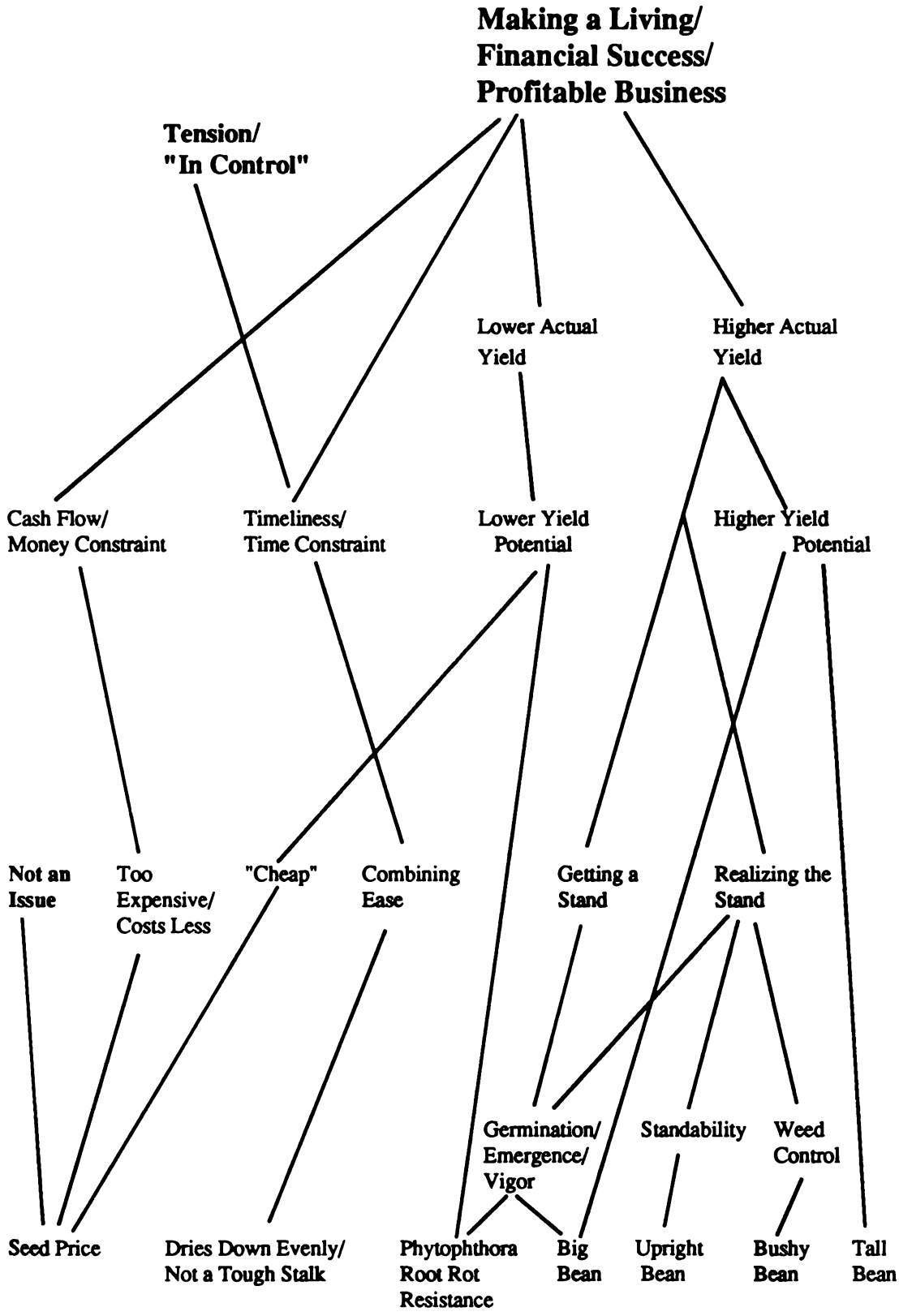

Figure 6.1 Perceptual Map - Soybean Varieties in General

Another illustrative example can be seen in Figure 6.2. Public varieties were often sighted as being "older." For some growers this was a positive distinction. It meant "consistent/dependable yields across conditions and years," with the consequence of "less risk," and a desired endstate of "making a living." For others, "older" meant "not progressive/non-competitive yields." These growers felt such varieties were fading with the consequence of "lower yield potentials," "lower actual yield," and the inability to "make a living."

Much can be inferred about the way soybean varieties are selected from these perceptual maps of soybean varieties (Figure 6.1 and Figure 6.2). In addition, simply through close examination of the maps, a great deal of information can be garnered concerning public and private differences. These significant links which are diagrammed out provide opportunities for understanding observed trends and for planning program strategies. But the examples above illustrate that the perceptions held vary, and pathways traveled differ even for the same attribute starting point and desired endstate. Just which means-end orientations are most important? Some idea of the common pathways or ladders is necessary in order to utilize the maps for situation examination, policy selection and program design. In addition, a closer look at which groups of soybean growers view varieties in which way may prove useful.

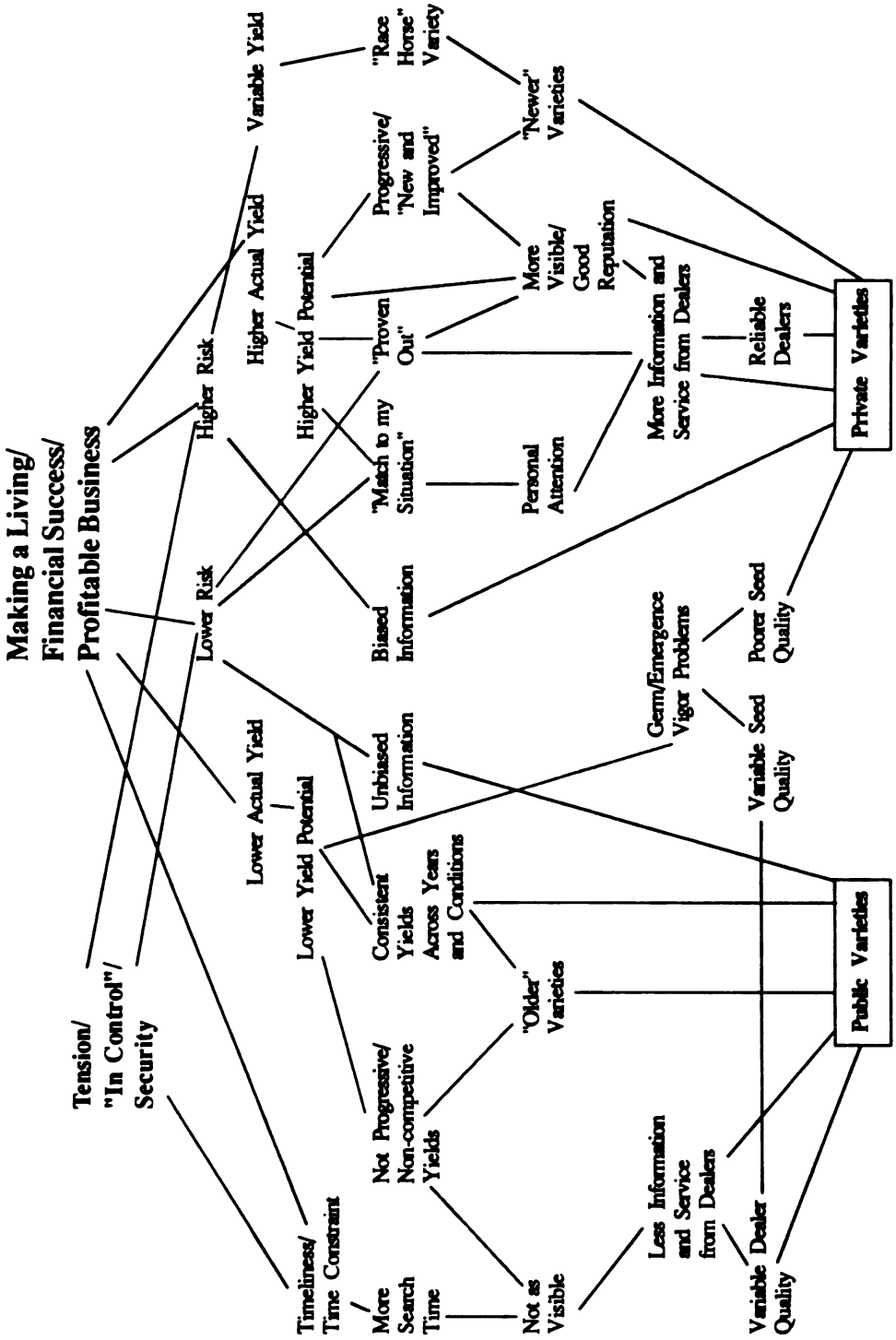

Figure 6.2 Perceptual Map for Private/Public Varieties

b. Most Common Perceptions

In Table 6.10, the seven most frequently elicited means-end orientations or ladders for soybean varieties in general are presented. "Most common" indicates that the full ladder (not just some of the linkages) was traveled by "many" subjects in the laddering process. The number of subjects eliciting the full ladder is presented along with the ladder components.

As can be seen, the ladder beginning with "standability" and ending with "making a living" was elicited by more than half of the growers interviewed. The "higher yield potential" ladder was also very common, and in this case "higher yield potential" represented a variety attribute (perhaps more abstract) not a consequence of other attributes. It is also of interest to note the frequencies of mention, of the different "seed price" ladders. Eleven of the twenty four growers stated that seed price was "not an issue." Six growers viewed seed price in a different manner and elicited ladder VII (Table 6.10). These seven viewed seed price as "too expensive" (private varieties) or "costs less" (public varieties) which impacts on "cash flow or money constraint" issues, affecting the ability to "make a living." Some of the growers (five) also cited seed price (of publics) as being "cheap" meaning "lower yield potentials"(Figure 6.1), and the remainder did not elicit any of these full ladders. Other common means-

Table 6.10 Common Means-End Orientations for Soybean Varieties in General

Number of Growers[a]	Ladder
15	(I) Standability ==> Realizing the Yield ==> Higher Actual Yield ==> Making a Living
12	(II) Higher Yield Potential ==> Higher Actual Yield ==> Making a Living
9	(III) Bushy Bean ==> Weed Control ==> Realize the Stand ==> Higher Actual Yield ==> Making a Living
9	(IV) Seed Price ==> Not an Issue
7	(V) Not a Tough Stalk ==> Combining Ease ==> Timeliness ==> Making a Living
7	(VI) PRR Resistance ==> Lower Yield Potential ==> Lower Actual Yield ==> Making a Living
6	(VII) Seed Price ==> Too Expensive(Privates)/ Costs Less (Publics) ==> Cash Flow/Money Constraint ==> Making a Living

[a] The number of growers eliciting the full ladder from start to finish

end orientations for soybean varieties, as elicited by this group of growers, are presented in Table 6.10.

The most common means-end orientations for these growers with respect to public and private varieties are presented in Table 6.11. Four ladders are presented for each "variety group," and these ladders reveal some contrasts between the perceptions regarding public and private varieties.

The most common public variety ladder elicited begins with "less information and service from dealers," and ends with "making a living" (Table 6.11). Because dealers of public varieties are seen as providing less information and service, farmers indicated that public varieties are "not as visible," and to them this means that these varieties are "not progressive/not competitive with privates." The general perception was that information and service are quality indicators. "If public varieties were as progressive and competitive as privates, they'd be pushed more by the dealers. You'd hear more about them." Thus, the ladder continues on with consequences of "lower yields" and potential difficulty in "making a living."

In contrast to this public variety ladder, is one of the most common private variety ladders. Eight of the growers felt that private varieties carry with them "more information and service from dealers." In this case, this information and service means that farmers "get personal

Table 6.11 Common Means-End Orientations for Public/Private Soybean Varieties

Number of Growers[a]	Ladder
	Public Varieties:
7	(I) Less Info & Service From Dealers ==> Not as Visible ==> Not Progressive ==> Lower Yield Potential ==> Lower Actual Yield ==> Making a Living
6	(II) "Older" ==> Not Progressive ==> Lower Yield Potential ==> Lower Actual Yield ==> Making a Living
6	(III) Consistent Yields ==> Lower Risk ==> Making a Living
6	(IV) Unbiased Information ==> Lower Risk ==> Making a Living
	Private Varieties:
8	(V) More Info & Service from Dealers ==> Personal Attention ==> "Match to My Situation" ==> Higher Yield Potential ==> Higher Actual Yield ==> Making a Living
8	(VI) "Newer" ==> Progressive/"New and Improved"==> Higher Yield Potential ==> Higher Actual Yield ==> Making a Living
6	(VII) Biased Information ==> Higher Risk ==> Making a Living
6	(VIII) Poor Seed Quality ==> Germ/Emerg/Vigor Problems ==> Lower Yield Potential ==> Lower Actual Yield ==> Making a Living

[a] The number of growers eliciting the full ladder from start to finish

attention." Salesmen make visits, "give me a bag or two of seed, and help me run some comparison trials." This allows these growers to best "match varieties to my situation," resulting in "higher yields" and "financial success."

Table 6.11 also points out the most common of the multiple paths for an attribute within a variety class (i.e. How is "older" most often viewed?"). As noted before, public varieties were often viewed as "older," and this distinction carried different connotations among growers. Table 6.11 presents the most common of these connotations. For six growers "older" indicates "less progressive," "lower yields" and failure to run a "profitable business." It should also be noted that three growers traveled a somewhat different, yet essentially similar pathway (older -> consistent yields -> lower yields -> profitable business). As mentioned before, other growers hold an orientation in which "older" means "consistent yields," "lower risk" and ability to "make a living." But this possible pathway for "older varieties" was not as frequently mentioned by this subject group.

Again, private variety perceptions contrast to this orientation to public varieties. Eight growers cited private varieties as "newer," "progressive/new and improved," with higher yield potentials and actual yields, resulting in a profitable business/ability to make a living.

The contrasts in common perceptions of public and

private varieties, and their relationship to desired endstates may explain some of the trends previously noted in this study (i.e. market shares). They may also prove useful in guiding policy selection and program strategies. In addition, some of the positive ladders for public varieties (i.e. consistent yields -> lower risk -> making a living; unbiased information -> lower risk -> making a living) may need to be emphasized in marketing and distribution strategies.

c. Grower Characteristics and Perceptions

While the common ladders mentioned above (and presented in Table 6.10 and Table 6.11), and the perceptual maps displayed in Figure 6.1 and Figure 6.2, may be of direct use, their use also depends on program goals and audiences. In light of this, it may prove helpful to examine just which growers elicited which ladders. What type of soybean growers hold a certain orientation for public varieties? In this way it may be possible to further reveal more about the current trends, and then to target strategies to specific audiences.

Although no cross tabulations on characteristics and perceptions were conducted, some matching of soybean grower characteristics to means-end orientations is possible. As a general proposition those growers that held relatively negative orientations for public varieties tended to be the larger farmers with education beyond high school. For

instance, all seven farmers eliciting ladder I (Table 6.11) planted more than 300 acres of soybeans, and had continued their education beyond high school. Likewise, all six of the growers eliciting negative orientations with regard with regard to "older" public varieties (ladder II, Table 6.11) were from this group. It should be noted that while this group did elicit these negative perceptions of public varieties, they also held some positive perceptions of public varieties (i.e. unbiased information). Some also felt that not all public varieties fit the above noted generalizations. Not all are "older and fading," and not all public variety dealers provide "less information and service." But the negative generalizations do dominate and affect the evaluation of those varieties and dealers that don't fit the mold.

When considering private varieties, these larger, more highly educated farmers more often held positive perceptions of private varieties and their attributes. For instance, seven of the eight eliciting ladder V (Table 6.11) planted more than 300 acres of soybeans and held more than a high school diploma. And all eight growers traveling ladder VI were of this group.

It is also of interest to note the "larger farmer" orientation to seed price. Nine of the eleven growers indicating that seed price is not an issue are of this group. Most of them echoed one farmer's perception that,

"At $6 more per pound all you need is one more bushel yield to make up the difference. It just isn't that big a deal."

In examining the smaller farmers orientations it is evident that this group is more positive with regard to public varieties and negative with regard to privates. For instance, four of the six growers eliciting ladder III (consistent yields -> lower risk -> making a living) plant less than 200 acres of soybeans. Likewise, all of those growers citing "new varieties" as "race horse varieties" needing specific conditions, resulting in "variable yields," "high risk," and problems with "making a living" (Figure 6.2) were from this group. Finally, five of the seven growers concerned with privates being "too expensive" and noting that publics "cost less" had less than 200 acres of soybeans.

Again, these generalizations are not from formal cross tabulations, but they do provide a sense of the type of growers holding certain perceptions and ladders for desired endstate achievement. As a general proposition, growers with larger soybean acreage, more education, and perhaps more progressive farming practices, feel that private varieties, and the programs from which they originate, are more progressive with higher yields. In addition, they note that these programs provide information and services that allow farmers to match varieties to their farm conditions and needs in order to obtain higher yields. On the other

side of the coin, this group feels that public varieties and programs do not have these positive attributes. Again, despite these generally negative perceptions of public varieties, these farmers do not rely solely on private soybean varieties. Most often some public varieties are also selected for specific conditions. Finally, this group tends to be less concerned, or not at all concerned, with seed price.

The generalization, for the smaller farmers is that they are more often concerned with high risk situations. They prefer what they see as "older" and more consistently yielding varieties. In addition, the smaller growers showed mistrust of private dealers, and their "seed propaganda." And they were more concerned with seed price than the larger growers.

Implications

The results reviewed in the previous sections of this chapter provide a great deal of insight into the nature of soybean grower behavior. This information illustrates how this study's subject group perceives soybean varieties, and how these perceptions relate to selection of varieties. In light of this knowledge, much can be inferred about what is happening in the seed industry. Some of the observed differences between public and private varieties, program philosophies, and market shares can be, at least partially, explained. In addition to explaining the situation, the

knowledge of soybean grower perceptions can inform choice. More appropriate and effective policies and strategies for public variety research, development and distribution can be selected[4].

Explaining Trends

As cited in Chapter II, plant breeders, Crop Improvement Associations, seedsmen and others have raised concerns over trends in public variety market share, as well as private variety seed prices and program philosophies. Some feel that if public and private soybean varieties are compared and evaluated on the basis of attributes traditionally believed to be most important (i.e. yield and disease resistance - Jeong 1988), public varieties should receive a greater market share than currently seen. In addition, they note that private varieties cost more than any added benefit is worth, and most of their new varieties are not really significantly improved. But the market share trends and grower perceptions revealed in this study, indicate that these traditional views of what affects variety selection are not sufficient.

While the traditionally upheld attributes appear in the grower perceptual maps (Figure 6.1 and Figure 6.2), their

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[4] It should be noted that the many of the strategies open to public programs are also open to private programs. And some of these strategies may have been implemented private interests. A content analysis of advertising efforts may be helpful in uncovering such strategies.

deeper meanings, and the existence of other distinctions, must be considered. Even if two varieties perform equally well in trials, the fact that they are public or private has a bearing on the manner in which they are evaluated. Referring to the language of Chapter IV, additional filters are likely applied. The varieties are typed by their source. Growers have ideologies or constructs concerning public/private varieties, and these affect evaluation and choice. The performance of soybean varieties is framed, not only by concrete and functional attributes such as yield, but also by their public/private grouping and the connotations that such a grouping carries. The framework within which that unit is viewed has a tremendous affect on comparisons and evaluation. And perhaps most importantly for viewing public/private differences, private firms have utilized and affected that framework applied to varieties, while public programs have not.

Figure 6.2 and Table 6.11 display the relatively dramatic differences in means-end orientations regarding public and private varieties. In addition, Figure 6.1 and Table 6.10 illustrate some other key soybean grower orientations and their affect on choice.

One of the traditional concerns of the public sector has been seed price. Often price cuts have been implemented in hopes of gaining market share, and as noted by Lawrence Copeland, destructive price wars frequently result. In

addition, several of the Crop Improvement Association officials, plant breeders and seedsmen contacted were unable to understand "why farmers would buy something that's no better for half again as much."

The perceptions concerning seed price that are presented in Figure 6.1 and Table 6.10 (ladders III and VII), reveal that the traditional notion of price, as held by many public seedsmen and others, is not the full picture. While some growers are concerned with seed expense, many feel that seed price is not an issue at all, even at "half again as much." Viewed from a lexicographic model of behavior, the price may still be within the appropriate range. Still others view the lower priced public varieties as "cheap" meaning lower yields (Figure 6.1). Thus, the perceptions revealed, indicate that price cutting may have an opposite affect on public variety market share, as Copeland noted. But this is not solely the result of reduced retailer margins. Price is also a quality indicator for many. Variety quality is evaluated not just by performance results, but also by price relative to others. Instead of a "less expensive" frame being applied, a "cheap" one is viewed by some growers. In this way, price cuts can hurt perceptions of public variety worth and ultimately their market share.

Another means-end orientation that sheds light on the industry situation is the orientation with regard to

information and service from dealers. It is evident from this study that the content of information concerning varieties (i.e. yield, standability) is not sufficient to explain choice. Perceptions and evaluation of varieties and the information are also highly influenced by the nature, extent and presentation of information. These factors affect the frame utilized by growers in evaluating varieties, and Figure 6.2 and Table 6.11 illustrate differences in means-end orientations for public and private varieties with regard to these factors.

Private interests have worked to actively provide information and service, and it appears that this effort has created and affected perceptions concerning private varieties. As seen in Figure 6.2, "more information and service from dealers" and "more viability" carries positive connotations. As a result of these efforts, private varieties are viewed as "proven out" and "progressive," with higher yields, enhancing potential profitability. These positive orientations to private information exist despite common perceptions that the information is "biased." And it appears that they result in a higher market share for private varieties.

As noted in the previous section, public varieties are not viewed in this manner. Because many public variety dealers provide less information and service, the varieties are seen as "less progressive" and "lower yielding." The

information and comparisons are available in the state performance reports put out by each state, but these are not actively distributed. Farmers must request these reports, and, good or bad, the reports are not formulated as recommendations. In addition, an "older" perception exists (see below), and this affects the use of the reports.

Public program failure to utilize the fact that more information and service, actively distributed, is a quality indicator has resulted in negative constructs being placed on public varieties. All else being equal, more information may allow private varieties to pass an additional filter. Or, using Prospect Theory language, less information and poor viability may frame the content of that information in a negative manner. The actual performance may be equal, but if framed in a negative manner, it is viewed as inferior. This may also explain some of the decreased public variety market share.

The "older/newer" variety distinction made by the growers interviewed in this study may also help to explain market shares and trends. As previously noted, public varieties are often viewed as "older," "less progressive," and lower yielding, while many view private varieties as "newer," "progressive/new and improved," and higher yielding. The positive frame placed on new varieties may have been affected by private marketing strategies, and certainly has been utilized by them. Meanwhile, public

efforts have not utilized this orientation to "variety newness," and have actually run counter to it.

As noted in Chapter II, private variety "lifespans" are generally much shorter than those for public varieties. In addition, private programs are noted for releasing more varieties more often, even if they are not "significantly" better. These two private sector trends, or development and release philosophies, may be the result of a realization that the above noted means-end orientation for "new varieties" exists. Even if not significantly better by some scientific standard, the variety is "new and improved" with a higher yield potential" to the consumer. Thus, the trends of decreased time on the market and more frequent release have affected perceptions regarding private varieties, and utilized such perceptions already in existence.

It should also be noted that this "rapid release policy" also combats the bin run/exclusion difficulty. If a variety can be differentiated as "new and improved," it will be adopted and past varieties will be retired. If new releases are made over relatively short periods, purchases will be more frequent. In essence, an orientation that "new equals improved" means that "old" varieties and bin run seed, even if the same in performance and genetics, will no longer be used.

Meanwhile, public programs have not affected or utilized perceptions concerning "old" and "new" varieties.

Traditional lengthy release procedures and policies of leaving truly old varieties in performance trials may have negatively impacted means-end orientations for public varieties. "Public varieties hang around and even if they're new the fact that it takes so long to get them to market means that private varieties have beaten them to the punch." This general perception is no doubt part of the frame utilized by growers in evaluating public varieties, and ultimately it has hurt their market share.

The main point of these three examples of means-end orientation impacts on market shares is that the perceptual maps of this study's subject group reveal perceptions and deeper meanings that affect choice and explain what is being observed. This emphasis here is not on traditionally upheld beliefs concerning the key attributes, but on what growers actually think. Again, these perceptions/means-end orientations that do affect choice (i.e. seed price, information and service, and old/new varieties) may have nothing to do with actual values, information content or variety performance. One unit does not always equal one unit. Instead, the frame within which that unit is viewed affects the what is seen.

The fact that these views/orientations/frames are not measurable in performance trials, the market or elsewhere does not make them less real. They are part of the seed consumer's reality. They are the way growers make sense out

of all the possibilities. Perhaps some higher priced varieties once yielded much better, and higher priced varieties are now framed as better yielding. Perhaps the fact that information and service from private dealers is more extensive, up-to-date and readily available than that from public dealers affects the frame put on the actual content. Given equal performance, perhaps information and service is an additional filter that privates pass and publics fail. At some time it was likely that new varieties were substantially better. A positive means-end orientation for new varieties developed, and private interests have utilized this.

In summary, the perceptual maps revealed in this study can, and do help to explain market share trends, as well as some of the different emphases and philosophies of public and private programs. And as will be seen in the following section, these perceptual maps, can be utilized by the public sector, as well as the private sector, to more effectively address its concerns and goals.

Informing Choice

It has been noted several times that choice of policies, strategies and procedures is dependent upon the goals of the institution. In Chapter III, alternatives regarding research and development emphasis, release policies and procedures, and marketing and distribution modes were reviewed. It was noted then that certain choices

have been made, alternatives pursued, based on decisions determining which goal(s) is(are) paramount. Agricultural Genetic Research Association (AGRA) was founded, and its relationship with Ohio State University developed, around the primary goal of increasing support for research. Other efforts such as Minnesota Public Seeds (MPS) were undertaken for different goals. Likewise, different policies may be implemented for different target groups or publics to be served. The point to be made is that the goal, or goals, desired must first be defined.

In light of the need for goal definition, the only overall and "safe" recommendation that can be made is to utilize the results of this study to achieve the program's goals. The perceptions revealed, the nature of farmer behavior uncovered, in this study can help in putting goals into action. Efforts must not run contrary to farmer perceptions. Policies must address audience needs as the audience sees them. Strategies must be formulated to affect and take advantage of farmer orientations. It is not enough to provide the concrete attributes in high levels or appropriate combinations. The frame with which these are viewed must also be considered. In essence, the all encompassing recommendation is for the public sector to get in tune with grower perceptions regarding the factors that affect their varieties and programs. Perceptions, not just measurable realities, matter, and these should be utilized

and/or affected to set the frame for variety and program success, however that may be defined.

It is evident that a number of possibilities for using the results of this study of soybean grower perceptions in reaching policy decisions exist, again depending upon the goals and audiences to be served. As noted by Reynolds and Gutman (1984a), any of the means-end orientations/ladders of soybean growers provide an opportunity for strategy development (in particular, marketing strategy). Olson and Reynolds (1983) state that marketing strategies need to select values or endstates that will be emphasized. They must determine how information, service, promotion, and the like will connect the product to these key endstates. And finally, the specific product attributes must be selected and communicated in the above manner to connect the product to desired endstates. In the language of Chapter V, the strategy must utilize core constructs, key attributes, and the linkages revealed here, to develop and distribute varieties that are framed in a manner that results in positive evaluation and product selection.

The previously noted manner in which private programs have undertaken an R&D philosophy and marketing and distribution strategy to frame their varieties as "new and improved" is a perfect example of the use of a means-end orientation in policy and program formation. Public programs have not utilized this positive orientation to

"new" varieties, and have actually run counter to it, resulting in a commonly held negative frame of "old" and "not progressive" public varieties. If increased public variety market shares are desired, changes will have to made in these public R&D and distribution practices.

While it may not be desirable or politically feasible to change certain practices (i.e. lower the standards of significantly improved), other procedures could be changed. For instance, truly old, non-competitive varieties should be removed from public variety lists and trials. This may improve the frame applied to other public varieties. Release procedures could be stream-lined to reduce time to market, again, improving the frame applied to public varieties.

One option along the same line of concern was suggested by a farmer. The idea is that public institutions could release some "experimentals" along with "proven varieties." By releasing more material through an "experimental" label, an image of public programs being progressive, with lots of research, working to make improvements may be created. This may improve the way all public varieties are perceived. In addition, there is obviously a group of farmers wanting the latest material, and they would be willing to take the chance on "experimentals." Finally, by developing a separate "experimental" label, the quality of tested and proven traditional release materials as significantly better

and trustworthy is not eroded. This farmer's suggestion essentially segments the market. Programs need not go all one way or all the other way. By segmenting the market different audiences may be served, and several concerns may be addressed[5].

It may also be possible to take advantage of the positive means-end orientation for "older" public varieties (Figure 6.2). From this study of soybean growers it appears that some growers desire "older," consistent yielding varieties to reduce the risk. This existing perception should perhaps be emphasized in marketing efforts, at least for a target group holding such perceptions. As noted, this group appears be made up of predominantly smaller farmers. In targeting this audience, emphasizing their perceptions and desired endstates, improved market shares may result.

Another example of private program success, and opportunity for public program improvement, revolves around the ladder(s) concerning "information and service from dealers" (Figure 6.2 and Table 6.11). The contrasting perceptions of private (more information and service) and public (less information and service), and their ladders to desired endstates, indicate that public program changes should address some of the previously noted concerns

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[5] This segmentation option may also exist for price. For instance, different pricing schemes may "fit" for those concerned with reducing costs, and those concerned with cheap meaning poor quality. In this way, programs need not commit totally one way or the other.

relating to marketing and distribution. As one seedsmen characterized public marketing efforts, "little attention is paid to maintaining an image of quality in both product and service," and this seedsmen's perception is reflected in the perceptual map for this study's subject group. In addition, the orientations for "seed price" reveal that current trends of lower prices for public seed, and price cutting efforts, may actually hurt their image, and market share.

In light of these orientations, some of the efforts to gain increased control and coordination over the manner in which public materials are marketed and distributed may be needed. Exclusive release to such organizations as AGRA, or Lakeside States, Inc. may be of help. Granting exclusive use to such groups will likely provide incentives for them to promote, provide services and control quality. But such efforts are not the only possibilities.

If restricted access is not a desirable or appropriate policy for some public institutions, efforts to improve the functioning of the present public variety distribution channel may be selected. Public variety seedsmen need to hold the line on price, perhaps even raise it. They need to actively provide information and service. Public programs may need to be more visible. A statewide public variety promotion group could be established to undertake such efforts. Roadside farm test plots, and provision of "a bag or two of seed" for farmers to try, are specific services

cited by farmers as improving viability, and indicative of variety "progressiveness" (Figure 6.2 and Table 6.11). In addition, "recommendations that match varieties and practices to my situation" are part of a common positive ladder for private varieties, and one that could be developed and utilized by the public programs.

These two farmer orientations (older/newer varieties and more/less information and service) revealed in this study of soybean grower perceptions indicate that new policies and practices are needed to improve the marketing and distribution of public varieties. Fee and royalty policies may help raise funds for research, but changes in the distribution channel may be needed to raise market shares. These changes may involve exclusive royalty bearing release, but other opportunities, such as increased and improved marketing efforts, may be useful. Such options do not rely on restricting access, and the use of exclusive rights which are only partially enforceable. In addition these efforts do not raise germplasm restriction concerns.

On the other hand, there are implications of increased marketing efforts that need to be considered. In essence, some would ask, what are the results of the public sector "joining the private sector" in promotion? While it may be necessary to get market share, ensure variety use, and/or support program efforts, not all results may be desired. Some would argue that the added costs of marketing and

promotion resulting from "joining the game" do not add value. Perhaps it simply adds costs, confuses the situation by increasing the flood of information, and takes the public sector out of their "objective" role.

This study also revealed that some specific soybean attributes carry certain perceptions that should be considered. Phytophthora root rot (PRR) resistance is an example of a specific attribute that may need to be handled carefully in information presentation. As can be seen in Table 6.10 (ladder VI), PRR resistance was very frequently associated with lower yield potentials. A common grower statement was, "I only use resistent varieties if I've had a problem. If I haven't had any problems in a field, I use non-resistent varieties. You just lose too much yield with resistance." Discussions with plant breeders reveal that most varieties have some degree of PRR resistance, and some of the newer varieties with higher yields are simply an older variety with PRR resistance added. Thus, from a "scientific" perspective, PRR resistance does not really mean lower yield potentials, in fact it helps to combat root rot and raise yields. But this is not the grower perception (unless PRR problems have been experienced), and so, it is not their reality as they select varieties.

The grower means-end orientation to PRR resistance indicates that variety evaluation is likely framed by perceptions regarding PRR resistance. For instance, if a

variety is pushed as, and predominantly viewed as, a PRR resistent one, it is framed as having a lower yield potential. Even if the "reality" is that its yield results are better than other varieties perceived as nonresistant, this is not the reality seen by the grower. The yield results are negatively framed by the perception that the variety is PRR resistent. The "reality seen" is that the resistent variety has a lower yield potential than does a variety viewed as nonresistant (even if this variety actually has resistance). Again, one unit does not always equal one unit; the frame affects the performance comparison.

The implication of the negative frame for resistent varieties is that while PRR resistance information should be provided, it should not be dominant. Varieties should not be labeled or pushed as "PRR resistent." This study indicates that if a resistent variety is desired, it will be sought out and selected. But if not needed, varieties viewed as PRR resistent will be avoided, while others not viewed as resistent (even if they do contain resistance) are selected.

Another option for action is to affect the perception of PRR resistent varieties. Such an activity may be part of the educational mission of the land grant system, and may involve articles that specifically address this "misconception" of PRR resistent varieties. An educational

effort may influence the perceptions concerning PRR resistance, and change variety selection.

Two other variety attributes that appeared of importance to several growers were "bushiness of bean" as it relates to "weed control," and "toughness of stalk" as it relates to "combining ease." While these distinctions have not traditionally seemed of importance to "making a living," they were relatively frequent means-end orientations for the growers interviewed (Figure 6.1 and Table 6.10). As such it may prove useful to growers, and helpful in gaining market share, to provide information regarding these attributes. In lexicographic terms, these may not be the most important attributes, or filters used in variety evaluation, but they may be additional ones that, given equal performance in other areas, allow a variety to pass an additional filter and be selected.

The perceptual maps may also prove useful in considering the future role(s) of public programs. These maps reveal some of the roles deemed important by the soybean growers studied. While private varieties were generally held in a more positive light, public varieties and programs also had positive merits in the subject group's eyes. As a source of "consistent yielding varieties" and "unbiased information," public programs are important in helping many achieve a desired endstate of "making a living." In light of this, it is evident that farmer

support for variety development and evaluation roles exists. And for many growers, even those with predominantly positive orientations to private varieties, these roles, especially unbiased evaluation, are essential. Common statements were, "If I'm not sure of the information I've got, I can count on university data." And, "If I don't know what conditions I've got, I often use an older consistent public variety that I know." Thus, the traditional public sector roles of variety development and evaluation are important and should be continued. Any policies that alter these traditional roles, or the ability to perform them, are not likely to be received well by growers. And one result of such policies may be reduced support from the traditional constituents and supporters of public programs.

Again, these are but a few examples of implications of the results of this study for informing choice. Many policies (i.e. restricted royalty bearing release) raise a number of concerns regarding conflicting interests and goals. Decisions regarding many of these must be made based the goal and emphases of the institution. In addition, some of these options rely on plant material ownership and restriction of use, and these rights are somewhat limited by the reality of exclusion costs. Other policies (i.e. marketing and distribution efforts) do not raise such concerns, and the perceptual maps, and specific means-end orientations, provide a number of opportunities for

informing choice with regard to such efforts. Past trends can be explained. Past efforts can be reviewed. Some of the options can be evaluated. And a number of strategies can be developed in light of the findings. All of this must take into consideration the desired goals and audiences to be served. Upon definition of these goals and audiences, specific policies and procedures can be, and should be, formulated to work with, utilize and/or affect the perceptions of soybean growers who ultimately determine program success or failure through their behavior with regard to variety selection.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Summary

Situation

In the United States, plant varieties are commonly classified as public or private by their source of development and release. These two sectors are made up of a number of participants that have traditionally been closely tied in symbiotic relationships. Private interests have been dependent upon public sector germplasm, basic research, and plant breeder training. Public interests have utilized materials developed in the private sector, and received a great deal of research support from them. The result has been a complex set of interrelationships working in a loose collection known as the seed industry.

While these two sectors have worked cooperatively, their goals, policies and procedures greatly differ. Because of the reality of the situation facing private firms, their primary goal must be profitability. All other goals, policies and procedures must support the need to survive financially. The public sector's goal (the land grant mission) of serving the public good is much less concrete. Its definition includes a broad spectrum of roles

and responsibilities from variety development to education and training. Again, the result is a complex set of interrelationships between a large number of industry participants with a variety of goals, emphases, policies and procedures.

A number of relatively recent developments have heavily impacted upon the seed industry. The tremendous opportunities made possible through biotechnology have increased the potential for, and interest in, plant research and development. These opportunities have also placed new demands upon old research programs and their budgets. At the same time, research funding has become increasingly tight. In addition, funding sources have changed, and research directions have been altered. Finally, the possibility of patent protection for plant varieties and plant materials has generated interest in the exclusive ownership and use of such materials. Through such mechanisms some see market opportunities for gaining returns on plant research investments, while others see restriction of germplasm exchange and use.

In addition to these developments, several trends have been observed with both interest and concern. Private sector input (expenditures) into plant breeding and research and output (variety development and release) from these efforts, has increased, while public sector efforts have remained relatively constant. In the soybean industry,

private variety numbers have increased tremendously. Not only has the amount of private material increased, but its use has grown as well, and it appears that public variety market shares have suffered. At the same time that private varieties seem to be gaining market share, their price, relative to public varieties, is higher. Finally, many note that this flood of "new and improved" private varieties is neither new or improved. These new releases "just are not that much different."

These developments and trends have greatly affected the seed industry. The participants, their relationships, their goals, and the "rules of the game" have changed, or been pressured to change. This change in institutions, and the environment within which institutions operate, presents possibilities, raises concerns, spurs debate, and necessitates choice. In essence, the complex set of participants and interrelationships, known as the seed industry, is changing its form, and the resulting form is being determined by private and public sector policy and procedure choice.

The choices being made, by the public sector in particular, involve the very nature, or definition, of basic goals. How can the land grant mission best be served? What roles and procedures should be continued, changed and/or eliminated as a result of the new environment? The proposed changes, options and debate specifically concern research

emphases and program roles (i.e. variety development vs. basic research), variety release policies and procedures (i.e. nonrestricted vs. exclusive royalty bearing release), and marketing and distribution modes (i.e. traditional limited efforts vs. increased control and coordination of marketing and distribution).

Objectives

Although many have offered opinions, and the pros and cons of many of the issues have been debated, little supportive research has been conducted. The wealth of options has not been explored, and their effects have not been concisely laid out. In addition, the many observed trends have not been explained in light of what the force that drives the industry - farmers as variety consumers - perceives. Finally, the effects of farmer perceptions, and behavior with regard to variety selection, upon variety and program success or failure have not been examined.

The basic premise of this study has been that the perceptions of farmers, with regard to plant varieties are essential to understanding trends and public/private program successes and failures. The manner in which producers view seed determines their choices, and ultimately the fortune of breeding programs. In addition, knowledge of these perceptions provides opportunities for informing choice. Strategies can be developed, and must be evaluated, in light of consumer perceptions. Programs must be in tune with

reality as seen by farmers, not economists, plant breeders or administrators. It is necessary to find out the key product attributes desired, the perceptions with regard to these attributes, and the manner in which these are linked together to drive behavior. With such information, trends can be explained, efforts reviewed, options evaluated, and strategies formulated.

Methods

As a commodity group where many of the previously noted changes and trends are being widely observed and felt, soybeans were selected for further study. Next, in hopes of addressing the lack of information available to guide choice, this study took an in depth look at the soybean seed industry situation, and some of the specific public sector changes and options being proposed. By simply laying out the background, the possibilities, and much of the debate, a great deal of supportive information is provided. And based on desired goals and emphases, some decisions can be made.

But additional information is needed, and this study particularly sought to uncover some of this. The study was designed to reveal soybean grower perceptions and behavior, and their implications for variety and breeding program success. Thus, a behavioral framework was developed to examine these issues. This framework was developed based on a notion that varieties and programs have attributes that have use consequences, and these affect upon the values or

desired endstates of growers. The framework was next operationalized, and implemented to investigate the perceptions of a group of Michigan soybean growers.

Results

The interview of twenty eight soybean growers revealed a number of interesting and useful perceptions. A range of distinctions between soybean varieties, and public and private programs were elicited (Table 6.7, Table 6.8, Table 6.9, Table 6.10). These distinctions provide the basis for constructing a perceptual map made up of specific perceptions and their relationship to desired endstates that drive behavior. In essence, they show what growers see as being important, and how this affects variety choice.

These findings displayed a dramatic contrast between how growers view public and private varieties. As a generalization, it must be stated that the public varieties are not viewed in as positive a light as are private varieties. In particular, they are often viewed as "older," "less progressive," with "lower yield potentials," while private varieties are frequently perceived as "newer," meaning "progressive/new and improved," and higher yielding.

Another specific contrast between public and private varieties concerns "information and service from dealers." Public seedsmen are commonly cited as providing less information and service, meaning that public varieties are "less visible." This carries a connotation that these

varieties are "not progressive/non-competitive" compared to private varieties, and thus, they are lower yielding. Private dealers, on the other hand, "provide more information and service," "give personal attention," with the perceived consequence that varieties can be "matched to my situation" for higher yields.

These are but two perceptions regarding public and private varieties. Numerous others were revealed and provide a complete picture of the manner in which soybean varieties in general, as well as public and private soybeans are viewed. In addition, the manner in which these perceptions are linked to the achievement of (or failure to achieve) the dominant desired endstate of "making a living" are revealed. And this link displays the force that drives behavior.

Conclusions

Implications for Soybean Seed Industry

The perceptions concerning soybean varieties, and particularly the contrasting perceptions of public and private varieties, have implications for the way the soybean industry does business. Specifically, the previously noted contrasting perceptions ("old/new varieties" and "more/less information and service") may explain some of the market share trends, and provide support for policy selection.

It appears that public varieties are frequently viewed as inferior, not based on actual performance, but on the

noted negative distinctions between them and private varieties. These negative perceptions frame all comparisons, and hurt the evaluation and use of public varieties. Meanwhile, the positive orientations for private varieties indicates that they are favorably framed, supporting their evaluation and sales.

As noted previously, many of the policy choices require definition of desired goals and emphases. Some of the material contained in this study which lays out the situation, options and debate may support these choices.

The study's examination of grower behavior also provides needed information. The perceptions of growers not only explain some of the situation, but they also provide opportunities for addressing concerns. For example, by simply removing the truly old varieties from public variety lists, the "old" perception that now exists for public varieties may be eased. "Experimental" releases, labelled as not yet proven, may help create a "progressive/new and improved" perception for public programs. Simply by releasing more varieties, more often perceptions can be changed. Marketing efforts emphasizing the positive perception revealed through this study for "consistent yielding" public varieties as "not as risky" may help to gain market. Increased provision of information and service, such as recommendations, a free bag or two of seed, and the like, may improve orientations toward public

varieties. Each orientation/pathway within the perceptual maps provides an opportunity that may prove helpful to program planners.

The most important implication of this study is that "a dollar is not always a dollar." The situation, the environment, the perceptions, the frame within which that "dollar"/variety performance is viewed greatly affects the evaluation of the variety. Private interests have realized this fact, and utilized positive orientations to certain factors (i.e. variety newness) to ensure that their varieties' performance is framed positively. The result is increased private variety market share, and program success.

Public programs have not realized this fact about the reality of perceptions. The real, but uncertain, world of the farmer perceptions that drive behavior has been ignored by many in favor of a scientific measurable world (of absolute yields, price levels, etc.). The result is a public breeding program that is out of touch with reality. "Good" public varieties may be developed, but if not presented in a "good" frame, such efforts are lost. Public programs must change to adapt to the new institutions and environment. And these changes must be made in light of program goals. But once the goals are defined, in whatever manner, public research, development, and especially distribution efforts, should work with, utilize and/or affect the perceptions of farmers as variety consumers who

ultimately determine program success or failure.

Suggestions for Future Research

This study did reveal a great deal of information concerning the perceptions of the soybean growers interviewed. The procedures employed in the study proved to be appropriate and useful. But a few changes are suggested.

As noted, the rating and ranking procedures, did provide some sense of soybean variety attribute importance, but they were flawed. Future procedures seeking to evaluate attribute importance as perceived by subjects should rate and rank only those attributes elicited by the subjects. Subjects should not be forced to evaluate and justify attributes that may not be of significance to them. In addition, any scales should be clearly developed and communicated to the subject group to avoid confusion as to whether the scale is ordinal or interval.

Since this study was useful in revealing this group's perceptions, it may prove useful to expand the effort. A larger sample, or targeted sample, may help to expand, and support or refute, the results of this study. While the process is time consuming, much is uncovered, and further investigation may help to examine some of the particular perceptions revealed here.

The research also uncovered the need for other discussions concerning a variety of topics. A review of possible royalty schemes may be of use. Currently, there is

much concern over "inventor shares" in royalty payments and the effects they have on incentives and working relationships. As briefly noted, a content analysis of private variety advertising and promotion may reveal successful efforts to utilize and/or affect perceptions to advantage. Research concerning perceptions regarding bundles of input goods (i.e. seed, fertilizer, herbicides, insecticides) may be of use.

Finally, it should be noted that the policy options appear limitless, and thus, so may the research opportunities and needs. Much experimentation with policies and procedures has, and will continue to, occur. Any research examining the effects of such efforts will only help to shed light on a complex and controversial topic.

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