ADOPTION OF PEANUT INTEGRATED PEST MANAGEMENT (IPM) PRACTICES IN ATOKA/BRYAN COUNTIES AND CADDO COUNTY OF OKLAHOMA

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ADOPTION OF PEANUT INTEGRATED PEST

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OF OKLAHOMA

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CHAPTER I

INTRODUCTION

A Brief Historical Sketch of Peanut Production in Oklahoma

Peanut production in the United States in the late 1800's was similar to those in developing countries, because United States farmers produced peanuts only a few acres per farm, dug in the fall, picked by hand from the vines, washed them thoroughly, spread on the sheds to dry, and parched them for eating during the winter (Woodroof, 1983). Thus, before they were established as a permanent part of agriculture, industry, and human diet in the United States (Woodroof, 1983), peanuts were first produced for fattening farm animals such as pigs, turkeys, and chickens. The invention of equipment in about 1900 for cultivating, planting, harvesting, and picking the nuts from the plants, and for shelling and cleaning the kernels has contributed much to the expansion of American peanut production (Woodroof, 1983).

The peanut industry in the United States grew rapidly after the American Civil War, and World War I (Woodroof, 1983). Of the factors that helped the expansion of peanut industry, the high food quality of peanuts and peanut products seem to be important. Burns and Huffman (1975) observed that peanuts are an excellent source of riboflavin, thiamin, and nicotinic acid and are high in calories due to their fat and protein content. Peanuts also have a pleasing aroma and flavor, crunchy texture, high energy value, and protein (Johnson, 1964; Burns and Huffman, 1975).

Literature indicates that several people helped the peanut rise from its early status of animal feed and children's snack food to one of the world's major industrial crops. Critical needs that were met were improved peanut varieties, and the invention of production technology such as those used for harvesting and processing of the peanuts. Of those people who gave international publicity to the peanut, two outstanding names are Amedeo Obici, who founded Planter's Peanut Company, and an African-American biochemist, George Washington Carver, who found over 300 ways of using peanuts, among other things (Johnson, 1964; Burns and Huffman, 1975).

Peanuts are grown in the three principal areas in the United States: the Virginia-North Carolina Area, the Southeast Area which includes Alabama, Florida, and Georgia, and the Southwest Area indulging Texas, New Mexico, and Oklahoma (Woodroof, 1983).

Song (1970) observes the United States is the fifth among the leading peanut producing countries in the world, with the largest acreage and the largest production among the countries in the western hemisphere.

Peanuts are one of the six basic United States' farm crops valued at more than $500 million annually. The United States produces more than four billion pounds of peanuts per year, which is about eight per cent of the total world's output (The Oklahoma Peanut Commission Report, February 25, 1986). Beginning from the American Civil War to the present, the continuous increase of the number of people involved in the production, processing, and in the sale of peanuts has affected both the peanut industry and the economy of the United States. An Oklahoma Peanut Commission report (The Oklahoma

Peanut Commission Report, April 30, 1986) states that there is no other country in the world which utilizes the full potential of the peanuts as a food as does the United States of America.

Literature indicates that Oklahoma has produced peanuts since 1905 (Chaffin, 1945; Self, 1947; Ligon, 1953; Green, 1977, 1990; Chrudimsky and Tucker, 1967; Leslie and Cuperus, 1993, Sholar, 1996). The major crop during the early years, 1896-1913, was corn (Green, 1990). It is stated that in 1905 the corn acreage was more than 3.4 million acres and the average annual production was 32.4 bushels per acre. At this time wheat, the second major crop, was grown on 1.5 million acres, while cotton became the third major crop in 1907 with 862, 000 bales of cotton harvested (Green, 1990).

The Oklahoma Agricultural Experiment Station was founded by the first territorial legislature in October of 1890 (Green, 1977) for agricultural research. At this research station, experiments on the fertility of peanuts were being developed, (Chrudimsky and Tucker, 1967). Furthermore, Ligon (1953) reports that experiments were also conducted on peanut varieties at the first experiment station as far back as in 1930 in Stillwater. However, the peanuts' importance as a farm crop prior to 1940 was small (Chaffin, 1945), the average annual acreage being 56, 000 acres, and mainly grown in the southeastern part of Oklahoma.

Large quantities of vegetable oils (Chaffin, 1945) were annually imported into the United States prior to 1941. With the beginning of World War II, these imports were stopped. It was necessary for U.S. farmers to expand peanut acreage and those of other oil-bearing crops to increase production, both for domestic needs and for exports. Peanut varieties recommended for planting in Oklahoma, on the basis of their yields, were

Argentine, Dixie Spanish, Spanish 18-38, and Spantex. Other varieties of peanuts tried include Tennessee Red, Jumbo, and Runner (Ligon, 1953).

Through the use of fertilizers, improved seed varieties, and better methods of cultivation, Oklahoma farmers were able to improve yields (Green, 1977). Although peanuts are a difficult crop to raise and losses often are over 50% from diseases, weeds, and insects. Input costs are also high including machinery and scouting costs. Oklahoma growers were able to produce more peanuts for domestic use and for export (The Oklahoma Peanut Commission Report, April 30, 1986).

A Short History of Social Evolution in the Research Sites: Atoka/Bryan, and Caddo Counties

Atoka County

Atoka County, originally called Champamay (Shingleton and Waterson, 1977; Oklahoma Almanac, 1995-1996), is located in southeast-central Oklahoma. The county comprises Indian Territory Recording District No. 23 (Shirk, 1974). It is bounded on the east by Pushmataha County, on the west by Johnston and Coal Counties, on the north by Pittsburg County, and on the south by Choctaw and Bryan Counties. Atoka County has an area of about 992 square miles, or about 634, 880 acres (Inventory of the County Archives of Oklahoma, 1941; Shingleton, and Waterson, 1977).

This county is named for Captain Atoka, a prominent Choctaw Indian who led a band of his people to this area. The name is from a Choctaw word hitoka or hetoka, meaning "ball ground" (Shirk, 1974; Oklahoma Almanac, 1995-1996). Atoka, the county seat of Atoka County, is one of the ten Oklahoma seats of government that bear the same name as the county (Inventory of the County Archives of Oklahoma, 1941).

Table 1. Population by Census Year, in Atoka, Bryan, and Caddo Counties, Oklahoma 1907-1990

Year	Population in the Research Sites		
	Atoka County	Bryan County	Caddo County
1907 (Statehood)	12, 113	27, 865	30, 241
1910	13, 808	29, 854	35, 685
1920	20, 862	40, 700	34, 207
1930	14, 533	32, 277	50, 799
1940	18, 702	38, 138	41, 567
1950	14, 269	28, 999	34, 913
1960	10, 352	24, 252	28, 621
1970	10, 972	25, 552	28, 931
1980	12, 748	30, 535	30, 905
1990	12, 778	32, 089	29, 550

Source: Oklahoma Almanac, 1995-1996

Table 1 indicates the population in Atoka, Bryan, and Caddo counties has remained fairly stable. Atoka County is predominantly agricultural, with major industries of cattle. Coal mining, and oil are secondary sources of income. Other industries include furniture manufacturing and dress manufacturing. Most of the early settlers were subsistence farmers. Timber, cotton, grain sorghum, peanuts, and small grains were the major cash crops (Inventory of the County Archives of Oklahoma, 1941; Shingleton and Waterson, 1977). Today, with livestock still as its leading industry, grass hay, peanuts, and wheat are Atoka county's main cash crops (Smith, 1995).

Atoka County is served by a net work of state and federal highways, and county roads. The main industries in Atoka County are furniture manufacturing, dress manufacturing, and considerable dairy farms (Shingleton and Waterson, 1977). The sociodemographic characteristics show a declining rural population (Peach and Poole, 1965). In 1920, the population of the county reached almost a peak of 21, 000 (Table 1).

Bryan County

Bryan county is located in the south-central part of Oklahoma. It is bounded on the east by Choctaw county, on the west by Marshall county, on the north by Atoka and Johnston counties, and on the south by the Red River. The county has an area of 929 square miles, or 594,560 acres (Cole, 1978). It was mostly the Choctaw Indians who settled early in this county.

Bryan County's economy is mainly agricultural, with livestock as its number one industry. Alfalfa, wheat, grass hay, peanuts, and corn, are the major cash crops (Cole, 1978; Smith, 1995). A network of transportation facilities is provided by interstate, and federal highways, as well as by county roads. Peanuts, grain, timber, and livestock are marketed at Durant, the county seat. In the northern part of the county, limestone is mined for agricultural and commercial purposes. Some smaller industries near Durant include clothing, toy, and stock trailer factories (Cole, 1978). The county's population increased from the time of Oklahoma's statehood to a peak of more than 40, 000 in 1920 (Table 1). Since 1920, however, the population has fairly remained stable.

Caddo County

Caddo county is located in the west-central part of Oklahoma (Moffat, 1973; Oklahoma Almanac, 1995-1996). It is bounded on the east by Grady county, on the west by Kiowa County, on the north by Blaine and Canadian counties, and on the south by Comanche county. It has an area of about 1,263 square miles, or about 808,320 acres. The county is primarily agricultural with major crops of peanuts, alfalfa, and wheat are produced here (Moffat, 1973; Oklahoma Almanac, 1995-1996). Most income in the county comes from the sale of farm products and from that of oil and gas. Peanuts, wheat, cotton, grain, sorghum, and hay crops are the major cash crops produced (Moffat, 1973). It is of historic importance to note that it was the farmers of western Oklahoma centering in Caddo who first began to raise peanuts for commercial markets during the Second World War when commodity prices for peanut oil were high (Green, 1990).

For adoption of technology, there should be a stable socioeconomic environment to enhance the introduction and diffusion of new practices. The socioeconomic variables that help measure IPM technology adoption such as population change, income, human and financial resources in the research sites will be discussed in greater detail in Chapter II.

Importance of the Research

This study is important because it examines socioeconomic influences on the implementation of IPM practices. The study deals with issues related to increasing environmental concerns, and the need to integrate environmental, social, and economic components into IPM programs. Agricultural practices are believed to be one of the major causes of environmental degradation which includes water pollution and loss of biological diversity (National Research Council, 1991). IPM is a rational effort toward developing environmentally healthy and economically beneficial agricultural practices. This study identifies major IPM adoption issues in the target counties, and then suggest plausible solutions.

Objectives of the Study

The objectives of this research are:

1. To develop a comprehensive measure to estimate adoption of IPM in the three-county area of Oklahoma: Atoka/Bryan, and Caddo counties,

2. To document ecological, social, and economic factors that may cause differences in IPM adoption among peanut growers in the study sites, and

3. To develop recommendations that may suggest solutions that facilitate adoption, if any.

CHAPTER II

LITERATURE REVIEW

The purpose of this study is to assess the adoption of integrated pest management (IPM) practices in Atoka/Bryan and Caddo counties of Oklahoma. This study is important because it examines how well IPM practices, a major component of sustainable agriculture, are adopted by peanut growers in the research cites. The study deals with issues related to increasing environmental concerns, and the need to integrate environmental, social, and economic components into IPM programs. Agricultural practices are believed to be one of the major causes of environmental degradation which includes water pollution and loss of biological diversity (National Research Council, 1991). IPM is a rational effort toward developing environmentally healthy and economically beneficial agricultural practices. This study identifies major IPM adoption issues in the target counties, and then suggest plausible recommendations.

Definition of Integrated Pest Management (IPM)

Integrated pest management is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks (National Coalition for IPM, 1992). IPM is a strategic approach to pest containment that seeks to maximize the effectiveness of management measures only as needed and with a minimum of environmental damage

(Luna and House., 1990). IPM combines analysis of the problem (control of insects, weeds and diseases) and a broad section of management methods to produce the maximum cost effective yield for the crop while minimizing adverse effects on human health and the environment (Leslie and Cuperus, 1993; Douce et al., 1983). IPM is an interdisciplinary approach toward minimizing the negative impacts of pesticides. IPM technically involves the selection, integration, and implementation of pest control based on predicted economic, ecological and sociological consequences (Cunningham et al., 1994). While it is believed that pesticides are used only against some 2000 species, pesticide residues are found in more than 200,000 that are non-target (Purdon and Anderson, 1983). Hence the dual challenge to continue is to maintain environmental quality and to feed an increasing population. This will require the efficient linking of modern technology and age-old ecological imperatives (Cooper, 1970).

National Research Council (1991) states that the willingness of US farmers to adopt proven agricultural practices is one of the strengths of the United States agriculture. This has given the nation a global leading role in production, agricultural research, and technology. With fewer larger farms producing more than before, technology has facilitated specialization and constantly increasing yields. Linford (1974), however, argues that a monoculture form of agriculture has limitations, and that technology has progressed more rapidly than humans' ability to use it properly. Concerns about the threats from pesticide chemicals led to Federal Environmental Pesticide Control Act of 1972, which imposed stricter criteria for assessing the environmental damages caused by all pesticides (Schapsmeier and Schapsmeier, 1975). Agricultural practices are one of the major causes of environmental degradation manifested in such symptoms as air and water pollution, deforestation, and desertification resulting in losses of biological diversity (National Research Council, 1991). Because of such concerns to humans, animals, and the environment, pesticides are used only when there is a pressing need, such as when pests reach economically damaging levels. Pesticides are then used only in the amounts necessary to knock the pest proportion back under the threshold level. IPM focuses on the ecology of the system emphasizing ecologically based approaches such as plant resistance, biological control, and cultural practices. If pesticides are used, they are as specific to the target species as possible and as short-lived as possible, to avoid harming the beneficial insects, birds, and the small mammals that are necessary to maintain biological control (Ashworth, 1991). IPM is the best way of controlling crop pests, based on the concept that all inputs should be utilized to maximize profit (Miller, 1994; Edwards and Wali, 1993). By definition, IPM encompasses economic, social and environmental components.

Social Components

Society benefits from the appropriate implementation of IPM programs. IPM is socially beneficial because its low input programs enable farmers to develop more sustainable, environmentally sound, and economically viable production system (Buttel et al., 1990). IPM, whose adoption is largely influenced by education, has a positive bearing on society, because as part and parcel of sustainable agriculture, IPM also contributes not only to the quality of the environment, but also to the protection of earth's biodiversity by minimizing the amount of agrichemicals (from pesticides) that may have negative effects on the environment (Benbrook, 1990; Edwards et al., 1991) As with any other form of technology, socioeconomic factors effect the pace of IPM technology adoption (Buttel et al., 1990). Social theorists such as Charon (1989), Turner (1991), and Coleman (1994) stress attempts to effect change require an understanding of variation in one phenomenon is related to variation in another, and persons decide and act rationally basically for satisfying their preferences or for maximizing utility. Persons act intentionally considering their social environment in order to achieve their goal. The adoption of IPM can be influenced by the socioenvironmental conditions, and the processes of adoption and diffusion are enhanced or retarded by social factors (Rogers, 1995). To bring about a change, it is important to integrate social climate, because this has a high influence on the change. For adoption to occur in IPM technology or any other innovation, it is important to consider whether there is a felt need for change by a group(s) targeted, and whether the current social behavior is conducive of the innovation intended.

Economic Impact

Among the major objectives of IPM programs is the furtherance of sustainable economic growth, which in turn, brings about such social benefits as enhanced social welfare and longevity (Seneca and Taussig, 1984). Much of cost reduction in IPM systems results from the appropriate timing of pesticide application, reduced applications, and from reduced rates since pesticide is applied to appropriate stages and only when necessary (The National Research Council, 1986). Hence in many situations the IPM approach has resulted in pest management systems that satisfy both economic and environmental objectives (Luna and House, 1990).

IPM programs save farmers more than $500 million annually and significantly reduce pesticide use (Rajotte et al., 1987). American farmers spend an additional $22 million annually for IPM services and information through private consultants and grower-financed programs operated by the Cooperative Extension Service. As a result of IPM impact, dramatic decreases in pesticide use in several crops have been observed. For instance, from 1971 to 1982, insecticide usage in cotton decreased from 73.4 million pounds of active ingredients to 16.9 million pounds, with a 46 percent decrease in total acreage treated with insecticides. Similar reductions were realized for grain, sorghum, and peanuts (Fribie and Adkisson, 1985; Adkisson et al., 1985).

Environmental Impact

IPM has always focused on environmentally based issues. Rachel Carson (1963) asked for a more rational approach to the use of pesticides. Environmental quality is one of the principal goals of IPM. Some of the procedures that are used to achieve healthy environmental quality include (a) to enhance the educational-technical awareness of the farming sector in such a way that growers can produce in socioenvironmentally sustainable manner, (b) to identify and evaluate pest problems, (c) to decide on the choice of management alternatives, and (d) to take appropriate management action (Edwards and Wali, 1993). A major effort of IPM is to reduce environmental impact and maintain a healthy biosphere (Cunningham et al., 1994), one with the continuous ability of supporting life so that humanity is not alienated from nature (Smelser and Swedberg, 1994). Despite such objectives, agricultural production leading to deterioration of the resource base are widespread. To withstand these challenges, a number of measures are taken. For example, scouting pest populations helps determine the best time as well as the best methods for controlling them, and using pesticides only when needed lowers pollution of soil and water and prevents insects from developing resistance (Cooper, 1994; Vrtis, 1994; Wahl and Shrdlu, 1994). The National IPM Initiative of the Clinton Administration has pledged 75 percent of the US growers will adopt IPM by the year 2000 to insure sustained economic growth without depleting the resources or without badly polluting the environment (Benbrook, 1996).

Constraints to the Adoption of IPM Technology

Major factors considered to be important constraints to IPM adoption are technical, financial, educational, institutional, and social issues, which are not usually mutually exclusive (Office of Technology Assessment, 1979; Zalom, 1993).

Technical Constraints

The fact that the basic biology of pests, beneficial organisms, and their interactions in agricultural ecosystems is not well understood is one of the main technical limitations to IPM adoption. There is lack of knowledge with respect to the application of the know-how to the management of pests in cropping systems through tactics such as biological and cultural controls. Adoption cannot succeed without adequate knowledge base, integration of components, an effective delivery system, and qualified personnel (Smith, 1978).

Communication

Lack of effective communication skills by education, producer, and industry personnel is also considered to be one of the major technical obstacles to IPM adoption (Office of Technology Assessment, 1979; Cuperus and Berberet, 1994). In most cases, agricultural extension agents are taught about plant varieties, animal nutrition, and fertilizers. They are mainly trained how to change farms, not to change farmers, not in adult education nor in communication. They are geared toward telling farmers without sufficient knowledge what to do to make these changes, and to make farmers more knowledgeable decision makers on their farms (Ban and Hawkins, 1988).

Financial Constraints

Even though many agree that IPM often increases net profits for growers who adopt it (Greene and Cuperus, 1991; Norton, 1994), there are still many growers who hold that IPM does not offer short-term economic advantages compared with conventional control practices because of additional labor costs from sampling and monitoring (Zalom, 1993). Probably the most important financial obstacle to IPM adoption is this negative perception of economic risk by growers (Willey, 1978; Cornejo et al., 1992; Cuperus et al., 1996).

Lack of Funds for Research and Extension

Another important financial constraint to IPM adoption is lack of funds for university research and extension programs. Zalom (1993) states that there has been a consistent decrease in base budget for research in agriculture and extension programs in the United States over the last 20 years.

Educational Constraints

Intensive education of users is required to implement IPM's complex innovation, because IPM tries to establish a complex set of behaviors, decision making procedures, methods, technologies, and values organized to provide efficient alternative methods of pest management. Because it is often perceived as complex, adoption is hampered (McDonald and Glynn, 1994). Therefore, it is important to look into the means by which IPM methodologies are taught that may lead to adoption (Rajotte et al., 1994; Zalom, 1993).

Institutional Constraints

Developing a sustainable production system depends on interdisciplinary efforts (Soule and Napier, 1992). Of the institutional constraints to the adoption of IPM, the lack of interdisciplinary collaboration in IPM research, extension, and teaching has been a major obstacle to widespreading IPM practices (Luna and House, 1990). Yet IPM bears positive impacts on methods of agricultural operation, enhances the quality of the environment, and increases net returns. Hence IPM programs improve the pace of economic activities. Economic activities are governed by institutional factors (Barlowe, 1986). Institutions represent established arrangements in society and established ways of doing things. Educational institutions-universities, colleges, in collaboration with local schools and farmers' cooperatives-can enhance the pace of IPM adoption if they move toward interdisciplinary research and education (Luna and House, 1990).

Social Constraints

Social factors such as the attitudes of farmers toward innovations have big influence on the rate of IPM adoption (Zalom, 1993). The rate at which IPM adoption occurs and the ultimate level of adoption can be tremendously altered by such sociocultural factors as the growers' perceptions of the technology, land ownership, and communication channels used by growers or managers, (Zalom, 1993).

The Lack of Effective Interpersonal Communication Skills

The lack of effective communication skills on the part of some extension agents can hinder the rate of IPM adoption (Cuperus and Berberet, 1994), and may indirectly aggravate difficulties in measuring IPM. It may not be appropriate, for example, to take for granted that the grower knows enough about the pest-damage relationship, that is, the pest response to the various alternative control methods (Headley, 1982). There can be gap of communication between the extension agent and the growers for various reasons, which can hinder IPM adoption.

Oklahoma Cooperative Extension Service's Role in IPM Transfer

One of the major objectives of the Oklahoma Cooperative Extension Service is to accelerate agricultural technology transfer and economic development. Oklahoma IPM efforts have had significant progress for the past twenty years to influence growers' behavior in Oklahoma to help farmers adopt IPM technology (Stark et al., 1990; Greene and Cuperus, 1991; Cuperus and Berberet, 1994; and Sholar et al., 1996).

The university is generally considered by many scholars (Commager, 1965; Birenbaum, 1969 in *Synthesis* [ND]) the chief servant of society, the chief instrument of social change, and the clearinghouse of new ideas. It is also stressed (Birenbaum, 1969) that knowledge obtained should be transmitted, or it will die. Knowledge acquired and transmitted has to be used, or it will become sterile and inert. The OSU Cooperative Extension Service has been active not only in the production of knowledge but also in devising the means to the imparting of usable knowledge and technology transfer, especially to the farming sector.

Frisbie and Magaro (1991) stress that Oklahoma State University and Texas A.& M. University are two universities that have a rich history of developing and delivering IPM to farmers by speeding up adoption since the early 1970's. They developed farm-level IPM programs for various kinds of crops that include peanuts, wheat, cotton, corn, hay, pecans, rice, livestock, sorghum, soybeans, sugarcane, citrus, and a number of vegetable crops besides developing specific management tactics for IPM such as use of pest resistant varieties, cultural techniques, the preservation and use of biological control agents, crop and computer forecasting models, pest monitoring techniques, as well as economic thresholds that relate the abundance of pests to plant damage for selectively timing the applications of pesticides. Cooperative Extension Service has focused on integrating teaching, research, and public service for impacting positive social change, especially in the farming sector of Oklahoma. For example, prior to the formation of the Texoma Crop Management Initiative (TCMI) in 1989, yield in Atoka/Bryan counties was one of the lowest in the state. More than 50 percent of growers there used to apply fertilizers based on guesswork instead of soil testing first. There were also serious problems regarding disease, weed, and harvest management.

Measurement of IPM

A brief discussion of how adoption takes place is in order before discussion of measurement. A number of researchers, mainly rural sociologists, have outlined the processes under which adoption occurs. Adoption takes place through a five-stage process though it may not necessarily be in the sequences cited below (Ban and Hawkins, 1985).

1. Awareness: First hear about the innovation.
2. Interest: Seek further information about it.
3. Evaluation: Weigh the advantages and disadvantages of using it.
4. Trial: Test the innovation on a small scale for yourself.
5. Adoption: Apply the innovation on a large scale in preference to old methods.

Rogers (1983, 1995) also cites almost the same idea slightly differently regarding the adoption process. According to Rogers (1983, 1995), adoption occurs through the following processes: (1) knowledge, (2) persuasion (forming and changing attitudes), (3) decision (adoption or rejection), (4) implementation, and (5) confirmation.

Rural sociologists stress that extension should serve as a major link between scientific research and the farmer to facilitate the rate of adoption. They also emphasize that some innovations are adopted more rapidly than others, because the farmers perceive them to have different characteristics (Ban and Hawkins, 1985). The following characteristics are believed to affect the rate of adoption:

1. Relative Advantage: Whether the innovation enables the farmer to achieve his/her goals better or at a lower cost than he/she could previously;
2. Compatibility: Whether the innovation does not violate sociocultural values and beliefs; whether it helps fulfill the farmer's felt needs;
3. Complexity: Whether the innovation is within the comprehension scope of the farmer, that it does not take too much time to understand;
4. Trialability: Whether the innovation can be easily implemented on a small scale on their own farm to see if the innovation proves to work better than the previous farming practice; and
5. Observability: Whether "early adopters'" performance can be seen by other farmers so that farmers may learn from observing and discussing their colleagues' experiences (farmer-to-farmer communication).

Historically, IPM has been measured by component analysis such as scouting, soil testing, variety selection, and crop rotation carried out by growers (Rajotte et al., 1994; Office of Technology Assessment, 1979). Measurement of IPM is important in order to see whether it (IPM) has impacted growers' farming operations in such ways as minimizing the adverse environmental impacts from pesticides and enhancing economic production of crops (Environmental Protection Agency, 1974; Thomas et al., 1990; Greene and Cuperus, 1991).

The wide spread use of IPM practices by growers indicates social acceptance. Adoption occurs at the individual level through time (Lambur et al., 1985). The adoption curve starts slowly, rises exponentially indicating rapid adoption rate, and gradually declines through time in an-*S*-shaped curve (Rogers, 1983; 1995). The success or failure of IPM programs largely depends on the individual responsible for applying this technology, and it is diffusion theory which explains the process by which new ideas (innovations) are imparted to members of a social system (Lambur et al., 1985) While adoption mainly occurs at the individual level, diffusion can occur at the social level, that is through farmer-to-farmer communication (Rogers, 1995). The diffusion-adoption perspective regards the grower as a decision maker whose rate of adoption and adoption behavior are influenced by individual characteristics like education level, farm size, and income (Lambur et al., 1985; Rogers, 1995). Younger, better educated growers usually have more contact than older farmers with information sources and change agencies, and they are able to use complex technologies (Thomas et al., 1990).

Yet the measurement of IPM has not been simple. IPM is more a philosophy than a rigid set of practices, and its concepts have been easily modified to fit a wide variety of crops and other situations (The National Evaluation of Extension's Integrated Pest Management 'IPM' Programs, 1987). The USDA's definition of IPM and its adoption criteria differ from the definition of IPM and adoption estimates of Consumers Union (Benbrook, 1996). Other situations that may affect measurement of IPM adoption include level of risk aversion among farmers, farm structure (larger farms vs smaller farms), land ownership, locational factors such as soil fertility, rainfall, and temperature (Carlson, 1985; Cornejo et al., 1992).

IPM's complexity also arises from the multiplicity of technologies it comprises, each needing basic knowledge about each type of technology (Miller, 1983; Thomas et al., 1990). Such complexity of IPM not only made measurement difficult but also caused low rate of adoption in a number of cases despite existence of information demonstrating the benefits of IPM adoption, that , for instance, it optimizes profits (positive economic impact) by protecting yields and lowering costs of production (Adkisson et al., 1985) It was believed that such factors as the incentive for increased profit, improvement of on-farm health and safety, and improvement of environmental quality would stimulate rapid adoption of IPM among growers (The National Evaluation of Extension's Integrated Pest Management (IPM) Programs, 1987). In fact, it is asserted that a major factor in the success of IPM was the efficiency and economy of its field scouting techniques (The National Evaluation of Extension's Integrated Pest Management (IPM) Programs,(1987). Field scouting, together with other IPM practices, such as soil testing, weed control, use of disease resistant varieties, cultivation, and timing of harvest, is a very important component of IPM. However, IPM is not confined mainly to scouting. The other factor that should be considered may be the level of delivery of communication regarding IPM practices among growers.

Single Factor Analysis

This approach holds that IPM is any agricultural practice that involves more than one management strategy, no matter when (Adkisson et al., 1985; Miller, 1983). Although IPM comprises a number of management practices, it does not seem logical to consider as IPM any agricultural practice that has more than one technique. It then could be argued almost all producers from the beginning of time used IPM.

The major objectives of IPM were to utilize a multi-facet approach to reduce reliance on pesticides for the safety of the environment (Pampel and van Es, 1977; National Research Council, 1986; Freedman, 1995).

Measurement of IPM is difficult , because it is a complex approach. IPM measurement systems vary region to region, crop to crop, and field to field based on a particular microenvironment (Adkisson and Frisbie, 1985). Efforts to measure IPM have evolved over time.

Use of Thresholds. In the early years, IPM adoption was often based on the use of action or economic thresholds and some evaluations suggesting this approach be taken (Zalom, 1993). The thrust behind this approach is to correctly time pesticide applications. Clearly this is an important element in IPM implementation, but adoption measurement may need to be broader than this concept. When control measures are initiated to prevent economic risk, one may need to bear in mind such factors as the ecological effects the pesticides may have on the environment, whose cost is usually born by society (Ban and Hawkins, 1985; Frisbie and Magaro, 1991).

Use of Scouting. Early evaluation efforts were based on scouted acres (Greene and Cuperus, 1991; Adkisson et al., 1985). While scouting is a critical element, the true management implications may often be lost, and when producers are asked if they scout fields, often nearly 100 percent indicate they scout fields (Stark et al., 1990).

Comparison of IPM and Non-IPM Adopters. In the mid 1980's an analysis was taken of national IPM programs targeting IPM adopters verses non-IPM adopters based on key elements including grower demographics, program delivery, grower acceptance of IPM, and pesticide use and grower economics (National Evaluation of Extension's Integrated Pest Management (IPM) Programs, 1987). The obvious limitations were often the criteria were narrow and the comparisons may have been biased in certain circumstances apparently comparing good managers to poor managers regardless of IPM influence.

IPM Certification Encompassing Multiple Strategies. A much broader evaluation attempt has been made by the efforts in the North Eastern United States that were targeting the certification of IPM for growers. Elements included soil and nutrient management, calibration, user of beneficial organisms, scouting, interest in education, utilization of the Extension Service (Rajotte et al., 1994). This approach developed a framework for an integrated evaluation systems, although no effort was made to develop guidelines for crops such as peanuts.

Ecologically-Based Approaches. Benbrook (1996) developed criteria for evaluating IPM programs primarily based on biologically-based approaches including biological control, and other approaches. As with the concept of IPM, the measurement of IPM has continued to evolve broadening and becoming more interdisciplinary in its approaches. As can be seen, each of these approaches takes a broader and more integrated approach to IPM measurement. These approaches need to be integrated into the measurement of peanut IPM programs.

History of IPM in Atoka/Bryan, and Caddo Counties

Atoka/Bryan counties, located in Southeast Central and South Central (Peach and Poole, 1965; Cole, 1978), and Caddo county, situated in West Central part of Oklahoma (Moffat, 1973), respectively, have had different history of the adoption of IPM.

Climate

The scouting programs usually take climatic conditions into consideration. Weather is the driving force behind pest and disease problems. Weather promotes buildups of the lesser corn stalk borer in peanuts. Temperature and humidity, or moisture, also influence the effectiveness of pesticides. For these reasons, weather data are important to guide scouting and control programs (Environmental Protection Agency, 1974).

There is less rainfall in Caddo county than in Atoka/Bryan counties (Table 2). The soils in Atoka and Bryan counties are mainly clay and clay loam which is not conducive for peanut growth, whereas the soils in Caddo county are largely loamy and sandy and

Table 2. 1961-1990 Precipitation Normals (mm) in Atoka-Bryan, and Caddo Counties Based on The Durant and Anadarko Weather Stations Respectively, Oklahoma

Month	Normal		Median	
	Atoka/Bryan	Caddo	Atoka/Bryan	Caddo
JAN	50.8	33.02	41.63	18.54
FEB	66.8	35.81	66.55	36.58
MAR	94.99	55.12	79.50	45.97
APR	107.7	62.48	87.88	58.93
MAY	141.7	118.87	146.05	100.33
JUN	116.57	98.04	88.14	73.66
JUL	58.17	52.58	58.17	45.47
AUG	66.29	59.94	125.06	57.15
SEP	137.41	94.23	138.43	89.66
OCT	106.17	68.58	84.84	45.72
NOV	79.76	43.94	78.23	31.50
DEC	56.39	30.48	46.74	22.35
ANN. PRECIP.	1082.8	746.25	1080.50	758.44

Source: Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1961-1990. Climatology of the U.S. No. 81. 1992. Oklahoma National Climatic Data Center. Asheville, NC.

optimal for peanut production (Moffat, 1973; Shingleton and Waterson, 1977; Cole and Steers, 1978).

Table 2 indicates that Atoka/Bryan counties have heavier rainfall than Caddo county. In Caddo county, strong winds and high temperatures make the rate of evaporation so high that little water moves through the soils (Moffat, 1973). Because of the differences in rainfall, the peanut production system has evolved significantly different. Caddo county has nearly 100 percent irrigated peanuts using center pivot systems. Atoka/Bryan counties have significantly more dryland peanuts, and the irrigation is primarily from ponds (Cuperus, 1992).

The following table (Table 3) demonstrates differences in inputs on dryland peanut farming between growers in Atoka/Bryan and Caddo counties.

Table 3. Farming Operating Costs and Returns ($/ha) to Investment for Dryland Peanuts, Southeast and Southwest Oklahoma: 1994

	$/ha	
	Southeast	Southwest
Total operating costs	344.75	568.28
Returns above total operating cost	495.25	871.73
Returns above all specified costs	281.98	659.83

Source: Enterprise Budget, 95481907, 1994 Southeast
Note: Atoka/Bryan counties are in the Southeast, and Caddo county is in the Southwest regions of Oklahoma, respectively.

The difference in level of input among peanuts and return between peanut growers in Atoka/Bryan, and Caddo counties is large with returns in Caddo county above all specified costs is more than double of that of the southeast's (Table 4). This is an interesting contrast between a relatively high input and high return management systems where Extension led a major educational effort to a relatively low input and low return area where the program was led by producers (Cuperus, 1992).

Table 4. Farm Operating Costs and Returns ($/ha) to Investment for Irrigated Peanuts, Southwest Oklahoma: 1994

	Southeast	Southwest
Total operating costs	NR	984.20
Returns above total operating costs	NR	1735.80
Returns above all specified costs	NR	1387.28

NR=not reported
Source: Enterprise Budgets: 95370047, 1994

Caddo county's steady progress in peanut production, beginning in 1942 is observable in Table 5. In 1940, Atoka/Bryan counties had significantly greater planted peanut acres respectively than Caddo county, which had just 100 acres of peanuts planted. Just a decade later, the reverse is the case. Presently, Caddo is the dominant county in peanut production in the state.

Table 5. Peanut Acres, and Yield in Atoka, Bryan, and Caddo Counties in Selected Years, Oklahoma 1940-1994

County	Year	Hectare Planted	Mean Yield (Kg/Hectare)
Atoka	1940	3158	261.1
	1942	5020	267.9
	1951	2874	160.7
	1990	1376	756.9
	1994	1052	2496.6
Bryan	1940	8987	290.7
	1942	18502	310.1
	1951	12672	158.5
	1990	6720	598.5
	1994	5870	2382.6
Caddo	1940	40	295.3
	1942	850	321.5
	1951	20247	404.7
	1990	14291	1657.6
	1994	13117	3682.2

Source: A. For 1940 and 1942 data, Statistical Handbook of Oklahoma Agriculture: 1894-1947; B. For 1951 data, Oklahoma Agriculture:1949-1954. 1953. C. For 1990 and 1994 data, Oklahoma Agricultural Statistics of Respective years

History of IPM in Atoka/Bryan, and Caddo counties is dramatically different. Caddo county traditionally had a very high input systems which resulted in agricultural industries such as Oklahoma's largest consultant company, and agrochemical companies flourished. During the mid and late 1970's, there was a significant Oklahoma Cooperative Extension support with extensive scouting programs in Caddo county. This was primarily driven by extension efforts. This culminated in the formation of Coop Guard, a large consulting company centered in Caddo county (Cuperus, 1992).

On the other hand, in Atoka/Bryan counties, there was very little extension effort until 1988-89 (Cuperus, 1992). Yield prior to 1989 in Atoka/Bryan counties was very low. In 1989, the Oklahoma Cooperative Extension Service targeted the Bryan/Atoka county area for an intense educational effort because yields were the lowest in the state (Cuperus, 1992; Table 5), inputs were relatively high, and technology transfer efforts had not succeeded. Initial efforts showed soils that were nearly all acid and required lime, and were nearly all low in phosphorus. This effort was led by local producers, and producers governed this program (Cuperus, 1992).

CHAPTER III

MATERIALS AND METHODS

Populations of peanut growers in Oklahoma were sampled to compare Atoka/Bryan counties to Caddo county in IPM technology adoption. Research techniques used in this study include telephone survey, personal interview, and secondary sources. The design and implementation of the telephone survey used in this study was based on previous survey examples provided by the OSU Cooperative Extension Peanut IPM committee as well as on other well established methods such as those suggested by Groves and Kahn (1979), Miller (1991), and Fowler (1993).

Development of Instrument: Telephone Survey

Many research scientists believe that, relative to mail questionnaires and personal interviews, telephone surveys are excellent vehicles, despite certain shortcomings, for measuring attitudes and orientations (Singleton et al., 1988; Babbie, 1992; Stewart and Kamis, 1993). Further, telephone surveys usually provide a high response rate , and give the investigator greater control over the data collection (Miller, 1991; Babbie, 1992; Bernard, 1994).

The first draft of the survey was developed and pretested by the Oklahoma State University (OSU) Cooperative Extension Peanut IPM Committee. After three reviews by the committee, the survey's fourth draft was produced. The peanut growers' name list and mailing addresses were provided to the investigator by the Oklahoma Cooperative Extension Service, and County Agents in each county. The growers' telephone numbers were obtained by the researcher by means of library research across regional telephone directories, and the internet.

Pretesting the Telephone Survey

Pretesting the questions, mainly for clarity and content, was made in March 1996 with a group of six peanut growers from Atoka and Bryan counties. The pretest was designed to learn if the questions flowed smoothly; if the producers could understand the questions; and whether the group found any unfamiliar terms or expressions.

Suggestions after the survey's pretest helped to revise and rewrite key questions and assisted in seeing, among other things, that the responses to close-ended and open-ended questions aligned with the research objectives (Miller, 1991; Fowler, 1993; Zimmerman and Muraski, 1995). The incorporation of producer suggestions helped make amendments in the questions before a fifth draft of the instrument was produced. This was again routed to the IPM Peanut Committee for final comments. The committee's additional comments were incorporated and the sixth and final draft of the research instrument was finalized. Common methods for obtaining information from surveys were used including unstructured or open-ended questions, multiple choice or structured questions and, scales, as well as rankings (Miller, 1991; Fowler, 1993) and were used in the survey. To measure certain IPM practices, multiple choice questions and/or fill-in-the-blank questions were used. For example, those measured by such questions included farm size (acreage), ownership, age, income, peanut varieties grown, and type of farming operations. Other aspects of IPM were measured by binomial (Yes/No) questions, and rankings. Close-ended questions usually have the simplicity of being coded and quantified, but they at the same time have the disadvantage, if used alone, of being biased. Open-ended questions are usually more difficult to code and to analyze, however, they have the advantage of allowing the respondents to express what they really think about an issue (Mason et al., 1988). According to Mason et al. (1988), close-ended questions are more biased than open-ended ones, for the former suggest their own answers and such biases are reduced in attitude studies through use of open-ended questions.

This survey has 21 open-ended, and 21 close-ended questions that helped to look into the peanut growers' attitudes toward IPM practices. This was done in the hope of creating a data set that can help to assess IPM adoption in Atoka/Bryan, and Caddo counties (Appendix A, the actual survey).

An attitude may be defined as a relatively enduring but modifiable tendency or readiness on the part of a person to behave in particular ways toward some object, person, or issue (Kuhlen, 1952). Attitudes are studied mainly by analyzing the verbally expressed opinions of people, such as those used by public-opinion pollsters whereby persons are asked concrete questions to which they are requested to give specific answers like 'yes,' 'no,' or 'uncertain'. Another method of measuring attitudes is to use a series of statements that represent graded or scaled attitudes relating to some issue. Both of these methods have the weakness that an individual cannot often adequately express his true attitude by stating 'yes,' or 'no,', 'agree,' or 'disagree'. Current attitude research involves procedures by which an individual is interviewed, sometimes at length, and asked to respond to open-ended questions which give him or her the opportunity to say what he/she wants to say, to expand, to qualify, and to relate a given attitude to another. The result is that a better, broader picture of an individual's attitude can be obtained (Kuhlen, 1952). To capture a broader picture of the attitudes of peanut growers toward IPM technology adoption in the research sites, the survey was coupled with personal interviews, as is stated in III (E) below.

Administering the Telephone Survey

Letters were sent to peanut growers in the research sites in May 1996 (See Appendix B). This announcement of the survey to the peanut growers and the Extension Agents in the research sites helped to legitimize the research project and enlisted the help of those who were approached: a number of peanut growers in Atoka, Bryan and Caddo counties, IPM Extension Agents in these counties, as well as those working in offices of farmers coops such as those at Eakly Farmers Coop, Hydro Coop Inc., both of which are in Caddo county, and Shawnee Farmers Coop in Bryan county.

Conducting the Telephone Survey

The telephone survey was conducted both by two trained research assistants in the Entomology Department, and the investigator between mid June 1996 till the beginning of September 1996 every working day from 6:00 p.m. to 9:00 p.m. and took 8-10 minutes to administer. In order to ensure adequate coverage of peanut growers in Atoka, Bryan, and

Caddo counties, a list of the growers obtained earlier from the Oklahoma Cooperative Extension Service was updated twice; in July 1996, and on August 7, 1996. The total number of peanut growers in the three-county area research site was 308, that is, 48 growers in Atoka/Bryan, and 260 producers in Caddo counties. With our 90 usable responses received, the response rate was about 63 percent in Atoka/Bryan counties (N=30), and 23 percent in Caddo county (N=60). Only 10 percent refused when asked to complete the survey although growers were very difficult to contact because of normal farming operations.

Conducting the Personal Interviews

Key questions were selected from the telephone survey to administer to producers prior to administration of the telephone survey. This was done to complement the data from the telephone survey. Personal interviews were conducted by the investigator with selected groups of fifteen peanut growers, of which six were from Atoka/Bryan, and nine from Caddo counties (SeeAppendix C). Responses were filled in by growers themselves to eliminate any possible gap in communication between the interviewer to whom English is the third language and the interviewees. These interviews were to capture the general views of peanut growers on IPM in both research sites. The interviewees belonged to different socioeconomic status, different age group, different experiences on peanut farming, and different educational backgrounds. These interviews were designed to be brief and average 10 minutes. The objective in this short-time interview was to obtain complementary information on the respondent's demographic characteristics, and on their overall attitudes regarding IPM adoption. Questions asked in the personal interview included whether the interviewees felt they had adopted IPM, whether they supported a widespread use of IPM practices, whether they felt that IPM field tours and workshops, or IPM displays at field days, and IPM publications were useful for their farm operations, and whether they felt more growers would favor IPM in their respective counties.

Secondary Sources

Fact-finding research approaches have been used focusing on the variables that might affect IPM adoption in Atoka, Bryan and Caddo counties (Miller et al., 1987; Rossi and Gilmartin, 1980). Secondary sources thought to enrich this study and enhance one's understanding concerning IPM adoption in the research sites are used to a considerable extent, as cited in the reference section of this study.

Survey results were analyzed by using SAS (1989) statistical software package. This helped make frequency tables for responses to questions in the instrument.

Integrated Pest Management comprises a complex set of tools or approaches mainly consisting of cultural, physical, biological, and chemical controls (Leslie and Cuperus, 1993; Eblen and Eblen, 1994). This study focused on the attitudes of peanut growers in Atoka/Bryan, and Caddo counties regarding IPM adoption, and how many key IPM components were practiced in the research sites. The main descriptive aspects of sociodemographic characteristics were reviewed, for they were believed to have a bearing on factors that can determine the rate of IPM adoption. Qualitative analysis, such as interpreting data from telephone survey and personal interviews, with the help of tables and/or figures, can be used to carry out research such as the study of technology adoption by farmers (Strauss, 1987; Reichardt and Rallis, 1994). This study uses telephone survey and personal interviews for assessing the adoption of IPM in the two sites of study, and the study's scope is limited to using normative, descriptive data generated by the survey.

CHAPTER IV

PRESENTATION AND DATA ANALYSIS

Demographic Characteristics

To measure IPM adoption, looking into (a) the demographic and related characteristics of growers in the two research sites and (b) key IPM practices, and use of extension as well as general IPM awareness were found necessary. These, which include major IPM practices in addition to growers' demographic characteristics in the study sites compared, were:

1. General IPM awareness
2. Size of weeds when herbicides applied
3. Soil testing frequency for nutrients
4. Scouting frequency
5. Use of disease resistant varieties
6. Timing of Harvest
7. Cultivation between emergence and harvest
8. Ability to identify diseases
9. Use of Extension
10. Use of Insecticides

Demographics

Demographic characteristics considered in data analysis include comparisons of peanut acreage, yield (production), income, years of peanut farming, age, education level, and interest of peanut growers in learning more about IPM. Thus the discussion, beginning with the variables involving demographic and other closely related characteristics, proceeds as follows.

Total Family Income. Total family income was measured by the question "What is your annual total family income? Please give ranges" This instrument in five categories ranged from less than $20,000/year to more than $50,000/year. Table 6 presents peanut growers' annual income in the counties under study.

Table 6. Annual Income of Peanut Growers: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

	Percent Farmers			
Annual Income	Atoka/Bryan		Caddo	
	N	%	N	%
< 20000	3	13.6	3	6.3
20000-34999	7	31.8	10	20.8
35000-49999	4	18.2	9	18.8
> 50000	8	36.4	26	54.2

Caddo county seemed to have greater incomes than Atoka/Bryan counties. Fifty-four point two percent of peanut growers in Caddo county made an income of more than $50,000/year, compared to 36 percent of the growers in Atoka/Bryan counties that made an annual family income of the same amount /year (Table 6). However, no significant difference in family income was found between Atoka/Bryan, and Caddo counties (Chi square value=2.7; d.f.=3; $p<0.441$).

Peanut Acres. Farm size is usually used as an indicator of growers' socioeconomic status. Larger peanut acres commonly indicate that there is more financial resources that enable growers to handle the risk which is usually associated with the adoption of new farming technology (Bertrand, 1978; Rogers, 1995). Owned and rented mean peanut acres in Atoka/Bryan, and Caddo counties are summarized in Table 7.

Table 7. Peanut Acres Owned and Rented for Peanut Production: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

	Atoka/Bryan			Caddo		
	N	Mean Size	SD	N	Mean Size	SD
Owned	16	95.9	38.6	45	116.2	93.1
Rental	20	186.8	131.2	37	106.8	92.5
Total	30	175.7	84.9	60	153.0	92.8

Table 7 indicates that Caddo county has larger owned peanut acres than Atoka/Bryan counties, while Atoka/Bryan counties have larger rented peanut acres than Caddo county. However, farms owned in Caddo county were found to be not significantly different from those owned in Atoka/Bryan counties (t = -0.841; df = 59; p<0.403). Farm size is usually considered to be related to growers' capacity to get information about new technologies (Bertrand, 1978; Rogers, 1995). Rented farms showed significant difference, with Atoka/Bryan counties having much larger rented farms (t = 2.68; df = 55; p<0.009).

Table 8 showed that Caddo county had approximately 18 percent of its growers with experience of more than 40 years in peanut production whereas Atoka/Bryan counties had none in this category. Agricultural knowledge, as any sphere of knowledge, grows with longer experience in the activity. Caddo county's longer experience in peanut production could have contributed to the marked differences between Atoka/Bryan counties, and Caddo county in peanut production and in the adoption of new technology such as IPM practices On the other hand, there are studies that indicate younger farmers have higher IPM adoption rates than older farmers (Rajotte et al. 1987). In this study, years of peanut production Atoka/Bryan, and Caddo counties were found to be highly significantly different (Chi square value =13.3; df = 5; p<0.001), with Caddo county having longer years of peanut production.

Table 8. Years of Peanut Production: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Years	County			
	Atoka/Bryan		Caddo	
	Frequency	%	Frequency	%
1-10	11	36.7	10	16.7
11-20	10	33.3	10	16.7
21-30	6	20.0	16	26.6
31-40	3	10.0	13	21.7
41-50	_	_	10	16.7
51 and over	_	_	1	1.6

Yield (Production). Producer responses indicated mean yield in Atoka/Bryan counties was found to be 2302.7 pounds/acre and 1417.1 pounds/acre under irrigated and dryland, respectively. In Caddo county, yields were 3202.7/acre and 1850.0/acre under irrigated and dryland respectively. Table 9 presents peanut mean yield in the counties under study.

Table 9. Mean Yield (kg/ha) of Peanuts under Irrigation and Dryland Conditions: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

County	Irrigated Mean			Dryland Mean		
	N	Yield	SD	N	Yield	SD
Atoka/Bryan	21	2625.3	871.6	14	1615.5	150.9
Caddo	56	3651.1	568.2	2	2109.0	350.0

Both under irrigated and dryland conditions, Caddo county was found to have considerably higher mean yields than those in Atoka/Bryan counties. Caddo county's yield/acre under irrigated and dryland conditions exceeds that of Atoka/Bryan counties by about 1026.0 kg/ha and 493.5 kg/ha, respectively (Table 9). The reasons may include soil type differences, type of irrigation, as well as differences in technology adoption.

Peanut Varieties Grown. This study documented main peanut varieties grown in Atoka/Bryan, and Caddo counties under dryland and irrigated conditions. Table 10 presents peanuts grown under dryland farming in both the study areas.

Table 10. Peanut Varieties Grown under Dryland Conditions: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

	Percent Farmers			
	Atoka/Bryan		Caddo	
Variety	N	%	N	%
Tamspan 90	4	30.80		-
Pronto	2	15.38		-
Okrun	-		1	20
Spanco	5	38.46	3	60
Starr	2	15.38		-
Florunner	-		1	20
Total	13	100	5	100

Tamspan 90, Spanco, Starr and Pronto were varieties most planted for dryland conditions in Atoka/Bryan, and Caddo counties (Table 10). These are recommended varieties for dryland farming (Sholar et al., 1996).

Peanut varieties grown under irrigation included Tamspan produced by 47.8 percent of farmers in Atoka/Bryan counties, and by 56.1 percent of those in Caddo county (Table 11). The second most popular variety under irrigated farming was Spanco, grown by 17.4 percent and 17. 5 percent of farmers in Atoka/Bryan, and Caddo counties, respectively. Tamspan 90 is resistant to sclerotinia blight and has had rapid adoption since introduction four years ago, (Cuperus, 1992; Sholar et al., 1996).

Table 11. Peanut Varieties Grown under Irrigation: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

	Percent Farmers Using			
	Atoka/Bryan		Caddo	
Variety	N	%	N	%
Tamspan 90	11	47.83	32	56.14
Pronto	3	13.04	1	1.75
Okrun	3	13.04	9	15.80
Spanco	4	17.39	10	17.54
Florunner	2	8.70	5	8.77
Total	23	100	57	100

Fifty percent of Atoka/Bryan growers' seeding rate lay between 58-79.8 kg/ha. Approximately fifty percent of Caddo growers had their seeding rates between 80.9-102.6 kg/ha. No growers in Caddo county had a seeding rate of 28.5-57 kg/ha while about 7 percent of those in Atoka/Bryan counties had this rate. Likewise, whereas approximately 20 percent of Caddo peanut producers had a seeding rate between 103.7-153.9 kg/ha, no growers in Atoka/Bryan counties reported having this relatively higher seeding rate (Table 12). The recommended seeding rates (kg/ha for different peanut varieties) are as follows:

Large Spanish types, 91.20-114.0 kg/ha

Small Spanish types, 88.90-109.44 kg/ha

Runner type, 82.08-109.44 kg/ha (Woodroof, 1983).

Apparently, many producers planted higher seeding rates than are recommended. Atoka/Bryan counties showed a better understanding of recommended seeding rates.

Table 12. Peanut Seeding Rate (kg/ha): Atoka/Bryan, and Caddo Counties, 1996

	County			
	Atoka/Bryan		Caddo	
Rate (kg/ha)	N	%	N	%
28.5-57.0	2	7.60	_	_
58.0-79.8	15	57.00	15.96	28.50
80.9-102.6	13	49.40	34.20	61.07
103.7-153.9	_	_	13.68	24.43
Total	30	100	56	100

For Atoka/Bryan counties' peanut growers, the top factors in variety choice were yield, disease resistance, and early maturity while for those growers in Caddo county, it was disease resistance, yield, and grade. Yield and disease resistance were found to be the major criteria for choosing a variety in both research sites (Table 13). The emphasis in Caddo county on disease resistance is due to the fact sclerotinia blight is a devastating disease on florunner peanuts. There is no effective pesticide that can be used for sclerotinia blight (Sholar et al., 1996). The focus on disease resistance in Caddo county demonstrates this understanding and rapid adoption of this variety. Similarly, in Atoka/Bryan counties, 47.8 percent of the growers are using Tamspan 90, which shows an improved understanding of IPM. Producers focused on disease resistance and early maturity. The indication of early maturing varieties in Atoka/Bryan counties shows a good understanding of their cropping system. Atoka/Bryan peanut producers often have a difficult time getting peanuts harvested with their heavy clay soils and fall rains.. If rain occurs, the peanuts may get trapped in the field due to rain (Peach and Poole, 1965).

Table 13. Key Factors Identified in Choosing Peanut Varieties by Growers: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

	Percent Farmers Responded			
	Atoka/Bryan		Caddo	
Factor	N	%	N	%
Disease Resistance	19	63.0	48	80.0
Yield	18	60.3	35	58.3
Early Maturity	10	33.3	4	6.7
Grade	6	20.0	15	25.0
Price	3	10.0	9	15.7
Drought Resistance	30	10.0	1	1.7

There were differences between Atoka/Bryan, and Caddo counties in age distribution of peanut growers (Table 14). Caddo county had significantly more growers in the '61 and over' years category (31.1 percent) than Atoka/Bryan counties that have just 4 percent of their growers in this age group. This supports the observations made in the discussion that Caddo county was found to have more experienced peanut growers than those in Atoka/Bryan counties. The greater percent of the growers from 18-40, however, is in Atoka/Bryan counties, and this may contribute to adoption differences.

Table 14. Age Distribution of Peanut Growers: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

	Proportion of Farmers (percent)			
	Atoka/Bryan		Caddo	
Age (years)	N	%	N	%
18-30	5	20.0	4	7.0
31-40	7	28.0	5	8.8
41-50	6	24.0	16	28.0
51-60	6	24.0	14	24.6
61 and above	1	4.0	18	31.6
Total	25	100	57	100

Education Level. There were five categories of education levels ranging from high school to the Ph.D. level. Growers' level of education ranged from 8th grade completed to advanced degrees. Table 15 summarizes education levels of peanut producers in the study areas.

Table 15. Education level of Peanut Growers: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

	Proportion of Growers (percent)			
	Atoka/Bryan		Caddo	
Education	N	%	N	%
High School	11	42.3	22	39.3
Some College	10	38.5	20	35.7
College degree	5	19.2	6	10.7
Advanced degree	-	-	5	8.9
Others	-	-	3	5.4
Total	26	100	56	100

No marked difference was demonstrated in educational attainment between peanut growers in Atoka/Bryan, and Caddo counties, but Atoka/Bryan counties had no growers with any advanced degrees whereas Caddo county had approximately 9 percent of its growers with advanced degrees. Education level was thought an important variable in the assessment of IPM adoption, for IPM applications in most cases require scientific and sociocultural information. Extension IPM's goal is to teach farmers to carry out more effective and environmentally sound practices. Thus adequate knowledge base is, in general, believed to enhance the adoption of IPM among farmers (Smith and Pimentel, 1978).

Key IPM Practices and Awareness

IPM Awareness

Sixty-six per cent of Atoka/Bryan county peanut growers were aware of IPM compared to only 39.9 percent of Caddo county The difference in level of IPM awareness between Atoka/Bryan, and Caddo counties is significant (Chi-square value=5.3; df.=1; $p<0.021$). Recent educational efforts in Atoka/Bryan counties apparently have left strong impression on producers. While consultants significantly operate in the Caddo county area, Caddo producers do not apparently seem to have a strong understanding of IPM, or at least the phrase "IPM".

Growers' Interest in Learning More about IPM

Peanut growers both in Atoka/Bryan and Caddo counties showed similar interest levels. About 65 percent reported they were interested in knowing more about IPM (Table 16). In the discussion of IPM awareness, it was found that less than 40 % of the growers in Caddo were familiar with IPM. In Table 16, the Caddo county peanut producers' proportion who reported they were interested in learning more about IPM was approximately 68 percent. This trend could mean that not enough extension effort has been made recently in Caddo county, and the growers need more IPM information.

Table 16. Proportion of Peanut Growers Interested in Learning More about IPM: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

County	Number	Percent
Atoka/Bryan	16	61.5
Caddo	39	68.4

Major Advantages Identified by Growers in Using IPM. This question, "What do you see as the major advantages in using IPM in your peanut farm?," was aimed at documenting perceived benefits peanut growers realize from using IPM (Table 17).

Table 17. Major IPM Advantages Identified by Peanut Growers: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

	Proportion of Growers (percent)			
	Atoka/Bryan		Caddo	
Benefit	N	%	N	%
Insect problem detection	4	22.2	3	16.7
Cost effective	2	11.1	2	11.1
Judicious chemical use	2	11.1	7	38.9
Crop management	1	5.6	-	-
Disease problem detection	4	22.2	2	11.1
Current Info. Source	5	27.8	2	11.1
Improve Environment	-	-		
Increase Yield	-	-	2	11.1
Total	18	100	18	100

Atoka/Bryan growers who were aware of IPM reported the program's top contribution was providing source of current information. The Caddo growers who were aware of IPM indicated judicious chemical use was the number one advantage of using IPM. Insect problem detection was identified by Atoka/Bryan, and Caddo growers as the second major advantage in using IPM, while disease problem detection was also cited equally as important as insect problem detection by Atoka/Bryan growers (Table 17). A significant, positive trend is shown with the responses covering 8 different areas emphasizing their perception of an integrated concept of IPM.

Scouting is one of the major components of IPM practices. Scouting in both sites is largely done by the growers, with more than 80 percent and 67 percent of the growers in Atoka/Bryan, and Caddo counties, respectively (Table 18). There was no significant difference between the two research sites regarding who does the scouting (Chi-square value=2.4; df.=2; $p<0.296$). The data emphasizes the consulting and agrichemical industry support that is available in Caddo county.

Table 18. Producer Response to Who Scouts for Leaf Spot Diseases on Peanut Farms in Atoka/Bryan, and Caddo Counties. 1996

	County			
	Atoka/Bryan		Caddo	
Scouting	N	%	N	%
Self	23	82.14	43	67.19
Consultant	2	7.14	13	20.31
Commercial field person	-	-	8	12.50
Others	3	10.71	-	-
Total	28	100	64	100

Note: Due to grower's multiple responses, total numbers may be more than the actual numbers of respondents in the research sites.

Farm management decisions were mainly made by growers themselves in Atoka/Bryan counties (Mean 3.7, Table 19). However, county extension agents and other farmers, agrichemical dealer, and the family seemed to exert considerable influence in farm management. County extension was listed as equal to other farmers and those dealing with farmers, and it shows a significant impact of the local program.

Table 19. Producer Response to Who Influences Farm Management Decisions in Atoka/Bryan Counties, Oklahoma 1996

Decision maker	Decision Scale				Mean
	1	2	3	4	
Self	1	1	2	21	3.7
Family	6	5	9	2	2.3
Private consultant	15	1	0	2	1.4
Landlord	13	3	1	1	1.4
County extension agent	6	7	6	4	2.4
Extension service specialist	6	6	7	2	2.2
Other Farmers.	2	11	8	1	2.4
Ag. Chemical Dealer recom.	6	6	8	3	2.3
Others	1	0	0	0	1.0

Scale: 1= least influential 2= less influential 3= influential 4= most influential

In Caddo county it also was growers themselves who most made decisions affecting farms. Yet, unlike Atoka/Bryan counties, private consultants and landlord were important decision makers (Table 20). It is, however, clear in both sites that producers looked to personal experience (self) as the primary source of information for farm

Table 20. Producer Response to Who Makes Farm Management Decisions: Caddo County, Oklahoma 1996

Decision maker	Decision Scale 1	2	3	4	Mean
Self	10	1	7	35	3.3
Family	13	6	8	9	2.4
Private consultant	10	3	8	7	2.7
Landlord	1	4	3	3	2.7
County Ext. Agent	13	3	5	4	2.0
Extension Service spec.	10	2	8	4	2.2
Other Farmers.	7	7	7	8	2.6
Ag. Chem. D. recom.	6	6	8	3	2.4
Others	0	0	3	2	3.4

Scale: 1= least influential 2= less influential 3= influential 4=most influential

management decisions, and that state extension impact was identical between Atoka/Bryan, and Caddo counties (Mean=2.2, Tables 20-21). In both Atoka/Bryan, and Caddo counties the individual makes the final decisions on their farms (Tables 19-20). County Extension Agents' role was more significant in Atoka/Bryan relative to proportion of their farm management influence among the growers in both study sites. However, it could be contended that county extension objective is to help farmers make their own decisions,, and that what enabled this large proportions of growers to make important decisions may mainly be the very efforts of county extension agents.

Information Sources for Treatment of Weeds, Diseases, and Insects on Peanut Farms

Extension personnel seemed to have made a considerable contribution to the Atoka/Bryan growers but had limited direct contact with the Caddo growers (Table 21). In Caddo county, numerous consultants are in place and directly contact growers on a daily basis. This situation is not in place in Atoka/Bryan counties (Cuperus, 1992).

Producers were asked what sources of information were used to determine timing of pesticide applications. The Atoka/Bryan growers depended mainly on personal experience, visual damage, and extension. Those in Caddo county also relatively relied on personal experience but differed in relying on professional consultants and aerial applicators. Extension effort has had a significant impact in the Atoka/Bryan area (Table 21).

Table 21. Information Sources for the Treatment of Weeds, Diseases, and Insects on Peanut Farms: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Source	County			
	Atoka/Bryan		Caddo	
	N	%	N	%
Extension Personnel	13	48.1	10	17.5
Professionals Consultant	1	3.7	20	35.0
Visible Damage	14	51.9	14	24.6
OSU Mesonet	2	7.4	1	1.8
Personal Experience	21	77.8	21	36.8
Aerial Applicator	3	11.1	15	26.3
Chem. Co. Recommendation	8	29.6	13	22.8
Others	2	7.4	4	7.0

N for Atoka/Bryan counties=27; for Caddo county, N=57

Table 22. Producer Response to How They Determine to Harvest: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Decision Factors	County			
	Atoka/Bryan		Caddo	
	N	%	N	%
1. Hull scrape	9	30.0	9	15.0
2. Visual	7	23.3	2	3.3
3. Hull blaster	3	11.5	19	31.7
4. Maturity charts	3	11.5	27	45.0
5. Personal experi.	2	7.7	3	5.0
6. Days planted	2	7.7	6	10.0
7. Weather Frz Dts	-	-	8	13.3
8. Consultant recom.	-	-	1	1.7

a. N=30 for Atoka/Bryan counties, and 60 For Caddo county.
b. Numbers may add to more than 100 % due to multiple answers by individual producer.

The recommended methods to determine when to harvest are the maturity table, hull blaster or hull scrape methods (Sholar et al., 1996). These methods time harvest so the majority of the peanuts are mature. Both locations used recommended practices and showed rapid adoption of this technology. Preliminary data (Cuperus, 1992) showed almost no use of these techniques at program inception in 1989 in Atoka/Bryan counties.

Producer response indicated most serious weeds were eclipta, morning-glory, crabgrass, and pigweed, as well as Texas panicum (Table 23) There was a highly significant difference between the two sites regarding eclipta (Chi-square value=10.2; df.=1; p<0.001), with a higher percentage (50 percent) of Atoka/Bryan counties' growers ranking this weed most serious. This is not surprising considering this weed which first

Table 23. Producer Response to Most Troublesome Weeds on Peanut Farms: Atoka/Bryan, and Caddo Counties. Oklahoma, 1996

Type of Weed	Proportion of Farmers Confirmed			
	Atoka/Bryan		Caddo	
	N	%	N	%
Eclipta	15	50	14	23.3
Morningglory	10	33.3	21	35.0
Pigweed	8	26.7	24	40.0
Crabgrass	10	33.3	18	30.0
Texas Panicum	8	26.7	3	5 0
Teaweed	7	23.3	2	3.3
Nutgrass	1	3.3	3	5.0

a. N=30 for Atoka/Bryan counties, and 60 for Caddo county.
b. Numbers may add to more than 100 percent due to multiple answers by individual producer.

invaded Oklahoma in the Bryan county area and recently has been found in Caddo county (Sholar et al., 1996). No significant difference was observed for morningglory (Chi-square value=0.6; df.=2; $p<0.448$) or for pigweed (Chi-square value=0.5; df.=2; $p<0.497$).

The recommended time of herbicide application on peanut farms is less than 5 cm in length (Sholar et al., 1996). Atoka/Bryan producers appeared to have better understanding in when to control weeds post emergence than did Caddo county producers (Table 24). Only 44.4 percent of growers in Caddo county applied herbicides at this time compared to 76 percent of producers in Atoka/Bryan counties. This shows a marked difference in weed management knowledge between peanut growers in the counties surveyed.

Table 24. Herbicide Application on Peanuts Based on Weed Size: Atoka/Bryan, and Caddo Counties

Size of weeds (cm)	Proportion of Farmers Practicing			
	Atoka/Bryan		Caddo	
	N	%	N	%
<2.54	5	17.86	11	24.44
2.55-5.08	16	57.14	9	20.00
5.09-7.62	3	10.71	12	26.67
>7.62	4	14.29	13	28.89
Total	28	100	45	100

Most commonly used herbicides in Atoka/Bryan counties are Blazer and 2, 4DB. In Caddo county, 2, 4DB and Pursuit are largely used. Some of the differences that occurred may be due to differing weed problems (Table 25).

Table 25. Herbicides Commonly Used by Peanut Growers: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Herbicide	Proportion of Farmers Practicing			
	Atoka/Bryan		Caddo	
	N	%	N	%
Blazer	20	66.7	10	16.7
Pursuit	9	30.0	33	55.0
Basagran	3	10.0	5	8.3
2, 4DB	19	63.3	41	68.3
Others	10	33.3	12	20.0

Major Disease Problems. The three disease problems peanut growers in Atoka/Bryan counties mostly encountered were cercospora leaf spot, southern blight, and pod rot (Table 26).

Table 26. Major Diseases of Peanuts and Fungicide Application Frequency: Atoka/Bryan Counties, Oklahoma 1996

	Proportion of Farmers Responded		No. Fungicide Application	
Disease	N	%	N	Mean No. Appl
Cercospora leafspot	26	86.7	17	3.6
Aspergillus	4	13.3	3	2.3
Fusarium	0	0	0	0
Sclerotinia blight	3	10.0	2	2.0
Seedling diseases	1	3.3	-	-
Pod rot	13	43.3	5	1.4
Verticilium	0	0	0	0
Southern blight	22	73.3	15	2.2

Pod rot was found in both sites to be the next serious disease to the first top disease problems (Tables 26 and 27), and, growers reported, this disease is a common problem on fields planted year after year.

Table 27. Major Diseases of Peanuts and Fungicide Application Frequency: Caddo County, Oklahoma 1996

	Proportion of Farmers Responded		No. Fungicide Application	
Disease	N	%	N	Mean
Cercospora leafspot	36	60.0	31	3.5
Aspergillus crown rot	0	0	0	0
Fusarium	4	6.7	1	3.0
Sclerotinia blight	24	40.0	12	7.2
Seedling disease	1	1.7	0	0
Pod rot	10	16.7	6	2.8
Verticilium	2	3.3	1	1.0
Southern blight	23	38.3	19	2.7

There are no treatments available for sclerotinia blight although 10 percent of producers in Atoka/Bryan counties, and 40 percent of growers in Caddo county reported that they applied fungicides against this disease (Sholar et al., 1996). There are not treatments for verticilium although 3.3 percent of the farmers in Caddo county indicated they treated for verticilium (Sholar et al., 1996; Table 26). Cercospora leafspot, southern blight, and sclerotinia blight were reported as the greatest problems.

Most Common Insect Problems

According to the growers, the three most common insect problems peanut producers encountered in the counties surveyed were thrips, spidermites, and caterpillars. Leafhoppers are considerably problematic in Caddo county (Table 28). Nearly 42 percent of the growers in Caddo county indicated leafhoppers were a problem, yet research has never shown treatment is justified (Sholar et al., 1996; Mulder and Berberet, 1995). Thrips are a common problem that usually exist in young peanuts. They cause wrinkled leaves , and may delay growth slightly. However, Oklahoma research has shown no yield decrease with high thrip population (Mulder and Berberet, 1995). A targeted educational program is needed for insect management.

Disyston, lorsban, and sevin in Atoka/Bryan, orthene, asana XL, and comite in Caddo county were insecticides commonly used. Systemic insecticides were used here for thrips by 48.7 percent of Atoka/Bryan and 12 percent of Caddo county producers, respectively (Table 29), even though research shows treatment is not cost effective (Mulder and Berberet, 1995). Here Caddo county peanut growers did better than those in Atoka/Bryan counties in the use of systemic insecticides. Whereas 48.7 percent of

Table 28. Farmers' Perception of the Most Challenging Insects: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

	Proportion of Farmers Practicing			
Insect	Atoka/Bryan		Caddo	
	N	%	N	%
Thrips	23	76.7	40	66.7
Foliage feeding caterpillar	13	43.3	10	16.7
Spidermite	10	10.0	18	30.0
Leafhopper	-	-	25	41.7
Others	-	-	-	-

Table 29. Insecticides Commonly Used in Peanut Production: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Insecticide	Proportion of Farmers Practicing			
	Atoka/Bryan		Caddo	
	N	%	N	%
Disyston	11	36.7	-	-
Lorsban	7	23.3	2	6.7
Malathion	-	-	1	1.7
Comite	3	10.0	10	16.7
Orthene	1	3.3	19	31.7
Temik	2	6.7	5	8.3
Phorate	-	-	2	3.3
Asana XL	2	6.7	6	20.0
Sevin	5	16.7	1	1.7

Atoka/Bryan growers reported they used systemic pesticides. Only 12 percent of the producers in Caddo county used these insecticides (Table 29).

The question inquiring how often peanut producers in the two study sites soil tested for nutrient levels and for nematodes was aimed at investigating how many of the growers surveyed were knowledgeable about the need to soil test as a means of establishing yield potential of their fields (Smith and Inglis, 1986). Seventy percent of growers in Atoka/Bryan, and about 52.4 percent in Caddo counties reported that they soil tested every year for nutrients. Little more than nineteen percent of producers in each research site soil tested every 2 years and every 3 years, respectively. Twenty percent of growers in Atoka/Bryan, and about 5 percent of those in Caddo county said they soil tested every five years. Ten percent of growers in Atoka/Bryan, and about 5 percent of producers in Caddo county indicated that they rarely soil tested. Although there seemed to be a wide gap among growers in the surveyed sites in their soil testing frequency, more frequent soil testing took place in Atoka/Bryan counties, because 70 percent of producers in Atoka/Bryan counties reported they soil tested every year, compared to those in Caddo county (52.38 %) who reported they soil tested annually (Table 30).

Table 30. Frequency of Soil Testing in Peanut Production: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Soil Test	Proportion of Farmers Practicing			
	Atoka/Bryan		Caddo	
	N	%	N	%
Every year	7	70.0	11	52.38
Every two years	-	-	4	19.05
Every three years	-	-	4	19.05
Every five years	2	20.0	1	4.76
Rarely	1	10.0	1	4.76
Total	10	100	21	100

Soil sampling for nematodes is one of the major components of IPM. The following table (30) presents summary of this activity in the counties surveyed, and a significant need in both research sites for education on nematode control strategies that may include genetic resistance, chemical control, and cultural methods such as rotations (National Research Council, 1989).

Table 31. Nematodes Sampling: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Sampling	County			
	Atoka/Bryan		Caddo	
	N	%	N	%
Annually	6	35.30	18	33.96
Every 2 years	-	-	4	7.55
Every 3 years	-	-	3	5.66
3-5 years	-	-	1	. 1.89
Every 5th year	2	11.76	4	7.55
10-15 years	-	-	1	.1.89
Never	9	52.94	22	41.50
Total	17	100	53	100

There were no significant difference in nematode sampling between peanut growers in Atoka/Bryan, and Caddo counties. Thirty-five point three percent of Atoka/Bryan growers and 34 percent of Caddo county producers reported they analyzed nematodes once a year. About 53 percent of Atoka/Bryan peanut growers and nearly 42 percent of Caddo county producers never sampled nematodes (Table 31).

The question, "How often do you rotate your peanuts?" was designated to assess how much growers were aware that crop rotation is one of the key components of IPM for pest management (Francis and Clegg, 1990). In Atoka/Bryan counties, a little more than 18 percent of growers rotate their peanut farm annually, whereas in Caddo it is nearly 50 percent of peanut producers who rotate their farms (Table 32). Caddo county producers rotate their crops more than Atoka/Bryan counties' growers. This seems to be due to more severe disease pressure and more available land with irrigation that will grow peanuts in Caddo county.

Table 32: Crop Rotation Practices by Peanut Growers: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Rotation	Proportion of Farmers Practicing	
	Atoka/Bryan	Caddo
	%	%
Every year	18.2	49.2
Every two years	27.3	23.7
Every three years or more	54.5	18.6
Never	-	1.6

In Caddo county about 7 percent of its growers reported they cultivated their peanut farms four times and about 18.9 percent claimed to never cultivate their farms (Table 33). One cultivation is recommended between emergence and harvest. The higher

Table 33. Frequency of Cultivations by Peanut Growers by Season: Atoka/Bryan and Caddo Counties, Oklahoma 1966

Cultivation	Proportion of Farmers			
	Atoka/Bryan		Caddo	
	N	%	N	%
One	15	55.56	15	25.86
Two	10	37.04	15	25.86
Three	2	7.40	13	22.41
Four	-	-	4	6.90
Never	-	-	11	18.97
Total	27	100	58	100

levels of cultivation in Caddo county may be partially due to Caddo county producers trying to minimize wind erosion during the summer. With about 56 percent of their growers reporting they cultivated just once, The Atoka/Bryan area farmers appeared to do appropriate cultivation, compared to those of Caddo county's 26 percent .

For the Atoka/Bryan area, the most popular fertilizer seemed 09-23-30, followed by 17-17-17, 06-24-24, and 13-13-13. In Caddo county, still 09-23-30 is relatively popular, followed by 10-20-110, 18-46-00, and 15-30-15 (Table 34). This data indicates many growers do not follow soil test results or that fertilizer dealers do not make correct blends.

Irrigation is a crucial input to managing the peanut crop. However, there are a number of producers in Atoka/Bryan county who do not integrate soil moisture testing to make decisions. This is probably due to the lack of available water because they irrigate from ponds with limited availability.

Table 34. Fertilizers Routinely Used in Peanut Production: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Fertilizer	County			
	Atoka/Bryan		Caddo	
	N	%	N	%
17-17-17	2	8.7		
06-24-24	2	8.7		
09-23-30	14	60.7	10	27.0
10-20-110	1	4.3	8	21.6
18-46-00	1	4.3	4	10.8
10-9-36	1	4.3		
13-13-13	2	8.7		
30-20-10			1	2.7
11-34-00			1	2.7
16-20-6			2	5.4
15-30-15			4	10.8
7-21-7			3	8.1
00-28-00			1	2.7
30-15-15			1	2.7
24-24-12			1	2.7
19-19-19			1	2.7

No significant difference was observed between the two sites in the ways they irrigated (Chi Square; df.=2; $p<0.255$). However, in Caddo county soil moisture testing were made more often (Table 35).

Peanut Growers' Disease Identification Capability: Table 36 presents peanut growers' response to the question, "Can you identify most of the diseases in your peanut farm?"

Table 35. Factors Helping in Irrigation Decision Making in Peanut Production: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Criterion	Proportion of Farmers Responded			
	Atoka/Bryan		Caddo	
	N	%	N	%
Visual observation (stress)	9	42.86.	15	14.0
Personal experience	3	14.29	2	2.8
Consultant recommendation	7	33.33	19	26.7
Soil moisture testing	0	0	27	38.0
Counting no. of days since last rain	2	9.52	8	11.3

Table 36. Peanut Growers' Disease Identification Capability: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

County	Proportion of Growers (percent)	
	Able to Identify	Unable to Identify
	%	%
Atoka/Bryan	96.4	3.6
Caddo	88.3	11.7

Here again, 96.4 percent of growers in Atoka/Bryan counties, and 88.3 percent of those in Caddo county reported they could identify most diseases in their peanut farms. These responses show the importance producers put in disease management. There was no statistically significant difference regarding growers' responses to variable inquiring their capability to identify diseases on their farms. (Fisher's exact test; $p<0.427$).

Growers' Scouting Frequency. Growers' response to the question, "On average, how often are your peanuts scouted for early Leafspot?" is presented in Table 37.

Table 37. Number of Scouting Practiced by Peanut Farmers for Leafspot Diseases: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Frequency/wk	Proportion of Farmers			
	Atoka/Bryan		Caddo	
	N	%	N	%
< Once	2	7.4	16	28.07
Once	17	63.0	31	54.39
> Once	8	29.6	10	17.54
Total	27	100	57	100

With their nearly 30 percent of peanut growers scouting more than once per week, Atoka/Bryan counties scouted more frequently than Caddo county producers. There was a pattern showing differences in scouting frequency between growers in the counties surveyed (Chi-square value = 5.14; df.=2; $p < 0.077$). This probably indicates that the Caddo county producers depend more on applications and dealers for assistance.

Growers' Use of Disease Resistant Varieties: A binomial question, "Do you use disease resistant varieties?" was used to measure whether IPM had developed growers' awareness that selecting a variety included choosing a variety of plant with best characteristics suitable for a given location's conditions (Smith and Inglis, 1986).

Eighty-eight percent of growers in Atoka/Bryan, and 71.7 percent of producers in Caddo counties reported that they used disease resistant peanut varieties on their farms. This may be somewhat surprising considering Tamspan 90 is the only variety which is presently grown with significant disease resistance, and that is to sclerotinia blight which does not occur in Atoka/Bryan counties significantly.

Impact of IPM on Growers Use of Pesticides. The question, "On your farm, has IPM increased or decreased pesticide use?" was used to assess whether IPM program had influenced peanut growers to judiciously use pesticides.

The perception of producers in both areas is that, with the help of IPM practices, they could reduce use of pesticides (Table 38). Traditionally, Atoka/Bryan counties have been very low input areas with a number of growers not using many inputs. Some of these producers have now increased input levels (Cuperus, 1992). This may be a partial explanation of the 'Not sure' response in Atoka/Bryan counties.

One of the observations that can be made in Table 38 is that use of pesticides can be reduced. The benefit from the reduction of unneeded pesticides is not limited to the direct benefits to farmers, for this reduction has been shown to provide significant social, economic, and environmental benefits (Pimentel et al., 1993; Cuperus et al., 1996). The benefits to society and the environment from the reduction of pesticides includes safeguarding humans from pesticide poisonings, and significantly contributing to controlling the sad occurrences such as reduction of fish and wildlife populations, livestock losses, destruction of susceptible crops and natural vegetation, destruction of natural enemies, evolved pesticide resistance, and creation of secondary pest problems

Table 38. Producer Perception of the Impact of Integrated Pest Management on the Use of Pesticides: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Recommendation	Number of Farmers			
	Atoka/Bryan		Caddo	
	N	%	N	%
Decreased	3	33.33	13	72.22
Increased	1	11.11	1	5.56
No change	1	11.11	3	16.66
Not sure	4	44.44	1	5.56
Total	9	100	18	100

(Pimentel et al., 1980; Buttel et al., 1990; Ashworth, 1991; Tweedy et al., 1991; Pimentel et al., 1993; Eblen and Eblen, 1994; Cuperus et al., 1996).

The Atoka/Bryan growers stressed benefits from the continuation of IPM Extension Program (Table 39). They also emphasized the need of more information on IPM. The Caddo county growers tended to focus on the needs of disease resistant varieties, workshops and newsletters, more need to manage the disease sclerotinia blight through use of disease resistant varieties. Growers in both sites reported need of more extension personnel and research. The growers' emphasis on the need of more extension work may be due to the understanding that the major role of extension is to disseminate information to farmers. The extension organization obtains information from agricultural research. This information is used by the management of extension to instruct extension agents what they should tell farmers, in the expectation that such messages may bring

Table 39. Producer Response to Things Oklahoma State University Could Do to Help Producers: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Recommendation	Number of Farmers Atoka/Bryan	Caddo
Disease resistant variety	0	9
Seminars/workshops	1	5
More newsletters	1	5
Sclerotinia blight	0	4
More extension agents/Area	0	4
Continue the program	5	0
Biological control of diseases	0	1
Improve scouts	2	0
More personal contact	1	0
Program economics/evaluation	1	3
Research	1	3
Noxious weeds	0	1
More information on IPM	2	1
Spring meetings	0	1
Advertisement	1	0
Don't want IPM information	0	1
Loss of pesticides	0	2

N= 30 for Atoka/Bryan and 60 for Caddo County.

about changes in farm management among growers. There is also a flow of information from farmers to extension agents, and then to the managers of extension organizations and the policy makers. This kind of feed back information is of crucial importance for successful agricultural extension work. Agricultural development is usually the result of a joint efforts by way of communication between extension personnel and the farmers (Douce et al., 1983; Ban and Hawkins, 1985; Coleman, 1994).

Growers' Response to the Personal Interviews. The following table (Table 40) presents peanut producers' responses to the personal interviews conducted with six growers in Atoka/Bryan counties, and with nine in Caddo county. The responses selected are to the first five questions, because these are some of the key questions in the telephone survey and suitable for comparing growers' responses in the two types of survey.

Table 40. Proportions of Peanut Growers' Sample "Yes" Responses to the First Five Personal Interview Questions: Atoka/Bryan, and Caddo Counties, Oklahoma 1996

Questions	Percent Growers			
	Atoka/Bryan		Caddo	
	N	%	N	%
1. Do you feel you have adopted IPM?	3	60	6	66.7
2. Do you support the idea of widespreading IPM practices?	4	80	8	88.9
3. Do you feel that IPM field tours and workshops, or IPM displays and IPM publications are useful for your farm operations?	5	83.3	9	100
4. Does IPM take more time to practice?	4	66.7	7	87.5
5. Do you feel more growers will favor IPM in your county?	5	83.3	6	85.7

Table 40 indicates that 60 percent of Atoka/Bryan and nearly 67 percent of Caddo county growers felt they had adopted IPM. Eighty percent of Atoka/Bryan and about eighty-nine percent of Caddo county growers reported they supported the idea of widespread use of IPM. The fact that IMP field tours and workshops, or IPM displays and IPM publications were useful for growers' farm operations was confirmed by 83.3 percent of Atoka/Bryan and 100 percent of Caddo county producers, respectively. About 67 percent of growers in Atoka/Bryan and about 88 percent of growers in Caddo counties, respectively, indicated that IPM took more time to practice when compared to the conventional methods of pest management. Nevertheless, perhaps due to IPM's positive socioeconomic impact, 83.3 percent of Atoka/Bryan and 85.7 percent of Caddo counties' producers, respectively, still felt that more growers would favor IPM in their counties. This review of the personal interview report indicates that Extension IPM is perceived to be well adopted in both areas of the study. Thus data analysis from the personal interview confirmed to the overall telephone survey assessment arrived at in this study indicating that IPM practices are effectively used in the counties under study. This shows high social acceptance of the IPM program in both sites.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary and Conclusions

Comparisons of data gathered by way of a telephone survey and personal interviews with samples of peanut growers in Atoka/Bryan and Caddo counties indicated differences in IPM practices between the Atoka/Bryan growers and those of Caddo. Although Caddo was influenced by IPM, it was found that greater IPM adoption took place in Atoka/Bryan counties rather than in Caddo county. With regard to soil testing for nutrients, 70 percent of Atoka/Bryan growers made soil sampling annually, compared to 52.38 percent of the Caddo growers (Table 30). Seventy percent of Atoka/Bryan producers applied herbicides when the weed size was between 2.55 cm. and 5 cm, compared to 33.3 percent of the Caddo growers (Table 24), and 55.53 percent of Atoka/Bryan growers cultivated their peanut farm once a year, compared to 25 percent of the Caddo growers (Table 33). Caddo growers (49 percent), reported they rotated crops annually, while 18 percent of the Atoka/Bryan growers expressed they rotated corps annually (Table 32). Atoka/Bryan growers are in the lead, for instance, in diseases identification capability (Table 36), in scouting for leafspot diseases (Table 37), and in level of familiarity with IPM (Thesis p. 51). These growers have come a long way since the time they had extremely low yields and low adoption of IPM (Cuperus, 1992).

a. Probably due to this desperate economic situation, the Atoka/Bryan extension effort was led by producers with the support of Oklahoma State University Cooperative Extension. This leadership and producer to producer communication may have offset the other factors. The Caddo growers did not demonstrate a leadership role or high public participation: the university Extension was there (in Caddo county) to teach or to advise (Cuperus, 1992).

b. Atoka/Bryan counties' have younger producers than Caddo county (Table 14), and it may be that these younger farmers in Atoka/Bryan counties may have had more information that may help become up-to-date with changes being made in agricultural technologies (Thomas et al., 1990).

c. The conflict of interest that exists with some industry personnel may not reflect IPM objectives, for while IPM is for less input of pesticides and sustainable agricultural production, some industry personnel perhaps such as those in Caddo county with the agrichemical industry may suggest more use of pesticides and higher crop yield irrespective of socioenvironmental consequences (Napier et al., 1984).

It was made clear from the producers responses (both in the survey and in the personal interviews) that growers in both the research areas had adopted components of IPM. Further, they indicated that they would make every effort toward widespread adoption of IPM among farmers in their respective regions. Over 80 percent and 88.9 percent from the Atoka/Bryan, and the Caddo interviewees, respectively indicated that they supported the widespread use of IPM practices (Table 40). Key findings are presented in Table 41.

Table 41. Findings in the Ten Major Explanatory Factors Used in This Study

	Counties and Percent Adoption			
	Atoka/Bryan		Caddo	
	N	%	N	%
1. IPM awareness	18	66.7*	21	39.6
2. Weed control knowledge	21	75.0*	20	44.4
3. Soil testing for nutrients	7	70.0*	11	52.4
4. Scouting for leafspots at least once a week	17	63.0*	31	54.4
5. Use disease resistant varieties	22	88.0*	38	71.7
6. Timing of harvest				
a. hull scrape	9	30.0	9	15.0
b. visual	7	23.3	2	3.0
c. hull blaster	3	11.5	19	31.7
d. maturity charts	3	11.5	27	45.0*
7. Cultivation between emergence and harvest	15	55.5*	15	25.9
8. Ability to identify diseases	27	96.4*	53	88.3
9. Use of extension	13	43.3*	10	16.7
10. Use of insecticides	13	43.4	7	11.6*

* Higher IPM adoption between the two areas
Note: Percentages are based on producers who were aware of IPM.

In almost all the explanatory variables in Table 41, Atoka/Bryan counties' growers scoured higher percentages in carrying out key IPM practices than the producers in Caddo county. The Atoka/Bryan growers demonstrated a marked difference in improved management in such major IPM components as soil testing for nutrients, weed control, and cultivation between emergence and harvest than the growers in Caddo county

The results of this study indicated that Extension IPM programs influenced peanut growers' farming operations. Growers in both sites tended to be convinced that IPM helped them to increase their profit from its low input system and also to contribute to environmental safety by minimizing pesticide use. Caddo county with its higher total family income appeared to have a much better socioeconomic climate than Atoka/Bryan counties for IPM adoption. It was the Atoka/Bryan growers, however, who were found to have higher rates of IPM adoption than the growers in Caddo county (examples, Tables 24 and 30).This seems largely due to Oklahoma State University Cooperative Extension's role in Atoka/Bryan counties since 1987, and more importantly the leadership role producers in Atoka/Bryan counties played (Cuperus, 1992). Compared to their socioeconomic conditions prior to 1987, Atoka/Bryan counties have made tremendous progress. These counties used to be one of the counties comprising the Lake Texoma Production Region, and they produced "the lowest" yields in the state (Cuperus, 1992). Presently, as a result of increased university-sponsored extension programs and the adoption of innovative, environmentally sound, economically viable IPM practices, Atoka/Bryan counties have demonstrated significant increase in yields through IPM adoption (Cuperus, 1992). These counties have come a long way:

a. From applying fertilizers on guesswork and often not making any soil testing at all (prior to 1987) to applying fertilizers, 85 % of them, based on soil test recommendations (Cuperus, 1992). This shows they have developed better nutrient management skills.

b. From applying fungicides on predetermined, calendar dates or not applying at all to much sounder applications today such as those based on weather conditions. This indicates their improved disease management skills.

c. From digging peanuts on calendar dates that resulted in poor yields and poor qualities to digging based on the hull scrape methods (Table 22). This, in turn, shows skills development in better harvest management.

d. From indifference to environmental concerns as reflected in their pesticides and nutrients applications irrespective of any environmental basis to integrating cost effective and environmentally sound farming practices into their farming operations, thus contributing to the reduction of environmental risks.

The findings may not seem consistent with most research on diffusion (Hoggart and Buller, 1987; Turner, 1991; Rogers, 1995) because Caddo county had larger farms, more educated farmers, more experience and a better industry infrastructure. However, Atoka/Bryan counties had a program developed by the OSU Extension Service, Extension IPM, that was led by local producers, that is, by people trying innovation after trusted sources (Cuperus, 1992). This seemed to make a major difference in adoption level between the two sites.

The main objective of this study when the questionnaire was developed and the personal interview questions were devised was to see if the IPM program was adopted in Atoka/Bryan and Caddo counties. Grower responses both in the telephone survey and in the personal interviews showed that it was. In summary, the IPM program is carried out in both the study sites, with Atoka/Bryan counties' growers doing a much better job than those in Caddo county in such key IPM practices as timeliness of weed control, soil testing frequency, crop cultivation frequency between emergence and harvest.

Table 41 summarizes a number of useful grower attitudes that can enhance the adoption of IPM programs. The fact that the growers reported they were aware of the IPM programs (even though there are differences in degrees of awareness), that they soil tested for nutrients, that they scout for leaf spot diseases, use disease resistant peanut varieties, determine harvest using hull scrape/hull blaster methods, or use maturity charts demonstrates that peanut growers both in Atoka/Bryan, and Caddo counties have adopted IPM practices, so they tend to decrease pesticide use without negatively affecting their profit. This reduction in pesticide use in both research sites may have a positive bearing on the public's socioenvironmental concerns over cleaner water, safer food, and wildlife conservation (Wallace, 1993). And IPM programs educate society to achieve these goals by helping farmers apply new information and technology to safer and sustainable farming.

Recommendations

The data gathered for this survey of adoption of IPM in Atoka/Bryan, and Caddo counties may be an important contribution to the body of knowledge, especially for serving as baseline data for future research on IPM adoption in these two sites and other sites needing similar attention. The fact that this study concluded (a) there is IPM adoption in the two different sites and (b) the degree of adoption was greater in Atoka/Bryan counties than in Caddo county is itself worthwhile information on the basis of which future socioeconomic data to individual decision to adopt IPM innovation may be carried out. Hence it is recommended here that through interdisciplinary effort, including scholars from the social sciences, data on ecological, social and economic factors be gathered for further IPM adoption research in these sites and/or other sites that need similar investigations.

IPM is an agriculture bound educational, technical, multidisciplinary venture by its very nature. With sociological insights put in, the engineers', and the biologists' effort can be greatly improved, for sociology examines not only what is physically needed , but also examines the influences that social institutions, values, and norms have on the ways people think, feel, and behave about, say, innovations (Nisbet, 1966; Abrams, 1982; Lee and Newby 1989; Bordieu and Coleman, 1991). Environmental sociologists can play a decisive role not only in applying theoretical principles to solving problems occurring in constituent groups, but also in pointing out areas of research in extension dealing with the adoption of innovations in agriculture (Christenson et al., 1977; Dunlap and Martin, 1983). Since agriculture is a major example of the relationships between humans and the physical environment that constitute the subject matter of environmental sociology (Dunlap and Martin, 1983), Oklahoma State University Cooperative Extension Service needs to further integrate environmental or rural sociologists in its programs for more effective results in its various rural development programs. To this effect, Oklahoma State University Cooperative Extension Service:

1. Should do its best so that its extension personnel become more of a recognized information source, especially in Caddo county.

2. Should do whatever it can for continued presence of its extension personnel among growers. Lionberger and Gwin (1991) emphasize that when growers find that they cannot depend upon an agency to supply what they need when they need it, they are not likely to adopt new practices that require that agency's services. Even though extension apparently has made significant impacts in the research sites, it is clear a continued presence is needed by growers so that continued efforts can be made to solve problems with perceptions of insects and the use of systemic insecticides on the use of soil sampling and nutrient management, weed management and disease management on peanut farms.

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APPENDIXES

APPENDIX A

TELEPHONE SURVEY ADMINISTERED TO GROWERS

IN ATOKA/BRYAN AND CADDO COUNTIES

County:_______ Name: _______ Phn#:______ Date________ Time ________

AN IPM TELEPHONE SURVEY IN ATOKA, BRYAN, AND CADDO COUNTIES

Oklahoma State University is conducting a survey to assess the adoption of Integrated Pest Management (IPM) practices. Some of these questions are considered personal, so your answers will be confidential. Your responses are very important to the Extension service to meet growers needs. The survey will take 12-15 minutes of your time.

1. Do you grow peanuts? ______ yes ______ No

2. What is your seeding rate? _____ pounds/acre, or ________ bushels/acre

3. Of the peanut acres you farm, how many are rental and how many are owned?
   _______ rental ________ owned

4. How many years have you been growing peanuts? ____________ years.

5. What peanut varieties do you grow?

   1. Tamspan 90 4. Spanco
   2. Pronto 5. Starr
   3. Okrun 6. Florunner

Irrigated		Dry land	
Variety	Acres	Variety	Acres
__________________	________	________________	__________

6. What are the top 3 key factors in choosing a variety?

   1. ______________________________________
   2. ______________________________________
   3. ______________________________________

7. How many bushels or pounds of peanuts/acre did you average in 1995?

   Irrigated: _______ Pounds/acre or ________ bushels/acre or _____ tons/acre

   Dry land: ________ Pounds/acre or _______ bushels/acre or _____ tons/acre

8. Who influences farm management decisions? Please circle the correct response on the scale of 1-4, with 4 indicating the greatest influence and 1 the least influence.

Influence Agent	**Scale of Influence**			
Self	1	2	3	4
Family	1	2	3	4
Private consultant	1	2	3	4
Landlord	1	2	3	4
County extension agent	1	2	3	4
Extension service specialist	1	2	3	4
Other farmers	1	2	3	4
Agrochemical dealer	1	2	3	4
Other _________________	1	2	3	4

9. Are you familiar with integrated pest management? _____ Yes ____ No
(If "No", then skip to question 16)

10. How did you first learn of the IPM programs to help manage pests in peanuts?
(If Newspapers are not selected, skip to question 12)

_____ Private consultant
_____ County extension agent
_____ Other farmers
_____ Grower meetings
______ Newsletters
______ Newspapers/Magazines
______ ASCS
______ Do not remember
_____ Other ____

11. If you have learned about IPM through newspapers, or magazines, specifically which newspapers or magazines did you read about IPM?

____

12. What do you see as the major advantages in using IPM in your peanut farm?

1. ____

2. ____

3. ____

13. On your farm, has IPM increased or decreased pesticide use?

_____Increased _____Decreased _____No change _____Not sure

14. How often do you soil test?

15. Do you feel that Integrated Pest Management program has caused you to soil sample more often than you did before?

____ No ____ Yes If yes, how ______________________________

____

16. What fertilizers do you add routinely each year?

____

17. How often do you rotate your peanuts? **If never, answer why and skip to question 19.**

_____ Every year. ____ Every 3 years or more
_____ Every 2 years ____ **Never (If never, why)?**_______________

____

18. If you rotate your peanuts, what crops do you use for rotation?

____

19. Do you keep the following records?

Financial ___ Yes ___ No
Field history ___ Yes ___ No
Pesticides ___ Yes ___ No

20. Would you be interested in learning more about Integrated Pest Management practices?

_____ Yes _____ **No (If "Yes," how)?**
_____ Literature _____ Workshops
_____ Newsletters _____ Other(s) (Please list) ______________________

____

21. What are the most troublesome weeds you have?

_____ Eclipta _____ Crabgrass
_____ Morning-glory _____ Texas Panicum
_____ Pigweed _____ Teaweed
_____ Other (List please) ______________________________

22. How big are the weeds when you apply herbicides?

_____ Less than 1 inch _____ 2-3 inches
_____ 1-2 inches _____ 3 and up inches

23. What herbicides do you use post emergence?
_____ Blazer ____ Basagran
_____ Pursuit ____ 2, 4-DB
_____ Others (List Please) ____________________

24. How many times do you cultivate peanuts between emergence and harvest?
_____ times

25. Can you identify most of the diseases in your peanuts? ____ Yes ____ No

26. Who scouts your peanuts for leafspot diseases?
Self ______________ Commercial field person ______________
Consultant __________ Other(s) (Please specify) ______________
Do not scout _________ **(If answer is "Do not scout", skip to question 28).**

27. On average, how often are your peanuts scouted for early leafspot?
___Less than once per week ___Once per week___ More than once per week ___

28. Do you use disease resistant varieties? ____ Yes ____ No

29. Please rank in order of importance your 3 major disease problems.

Cercospora Leafspot Seedling Diseases
Aspergillus Crown Rot Pod Rot
Fusarium Verticillium
Schlerotenia Blight Southern Blight

No disease Problem _______________

Diseases	Number of fungicides applications
1. ______________________________	___________
2. ______________________________	___________
3. ______________________________	___________

30. How do you decide when to apply fungicides for the following?

	Southern Blight	Leafspot	Schlerotenia Blight
Do not use fungicides	_____	_____	_____
Personal experience	_____	_____	_____
Professional consultant	_____	_____	_____
Time of year	_____	_____	_____
visible damage	_____	_____	_____
Extension recommendations	_____	_____	_____
Aerial applicator recommendations	_____	_____	_____
Field history	_____	_____	_____

Other(s) (Specify please.) ______________________

31. How often do you sample for nematodes on your peanut farm?

____

32. What are your three most common insect problems? **(Check only Three).**

Insect	Insecticides Used
______ Thrips	______________________
______ Foliage feeding caterpillars	______________________
______ Spider Mites	______________________
______ Lesser cornstalk borer or cutworms	______________________
______ Leafhoppers	______________________
______ Other **(Please list)**	______________________

33. Where do you get information to determine when to treat for weeds, diseases, and insects in your peanuts?

______ Extension Personnel	_____ Personal experience
______ Professional consultant	_____ Aerial Applicator
______ Visible damage	_____ Chemical company recommendations
______ OSU Mesonet	_____ Other(s) (Please list) ___________

34. How long does it take to scout 10 acres of your peanuts?___________________
____

35. How do you determine when to harvest?
____

36. How do you determine when to irrigate?
____

37. Do you make income from off-farm employment? ____ Yes ____ No

38. Does your spouse make income from off-farm employment?____ Yes ____ No

39. What is your annual total family income? Please give ranges.
1. Less than $20,000/year
2. $20,000-$34,999/year
3. $35,000-$49,999/year
4. More than $50,000/year

40. Would you mind identifying your age? ______ years old.

41. What is the highest grade you completed?
1. _____ High school
2. _____ Some college
3. _____ College degree
4. _____ Advanced degree
5. _____ Other

42. How can Oklahoma State University help implement IPM programs into your peanut production system?
____
____

Thank you so much for your cooperation. Good bye.

APPENDIX B

INSTRUMENT—PERSONAL INTERVIEW

CONDUCTED WITH PEANUT

GROWERS

AN IPM TECHNOLOGY ADOPTION IN-DEPTH PERSONAL INTERVIEW IN ATOKA, BRYAN, AND CADDO COUNTIES

June 18, 1996

NAME ________________ COUNTY _____ DAY/TIME _________

TEL.# _____________

(Key: 1=Yes 0=No)

1. Do you feel you have adopted IPM? 1. 0
2. Do you support the idea of widespreading IPM practices? 1. 0
3. Do you feel that IPM field tours and workshops, or IPM displays at field days and IPM publications are useful for your farm operations? 1. 0
4. Does IPM take more time to practice? 1. 0
5. Do you feel more growers will favor IPM in your county? 1. 0
6. Are you a full time grower, or a part-time grower? FT PT
7. What is your major farming goals?
   a. keep farm in family 1. 0
   b. retirement income 1. 0
   c. Maximize present income . 1. 0
   d. supplement present income 1. 0
   e. permits living in area 1. 0
   f. no other job available 1. 0

APPENDIX C

LETTER TO EXTENSION AGENTS

Oklahoma Cooperative Extension Service
Division of Agricultural Sciences and Natural Resources
Oklahoma State University

Department of Entomology • 127 Noble Research Center • Stillwater, Oklahoma 74078-3033
(405) 744-5527 • Fax (405) 744-6039

May 11, 1996

David Nowlin
Extension Agriculture Agent
201 W. Oklahoma
Anadarko, OK 73005

Dear David,

Desalegn Seyum and I have been working on this survey and thesis project. The surveys are being administered both via phone and in person. We have a request. Would you please work with us on getting surveys to growers. Wes and Desalegn will try to interview them in the field/home. We need to get data flowing to get the dissertation finished. We will continue to have the phone surveys, but need on the ground assistance. Desalegn will FAX you names of producers we have not contacted yet. We appreciate your time and efforts. If you have questions, please call Wes or I.

Sincerely,

Gerrit Cuperus
IPM Coordinator

APPENDIX D

INSTITUTIONAL REVIEW BOARD (IRB)

APPROVAL FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 04-29-96 **IRB#:** AG-96-023

Proposal Title: AN ASSESSMENT OF INTEGRATED PEST MANAGEMENT (IPM) ADOPTION IN ATOKA, BRYAN, AND CADDO COUNTIES: A GRADUATE RESEARCH PROPOSAL

Principal Investigator(s): Gerrit Cuperus, Desalegn Seyum

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING.
APPROVAL STATUS PERIOD VALID FOR ONE CALENDAR YEAR AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval are as follows:

Signature: John H. Wychoff

Chair of Institutional Review Board

Date: May 8, 1996

2

VITA

Desalegn Seyum

Candidate for the Degree of

Doctor of Philosophy

Thesis: ADOPTION OF PEANUT INTEGRATED PEST MANAGEMENT (IPM) PRACTICES IN ATOKA/BRYAN COUNTIES AND CADDO COUNTY OF OKLAHOMA

Major Field: Environmental Science

Biographical:

Personal Data: Born 12-22-53 in Ethiopia.

Education: Received Bachelor of Arts degree in Education from Emperor Haile, Selassie I University, Addis Ababa, Ethiopia; received Master of Arts degree in Literature from Addis Ababa University, Addis Ababa, Ethiopia in July 1979 and November 1985, respectively; completed the requirements for the Ph.D. degree with a major in Environmental Science at Oklahoma State University in May, 1997.

Experience: Raised in a small rural village near the Blue Nile Valley in Ethiopia; employed by Addis Ababa University as Dean of Students at Awassa Agricultural College in southern Ethiopia in November 1979; elected President University Teachers Association, Alemaya University of Agriculture, Ethiopia, 1988-1990; elected Chairman, University Teachers Self-Help Program Alemaya University of Agriculture, 1987-1992; elected President, Ethiopian Students Association, OSU, 1993-94.

Professional Memberships: Alpha Kappa Delta, International Sociology Honor Society, member since March 1993.