EVALUATION OF THE NEEDS OF OKLAHOMA EXTENSION PERSONNEL RELATIVE TO ENTOMOLOGY PROBLEMS

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INTRODUCTION

During the past fifteen years, research and industry have accomplished phenomenal growth in the development of chemicals for agricultural purposes. While benefits from the use of these materials are many, the rapid development and expanded use of the pesticide chemicals have created the possibility of undesirable secondary effects to man's environment. Questions from various sources have arisen as to the potential hazards created from widespread use of these materials, expecially the insecticides. The inherent nature of insecticide usage, their relative toxicity, and their ability to persist for extended periods of time in the environment have been the basis for considerable reappraisal of their recommended uses. It is within the interest of everyone that these chemicals be used in such a way that they will provide maximum benefits to all and yet permit maximum safety to society.

In a recent article in American Scientist, Dr. Frank E. Egler stated,

> The problem of pesticides in the human environment is 95 per cent a problem--not in the scientific knowledge of pesticicides, not in the scientific knowledge of the environment--but in the scientific knowledge of human behavior (Egler, 1964).

As attempts to understand the present dilemma have increased, it becomes apparent that intensified efforts toward a more enlightened public is equally as important as some of the more subtle aspects of the problem. This trend in thinking was expressed by Dr. Charles E. Palm, Dean of the College of Agriculture, Cornell University, in an

address to the 1965 meeting of the Entomology Society of America. He suggested that a larger share of funds available for entomology regulatory purposes be spent in public relations and research designed to guide control programs.

The Cooperative Extension Service of the U. S. Department of Agriculture has been designated as the Federal Agency responsible for conducting educational programs on the proper and safe use of the pesticide chemicals. In conducting these programs, extension subject matter specialists are constantly challenged to develop more appropriate and effective testing methods and educational materials-

This study was designed as a means of evaluating some of the methods and techniques presently employed by the Oklahoma Agricultural Extension Service in conducting entomology programs and to establish the needs of extension personnel in future educational work in entomology and the safe use of pesticides.

Extension programs and philosophy have undergone some major revisions in recent years. The revisions are primarily due to the sweeping changes in agriculture and the resulting complexity. These developments are important as background information relative to some of the aspects of this study and have been included in Appendix A.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

CHAPTER I

REVIEW OF SELECTED LITERATURE

Scientific knowledge per se will not solve the pesticide problems of today. As new information or new knowledge is made available, it must be disseminated through organized communication by individuals capable of making accurate interpretation of research to reach the general public who use a high per cent of all pesticide chemicals. The Cooperative Agricultural Extension Service has been designated as the federal agency responsible for conducting the educational program on safe use of pesticides. Programs, procedures and effectiveness of extension workers have been investigated by various workers. One of the earliest studies of agricultural extension work was conducted cooperatively by 12 states during the period from 1922 to 1929. These studies were conducted as surveys for the purpose of determining the effectiveness of agricultural extension work as a method of improving farm practices (Smith and Wilson, 1930).

As early as 1920, Crosby reported results of a survey to determine courses being offered to train extension workers. He reported only six states were offering any courses for prospective extension personnel at that time (Crosby, 1921).

In 1929, a study of the curricula of the land-grant colleges to determine what special courses were available for prospective extension workers showed 19 of 23 colleges surveyed offered extension methods

courses (Shinn and Merrill, 1927).

A study in 1938 included data from 7,873 extension workers relating to the preparation and training of extension employees. Information included tables to show tenure, degrees held, subjects completed as undergraduates, advanced degrees, and experiences of workers (Wilson and Crile, 1938).

In 1941, a study relating to the preparation and training of state extension subject matter specialists was published. The purpose of the study was to obtain information on the nature of training needed by prospective or in-service extension subject matter specialists (Crile, 1941).

In 1950, Matthews investigated training needs of county agents for the purpose of planning training programs for agricultural extension workers in Texas (Matthews, 1951).

The Agricultural Experiment Station of the University of Missouri published results in 1952 of a study which investigated the relationship between county agent's success as an agent and such factors as background, training, vocational interests and personality traits (Nye, 1952).

In 1954, Adams surveyed 126 county agents and assistants in Oklahoma as a study of the performance of specified extension tasks by county agricultural agents in relation to their professional training and experience. He reported there was positive association between the amount of formal training and the facility with which agents reported having performed specified tasks in extension work (Adams, 1956).

An Oklahoma study by Warren in 1960 analyzed some of the training factors associated with the success or failure of county agents in the

state. He concluded that the most successful agents were those who undertook a very broad field of study at both the undergraduate and graduate levels (Warren, 1960).

In 1961, Casey did a study concerned with the development of an instrument to determine how well extension agents do their job. He designated the instrument A Performance Review and concluded the instrument could be used with validity (Casey, 1961).

In 1964, Taggert analyzed the short-course system in selected facets of extension animal science teaching and program planning. He concluded "in depth" subject matter instruction was successfully taught to students of varying age, experiences and educational backgrounds (Taggart, 1964).

Only a few studies have been conducted on extension entomology problems or problems related to the pesticide situation. In 1958, a committee of the Chemical Specialties Manufacturing Association conducted a survey to determine how carefully people read labels on household pesticides. Only 64.2% of 1,206 respondents reported they read all the instructions on the last insecticide package they used. Only 33.5% reported they knew an important ingredient, and only 15% knew important precautions given on the label (Miller, et al., 1958).

A similar study by the University of Wisconsin was conducted for the purpose of determining how well farmers understand what they read on pesticide labels. Farmers comprehension of terminology used on labels was not as adequate as would be expected. Such terms as wettable powder, fungicide, herbicide, infestation and toxic symptoms was missed by over 40% of those tested (Farm Chemicals, 1965).

The most comprehensive study and the one most nearly related to

this study was conducted by Allen in 12 of the north central states. He investigated extension entomology problems and methods by surveying 812 county agents in Illinois, Indiana, Iowa, Kansas, Kentucky, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin. He concluded that county agents devote 14.2% of their working time during the growing season to entomology problems. A high per cent (91.9%) of county agents want organized in-service training in entomology. The majority of agents surveyed (56.5%) thought it necessary to have an extension entomologist at the state office each day during the growing season. Of the methods examined as sources of current information, agents listed newsletters most frequently and 84.5% said they used them frequently in their programs. Only 1.4% of the agents in Allen's study thought the public understood insect control recommendations "every time" (Allen, 1964).

History has been witness to the fact that man's primary concern has always been his struggle for survival and control of his environment to whatever extent possible to the improvement of his lot. It has been estimated that for more than 99% of the time man has been on earth he existed by searching for his food (Smith, 1965). In very recent years, man has been called an ecological dominant, capable of molding his environment to his will while retaining his independence of it (Rudd, 1964).

In an address before the Great Lakes Consumer Conference in Detroit, Secretary of Agriculture Orville Freeman referred to rapid changes of today as an era of collapsed time. Changes which once spanned a generation or more may now take place in only a year or two. The statement is probably nowhere better reflected than in the rapid

technological developments in pest control within the past two decades. On the one hand, the new chemicals are giving agriculture greater protection from pests than it has ever known. On the other hand, they present a potential problem of environmental contamination which must be taken into consideration. Unaided, nature is extremely slow to change, while society is in a hurry to make sweeping changes, since man's health and material progress has depended on his ability to exploit nature's resources.

An eminent sociologist has commented on the role of insect control in the accelerating extension of life expectancy in recent years. He stated that life expectancy at birth was probably not more than 30 years in Egypt, Greece and Rome at the beginning of the Christian era. In 1650 to 1700, it was only about 33 years in Western Europe and North America. By 1900, life expectancy at birth had reached a level of 45 to 50 years in Western Europe and North America, and by 1960 had reached a level of approximately 70 years in these areas. As many years have been gained in the last six decades as in the previous 19 centuries. The increase in life expectancy has been contributed to three major factors: (1) technolgoical advances and long periods of peace; (2) improved environmental sanitation and personal hygiene; and, (3) modern medicine, chemotherapy, and the recent developments with insecticides (Hauser, 1964).

Others have expressed similar views. Sir Harold Hartley in a lecture at Oxford said,

> The outstanding achievement of medical research into man's relation with his environment has been the control of microbial infections by the most varied means. To this many agencies have contributed, vaccines, antibiotics, new pharmaceuticals, anti-malarial drugs and insecticides like DDT. (Hartley, 1965)

Application of agricultural technology, of which pest control is a part, has greatly increased the yields of American forests, crops, fruits and vegetables. The area under agriculture is about the same now as it was in 1910, but only one person in five now lives and works on farms as contrasted to the three out of five in 1910 (Clawson, et al., 1960). The ratio between numbers of farm workers and consumers may also be cited as some measure of success of agricultural technology of which pest control prominently figures. In 1920 one farm worker produced food and fiber for eight, whereas in 1957 the ratio was one to twenty-three (Gunther and Jeppson, 1960).

Crop losses to insects are unquestionably important. For many years 10% loss has been accepted as standard for insect damage to agriculture. In 1954 Decker suggested three major corrections that should be applied to the 10% rule. He suggests that it was first probably an underestimate. Second, that many of our most destructive insect pests were introduced from other areas about 1891 or shortly thereafter. Third, that American market standards have risen so sharply that insect-damaged produce is not acceptable in commerce (Decker, 1954). Losses to food production from insect damage are now estimated by some to be as high as 30% (Steinhaus, 1964).

Convincing data on insect losses are difficult to find as illustrated by a report in the Journal of Economic Entomology in 1942 (Parker, 1942). Some estimates have been attempted, however, and in 1952 Haeussler estimated injurious insects were costing the United States four billion dollars annually (Haeussler, 1952).

Specific estimates applying to particular crops are most useful, and the best summary available of this type is a publication by the

Agricultural Research Service. Insect losses due to damage during production, control costs, and storage losses are estimated in excess of five and a half billion dollars (ARS, 1965).

Since the benefits from insect control can be demonstrated to be unusually high, what are the contributing factors which have led to the present dilemma in use of insecticides?

The use of agricultural chemicals as pesticides was of minor significance until the latter half of the nineteenth century. During that time Paris green, one of the copper arsenites, was developed and found extended use as a control for the Colorado Potato Beetle (Brown, 1951). Various other pesticides, including arsenicals, mercury and copper compounds, sulfur, cryolite, pyrethrum, nicotine sulfate and a few other products, were developed and gradually increased in usage so that by 1948 the total reached 250,000 tons (Baldwin, 1962).

As the newer chemicals appeared on the market, the total volume used continued to climb. In 1962 the value of pesticide sales in the United states was an estimated $695 million (U. S. Bureau of the Census, 1962).

With the advent of DDT in 1945, there followed a rapid development of a whole series of organic chemicals for agricultural uses. This is generally considered the introductory date for the synthetic organic insecticides. Actually, the United States Department of Agriculture began studies in 1922 on some of the synthetic organic insecticides as potential repellents and fumigants and a few years later synthesized some of them as poisons for insects. Such materials as carbon disulfide, napthalene and p-dichlorobenzene are examples of these early materials. Ethylene dichloride, ethylene dibromide, methyl bromide and thiocyanates have been used for over 35 years. Phenothiazine was introduced as an

insecticide in 1935 and is considered one of the early members of the newer synthetic age (Bowen and Hall, 1952).

The advent of organo-synthetic insecticides in the mid-to-late thirties is said to have contributed greatly to committing insect pest control to primarily technological solution for the following 20 or more years (Arrington, 1951).

The introduction of DDT into the United States by J. R. Geigy Company in August of 1942 is considered the base point for the very rapid expansion in the use of the organic insecticides (Bowen and Hall, 1952).

Rapid replacement by these new pesticides came about as a result of the improved controls and increased effectiveness at lower application rates than was possible with the older materials. The discovery and use of chemicals other than insecticides such as herbicides, rodenticides, defoliants and desiccants has also increased in both tonnage of chemicals used and acres treated within the past 20 years. The committee on policy and procedure for pest control of the National Academy of Sciences, National Research Council reported in 1962 that almost a billion pounds of pesticide chemicals were used in the United States representing a fivefold increase in the past 25 years (Baldwin, 1962).

In the early years of their use, pesticides were considered almost solely in terms of their contributions to our comfort, safety and productivity. Now, general attention is focused on the possible harmful effects which must be avoided or controlled. As new chemicals were developed and their use in agricultural production grew, indications of increasing environmental contamination became evident. Many of the

pesticides in use today produce residues that persist for noticeable periods of time. They are highly variable in their persistance. Some may survive for only a day or two, while others, depending on soil type, climatic conditions, moisture and other factors, may persist for several years. In most instances, residues on the immediate target area will not retain pesticide value for more than two or three weeks and some for much shorter periods of time. There are exceptions to this general statement as with the systemic chemicals and some of the more stable compounds that lose their identity slowly. Chemicals such as DDT, BHC, heptachlor, dieldrin and chlordane remain for long periods of time in soil. Experiments with DDT applied at heavy applications of 100 pounds per acre in 1947 had residues of 28.2 pounds per acre in 1951 (Allen, et al., 1954). Work reported in 1953 showed a loss of nearly 10% per year over an eight year period in areas heavily treated with DDT for Japanese beetle control (Fleming and Maines, 1953). In a study involving 14 orchards, the recovery of 26.6% of the total amounts of DDT applied as sprays for a ten year period was reported (Leichtenstein, 1957). In a five year study, the respective average annual losses of DDT and BHC were reported at 12 and 16% (MacPhee, et al., 1960). No heptachlor was recovered from soils treated nine years previously; however, its conversion product, heptachlor epoxide, was present at almost 5% of the original application rate. Under the same conditions, 15% of a single chlordane application was detectable after 12 years (Leichtenstein and Polivka, 1959). Heptachlor also appears to be very stable in soil. The most extensive use of heptachlor in the United States was in the fire ant control program involving large acreages in several states at the original rate of two pounds per acre applied to

the soil surface. Twelve per cent of the insecticide remained in the top six inches of soil for six months following treatment. This percentage consisted of over twice the amount of heptachlor epoxide, the conversion product, than of heptachlor (Barthel, et al., 1960). The U. S. Department of Health, Education and Welfare compiled an annotated bibliography in late 1964 with 437 references on pesticides in soil and water (Thomas, et al., 1964).

In addition to the problem posed by persistance of chemical residues in soil, various studies have shown that pesticides may be transported from one area to another by air currents, run-off water or by living organisms through extended food chains. It is generally believed that toxic residues are transferred from treated areas primarily by water movement to untreated areas. Studies in 1948 traced phenols in ground water to waste discharged from a plant producing a weed killer containing predominately trichlorophenol. The phenols were detected within 17 days of the time of discharge into the city's activated sludge sewage treatment plant. The plant discharged its chlorinated effluent to the Rio Hondo river. The waste percolated down through the river bed to a ground water basin. This short time discharge of waste caused odors and taste in water supplies detectable five years afterward (Sayre and Stringfield, 1948).

Contaminated surface water from irrigation and excess rain water has been shown to carry chemicals from treated areas into streams and ponds (Nicholson, et al., 1962). The U. S. Public Health Service has within the past six years begun measuring of chemical contamination in some of the major streams in the United States as a study on pesticide movement from target areas (Tarzwell, 1959). Studies of fish

contamination also demonstrate the problem of residue transfer. Trout from Rocky Mountain streams far from sprayed areas had DDT deposits in tissues (Cope, 1961). Studies in 1963 demonstrated some of the effects of insecticides on aquatic life (Mulla, et al., 1963).

Collections of several species of water fowl near Great Slave Lake in Canada, over 500 miles from the nearest known insecticide application, showed DDT residues in almost 50% of all adult birds analyzed (George, 1963).

Perhaps even more important than the physical movement of chemicals in the environment is the biological paths followed when residues move from the area of deposition.

Two methods of expression of the toxic effects of pesticides in biological transfer have been noted. The two-link transferral in which both members die has been described as "secondary poisoning". The transferral of chemicals along two or more links of a food chain in which only the terminal member dies is referred to as "delayed expression". In delayed expression, tissue contamination, but not death, must occur in at least the first one or two links in the food chain. Because the initial toxicity is low, a chemical must be concentrated at each successive step in its transfer for ultimate toxicity (Rudd, 1964). The concentration of chemicals biologically is most readily effected in the "closed" ecosystem. The best example of such a system would be stable bodies of water in which obligate feeding relationships exist in the environment where chemicals are confined. One of the most often cited examples of delayed expression is that of the death of fish-eating birds following the application of DDD to control the gnat Chaoborus astictopus Dyer and Shannon at Clear Lake, California.

Applications of DDD were made in September of 1949, 1954 and 1957. The latter applications were applied at one part DDD to fifty million parts of water. Following each application of the insecticide, the death of several western grebes was noted. Also, the summer breeding colony showed a very sharp decline after the first application. Following the third DDD application, a third die-off of birds was observed and wildlife biologists discounted disease as a cause. As an afterthought, the viceral fat of two grebes were removed and analyzed for DDD. A surprising level of 1600 parts per million was found in these tissues. Contaminated food was judged to be the source. This conclusion led to a large study of lake organisms that might be considered as biological concentrators. Hundreds of samples of plankton, fish, frogs and birds from the Clear Lake area were chemically analyzed. All contained DDD. The concentration ranged from a little over five parts per million in frogs to as high as 2500 parts per million in some fish species (Hunt and Bischoff, 1960).

Similar examples of delayed expression have also been recorded in terrestrial ecosystems. One of the most highly publicized was the bird losses resulting from attempts to control Dutch elm disease with DDT sprays for the control of elm bark beetles responsible for spreading the fungus from infected to healthy trees. Due to the expense of removing infected trees, insecticide applications have been the most used method of attempting to prevent elm tree losses. The choice of chemicals until quite recently was limited to either DDT or methoxychlor. Since economics often dictates choice of chemical used in control programs, most organized community programs depended on DDT as the most economical method of bark beetle control. Although some bird mortality had been

recorded earlier, it was not until 1950 that studies were instigated that ultimately led to the conviction that DDT transferred through other organisms in the food chain was responsible for bird mortality (Baker, 1958).

Sharp decline of several species of birds has been recorded when Dutch elm disease control with DDT has been used repeatedly. One study has shown a decline in the number of robins on the Michigan State University campus in three years from over 300 to only four birds. Although robins seem to be the most obviously affected by DDT in Dutch elm disease programs, the study listed 94 species found dead or dying in treated areas. Samples of 41 species were analyzed and 34 of these contained DDT (Wallace, et al., 1961).

Many papers have been published on the effects of various chemicals on fish, birds and other animals. Those cited are used only as examples of some of the problems encountered as research workers gradually discovered devious means of chemical displacement.

Chemical Drift Problems

Wherever chemicals are applied for the control of agricultural pests, drift may have to be considered as a problem depending on the nature of the application and types of crops grown adjacent to the target area. Probably of major concern is the drift hazard created by the displacement of chemicals from the intended target area into adjoining areas such as wildlife habitats, streams, lakes, ponds, housing areas or agricultural crops grown for human or livestock consumption. The possibility of immediate harm is not so great as the more complex situation of potential undesirable residues on fruits and vegetables or

contamination of feed crops to be consumed by domesticated animals.

Several factors are considered important in relation to drift problems; however, none has approached the impact of the use of the airplane as a tool in pest control. In the United States, attempts were made as early as 1918 to use the airplane to control insects, but it was not until 1921 that a specially equipped plane proved the feasibility of using this tool as an effective method. The first successful use of the airplane was for control of an infestation of catalpa sphinx near Dayton, Ohio in 1921 (Messenger and Popham, 1952).

Since this early beginning, use of the airplane as a method of applying agricultural chemicals has grown to a multi-million dollar industry. A report by the Federal Aviation Agency in 1962 shows that 150 million pounds of dust insecticides and 74 million gallons of liquid insect sprays were applied by air in 1960. The same report showed 25 million pounds of dry chemicals and 44 million gallons of liquids applied for all other aerial pest control operations including fungicides, herbicides, desiccants and defoliants. The total acreage treated was over 46 million (Federal Aviation Agency Report, 1962).

As use of the airplane for chemical application in agriculture grew, various problems became evident and chemical drift was soon a major issue. The issue resulted from action by the 83rd U. S. Congress on July 22, 1954, when Public Law 518 was passed to amend the Federal Food, Drug and Cosmetic Act with respect to residues of pesticide chemicals in or on raw agricultural commodities. The amendment provides that: (a) chemical residue tolerances will be allowed for specified chemicals on specific crops; (b) zero tolerance will apply to all chemicals on crops unless a specific tolerance is granted; and, (c) for milk and milk

products, no tolerance has been granted.

With the passage of Public Law 518, now called the "Miller Amendment," the Food and Drug Administration increased its examination of food shipments and seizures were made where products containing illegal residues were found.

The discovery of the hormone herbicides and their resulting widespread use by aerial application served to draw attention to the potential hazards from drift. Under specific weather conditions, the drift from large sprayed areas could produce crop damage symptons as much as 15 miles from the sprayed area.

In 1953 the editors of Stanford Law Review examined the actions of various courts throughout the United States and determined there was growing evidence of court decisions placing aircraft chemical application in the "strict liability" or inherently hazardous category. The burden of liability for drift damage is thus placed on the applicator and the farmer who hires him without need for proof of negligence (Stanford Law Review, 1953).

Factors affecting drift of agricultural chemicals from airplanes were reviewed by workers in California in 1964, including distribution of chemicals in the aircraft wake, types of chemical formulation, spray particle analysis and micro-climatology (Akesson and Yates, 1964).

Chemical drift may create problems of several kinds. Improper and poorly timed application of chemicals often reduces effectiveness which may require more frequent applications. When applications reduce effectiveness, the chemical users or manufacturers may protest. Within recent years, the contamination of food and forage crops by chemical drift has become a major problem. Chemical placement problems are not

confined to aerial applications, however, and several physical and mechanical aspects of insecticide application have been reviewed by Courshee (Courshee, 1960).

While research workers in many areas of government, industry and universities worked to solve the problems created by widespread use of chemicals, a publication in 1962 charged that irresponsible use of agricultural chemicals had caused universal contamination of the environment. The book, Silent Spring, by Rachel Carson charged that man has now upset the ideal state of "adjustment and balance" of life through his "synthetic creations having no counterpart in nature" (Carson, 1962). The book became an immediate bestseller and many in America's scientific community have been concerned with the public comment and publicity accorded this publication. Though many scientists are doubtful of the public's scientific knowledge or detachment in objectively appraising its central conclusions, it is believed by some that the book has rendered a service. It has been given credit for arousing an apathetic public to a more serious problem of producing enough food for a rapidly growing population as well as protecting man from the scourge of disease (Stare, 1963).

While the book may have awakened the public to some of the problems in use of insecticides, it likewise left considerable doubt in the public mind as to the benefits or the needs of argicultural chemicals. The implication that industry, university scientists and government employees had done little to determine the effects of these materials on the environment and human health is not valid in light of the many research papers available on these subjects.

As early as 1946, studies were made with DDT to determine the effect on dairy cows when ingested (Allen, et al., 1946). Investigations at

Oklahoma State University were conducted in 1946 demonstrating that DDT could be recovered from milk of dairy cows following repeated spraying. Recovery up to 33.6 PPM of DDT was effected following 30 days of applying two quarts of 5% DDT spray (Howell, et al., 1947). The United States Department of Agriculture conducted studies as early as 1950 to determine the contamination of meat and milk by chlorinated hydrocarbon insecticides used for livestock pest control (Bushland, et al., 1950). Earlier work by U.S.D.A. had also investigated the chlorinated hydrocarbon content of milk from cattle sprayed for horsefly control (Carter, et al., 1949). In 1957, Barnes reviewed information on the control of health hazards associated with the use of pesticides. He cited 139 papers on toxic properties of pesticides, manufacture and distribution, user hazards, medical control and treatment, accidental poisoning and residues on food (Barnes, 1957).

A symposium held at Beltsville, Maryland, in April of 1960 attracted over 500 scientists representing federal research and regulatory agencies, state agricultural experiment stations and chemical companies. During the three-day meeting, papers were presented which cited almost 600 research studies on the nature and fate of chemicals applied to soils, plants and animals. The Agricultural Research Service subsequently published those papers presented and references cited (ARS, 1960).

A literature review by Hays in 1960 cited 112 papers on pesticides in relation to public health (Hays, 1960).

A subsequent review of literature by Durham includes 200 papers on pesticide residues in food in relation to human health, dating from work as early as 1892 (Durham, 1963).

By late 1961 or early 1962, many industrial organizations, trade

and scientific associations, government agencies and others were preparing a consensus of scientists on the pesticide situation. The Subcommittee on Policy and Procedure for Pest Control, National Academy of Sciences, and National Research Council, released a report on the impact of pesticides on wildlife in 1962 (Decker, 1962).

A similar report was prepared by the Subcommittee on Policy and Procedure for Pest Control (Baldwin, 1962).

The publication of Residue Reviews was instigated in 1962. Objectives of the publication are to provide concise, critical reviews of accomplished or needed endeavor in the total field of residues of chemicals in food, feeds and transformed food products. Problems of environmental contamination are also treated by review papers in this publication. Ten volumes have been published and manuscripts from all over the world have reviewed many aspects of the chemical residue problem (Gunther, 1962-1965).

Recognizing the possible controversy over the use of pesticides and their potential environmental contamination, Secretary of Agriculture, Orville Freeman, recommended the establishment of a Federal Pest Control Review Board by written correspondence with the Secretary of Health, Education and Welfare on March 21, 1961. Secretary Freeman recommended the participating departments to be Agriculture; Defense; Interior; and Health, Education and Welfare. The four Departments concurred, and on June 22, 1961, by written agreement, the Federal Pest Control Review Board was established (Anderson, 1963). It was established in the written agreement that the Board would consider and resolve, or recommend for policy determination, any problems arising from the use of chemicals in programs administered or participated in

by the Federal Government. It was further agreed that particular attention would be given to development of chemical pest control as they relate to adverse effects on human health, or on valuable forms of plant and animal life. The particular point of importance is that this board met regularly and reviewed 50 programs a full year before public controversy was aroused.

A report by the Committee on Public Information of the Entomological Society of America in 1962 showed less than 5% of the acreage of the 48 states have insecticides applied on them in any one year. Only 0.41% of 1% of the total land area generally considered favorable to wildlife, such as forests, grassland pastures, water area and non-forested special use areas have insecticides applied on them in any one year. This report also showed 85% of the acreage planted to crops by U. S. farmers and ranchers each year is not treated with insecticides, and that 95% of U. S. forest lands have never had an application of insecticides (Hall, 1962).

By May of 1963, the President's Science Advisory Committee had reviewed the various aspects of use of pesticides and submitted a report with several recommendations on legislation and technical proposals. Recommendations of this committee included the following statement on education:

> To enhance public awareness of pesticides benefits and hazards, it is recommended that: The appropriate Federal department and agencies initiate programs of public education describing the use and the toxic nature of pesticides. . . . The government should present this information to the public in a way that will make it aware of the dangers while recognizing the value of pesticides. (Wiesner, 1963)

The educational program recommended, as well as other recommendations of the President's Science Advisory Committee, is presently in

various stages of development.

In May of 1963, hearings were begun before the Subcommittee on Reorganization and International Organizations of the Committee on Government Operations, relative to interagency coordination in environmental hazards. The committee was under the direction of Connecticut's Senator Ribicoff and hearings were conducted through August 21, 1963. Four volumes were published by the U. S. Government Printing Office containing 1044 pages of testimony and many valuable documents pertaining to the pesticide problem (Ribicoff, 1963).

On July 8, 1964, Senator Whitten of Mississippi, Chairman of the Subcommittee on Department of Agriculture and Related Agencies Appropriations, submitted proposed amendments to the 1965 budget providing for additional funds to accelerate work on pesticide residues and educational activities following hearings begun on June 18, 1964 (Whitten, 1966). Substantial increases in the budget were voted by Congress for both research and education.

The most recent publication released in November 1965 is a comprehensive report on restoring the quality of our environment by a panel of the President's Science Advisory Committee. This report includes many aspects of environmental contamination and has an extensive section on insect control practices resulting in environmental contamination problems (Hornig, 1965). The preceding three citations are the most comprehensive reports ever attempted on the effects of chemicals on the environment and should be reviewed by anyone interested in the present pesticide situation.

This literature review is not intended as a comprehensive report of the thousands of research papers and other publications having some

bearing on extension methods and the pesticide situation. Citations used were selected as examples for the purpose of emphasizing the complex nature of the problem and to provide background establishing the need for studies of this type.

CHAPTER II

PROCEDURE

The purpose of this chapter is to present methodology used to investigate and analyze the problem selected for this study.

The study was designed to obtain information to be used in evaluating the educational needs of Oklahoma extension personnel relative to entomological problems and the safe use of pesticides.

A questionnaire with seven broad categories was formulated for use with all men and women extension agents in order to obtain information significant to the study.

A second questionnaire was developed to sample opinions of extension cooperators which could be used to draw comparisons with those expressed by extension personnel and their constituents on questions relevant to the present pesticide situation.

Development of the Questionnaires

The questionnaires used were designed by the writer with the assistance of staff members in the Entomology Department and the College of Education at Oklahoma State University.

The questionnaire used by extension personnel provided items for reporting information in the following categories:

I. Formal entomological training

II. Agent's experience and academic qualifications

III. Agent's evaluation of entomology training needs

IV. Evaluation of information available and publications needed

V. Agent's evaluation of insecticides as an aid in agricultural production

VI. Agent's evaluation of insecticide usage practices

VII. Agent's evaluation of extension's present educational efforts on safe use of pesticides

This instrument was designed to obtain information to serve as an aid in future planning by the state staff in assisting extension field personnel with entomological problems. It will also serve the purpose of evaluating various programs, supplementary materials and activities now considered standard in the extension entomology program. Additional information gained from the study may be used as a guide for future educational programming on the safe use of pesticides.

Sixty-five per cent of the questions in this instrument required only negative or positive responses. In the remainder, the agent selected an interval most nearly describing the individual's opinion on various items or he listed information relative to some phase of the study. (See Appendix B)

The second questionnaire developed for use by extension cooperators provided three major categories, all on the safe use of pesticides. Appropriate items were included for reporting information in the following categories:

I. Laymen's evaluation of proper insecticide usage

II. Laymen's evaluation of information available on insecticides

III. Laymen's evaluation of the present insecticide situation and research needed

Approximately 80% of the questions used required only positive or negative responses. The remaining 20% requested the respondent to enumerate various types of information relevant to the study. (See Appendix C)

Selection of Respondents

There were 176 men agents consisting of county agents and associate county agents in addition to 135 women agents including home demonstration agents and associate home demonstration agents at the time of the study. The 311 individuals in this group represent the field staff of the Agricultural Extension Division of Oklahoma State University in the 77 counties of Oklahoma.

Research information from the College of Home Economics and the Agricultural Experiment Station is channeled to the public through the educational programs conducted by this field staff. The total number of extension agents is relatively small and since they influence the entire extension entomology program for the state, all agents were included in this study.

The following table shows the distribution and response to the questionnaire used for this part of the study.

In recent years extension has been charged with the responsibility of conducting educational programs on the proper and safe use of pesticides. This area was chosen as one in which valuable information could be obtained by collecting data from a state-wide sample of laymen who are known cooperators of the Oklahoma Extension Service. By making comparisons between opinions expressed by laymen and those expressed by extension workers, a more critical analysis can be made of the

effectiveness of present programs and, most importantly, those needed in the future.

TABLE I

NUMBER OF QUESTIONNAIRES DISTRIBUTED AND RETURNED AND THE PERCENTAGE RETURNED

Item	C.A. and A.C.A.*	H.D.A. and A.H.D.A.	Totals
Number Distributed	176	135	311
Number Returned	152	98	250
Percentage Returned	86.4	73	80.4

*C.A. = County Agents
A.C.A. = Associate County Agents
H.D.A. = Home Demonstration Agents
A.H.D.A. = Associate Home Demonstration Agents

To keep the size of the study reasonable and to facilitate ease of handling and computation ten cooperators per county, equally divided as to sex, were chosen. The county agent and home demonstration agent in each county were supplied five questionnaires for a total of 770 to be distributed to laymen. When the data were accumulated, 21 agents failed to return any questionnaires. Since these agents neither returned their own part of the study nor any part of the laymen's questionnaires, it is assumed that these instruments were never distributed. If we accept this assumption, then only 665 questionnaires were distributed and only 560 of these were returned for an average of 7.3 per county.

The following table presents the number of questionnaires distributed to laymen and the number and percentage returned.

TABLE II

NUMBER OF QUESTIONNAIRES DISTRIBUTED AND RETURNED AND THE PERCENTAGE RETURNED BY EXTENSION COOPERATORS

Item	Male Cooperators	Female Cooperators	Totals
Number Distributed	340	325	665
Number Returned	305	255	560
Percentage Returned	89.7	78.5	84.2

Collection of Data

Collection of data was accomplished through the assistance of a large number of people. Separate meetings were held with the men and women district agents, and all were supplied with the number of instruments required to complete each phase of the study. The state's five men and five women extension district agents assisted in distributing the instruments and giving the necessary instructions to extension personnel. All county agents and home demonstration agents further assisted in data collection by distributing and gathering data from extension cooperators within their respective counties.

Agents were requested to select typical extension cooperators who would participate in this study.

This method of sampling groups "representative" of certain known characteristics of population is referred to as purposive sampling. The method of purposive selection is said to be biased, but the biases are probably smaller for very small samples selected purposively than the random errors would be in a measurable method that depended on a random selection of such a small sample. On the other hand, if the sample

includes a large number of units, then the biases of purposive methods may be more serious than random errors introduced by random sampling (Hansen, et al., 1953). Random sampling is no doubt more desirable in most studies. In this study, however, it was felt that the purposive method would yield estimates reliable enough that the cost necessary to take an accurate random sample in all 77 counties of Oklahoma could not be justified.

All agents, men and women, were requested to complete questionnaires without consultation. They were further requested to distribute and reclaim laymen's questionnaires as rapidly as feasible. All questionnaires were returned within twelve weeks.

Data Tabulation

Separate data submitted by county agents, associate county agents, home demonstration agents, associate home demonstration agents, plus male and female extension cooperators selected by the field staff were tabulated separately. This separate treatment was planned to allow for comparison between groups of individuals whose responsibilities are quite variable within the framework of extension planning and program execution at the county level.

Statistical Computations

Frequency tables were compiled for the purpose of applying the chi-square test to determine the divergence of observed results from those expected.

In application of the chi-square in situations where there are two variables, each categorized in two ways, there is the problem of

determining the expected frequencies. Since we have no a priori reason for suspecting any specific ratio or proportion in a problem of this kind, the best we can do under the terms of the null hypothesis is to pool the total frequencies of positive responses and divide this sum by the total sample size which gives the estimate of the population favorable to any specific question. Similarly, the sum of the negative responses divided by the sample size gives an estimate of the population proportion unfavorable to the same question. This computation supplies the expected frequency of occurrence when no specific ratio is hypothesized.

Garrett states (Garrett, 1958) that the chi-square test represents a useful method of comparing experimentally obtained results with those to be expected theoretically on some hypothesis.(1)

In making application of the chi-square test, the hypothesis to be tested is the null hypothesis; namely, that there will be no significant differences in divergence between observed and expected frequencies in response to specific items by various groups of respondents.

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(1) The formula for chi-square is stated as follows:

$$X^2 = S \frac{(fo - fe)^2}{fe}$$

Chi-square formula for testing agreement between observed and expected results in which :

fo = frequency of occurrence of observed or experimentally determined facts.

fe = expected frequency of occurrence on some hypothesis.

The difference between observed and expected frequencies are squared and divided by the expected number in each case and the sum of these quotients is X^2 (Garrett, 1958).

In order to investigate the relationship between groups of respondents, fourfold contingency tables were constructed for computing chi-square and, hence, only one degree of freedom was used in all computations, and the .05 level of confidence was selected for the test of significance. Tables have been constructed by Fisher and Yates for determining the significance of chi-square values. The chi-square values reprinted in Tables for Statisticians were used. (Akin and Colton, 1963). This table of chi-square values indicates probabilities ranging from .001 to .99.

CHAPTER III

STATISTICAL EVALUATION OF DATA

One phase of the data analysis was the use of the chi-square test to determine the divergence of observed results from those expected under the null hypothesis that observed frequencies in response to questions by various groups are a chance departure from the expected frequencies computed for that item.

The more closely the observed results approximate the expected, the smaller the chi-square will be and the closer the agreement between observed data and the hypothesis being tested. Contrawise, the larger the chi-square value, the greater the probability of a significant divergence of experimentally observed from expected results.

Comparisons of the Responses Between the County Agents and Associate County Agents

Data in Table III presents comparisons between county agents' and associate county agents' responses to six items on entomology training needed by agricultural extension agents.

Agents and associate agents were in close agreement on all items with the exception of the number now working on an advanced degree. There was a significant difference at the .05 level in response to this question, with a higher ratio of associates working on advanced degrees. Table XIX in Chapter IV shows that a higher per cent of county agents than associate agents have already completed work for the M.S. degree.

TABLE III

COMPARISONS OF RESPONSES BY COUNTY AGENTS AND ASSOCIATE AGENTS TO QUESTIONS ON ENTOMOLOGY TRAINING NEEDED BY AGRICULTURAL EXTENSION AGENTS

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Have you had 513 entomology short course?				
C. A.	64	19	45	0.39
A. C. A.	80	20	60	
2. Have you had 453 entomology short course?				
C. A.	63	24	39	3.58
A. C. A.	77	18	59	
3. Would you recommend expanding entomology short course work?				
C. A.	66	61	5	0.87
A. C. A.	76	73	3	
4. Are you now working on another degree?				
C. A.	67	33	34	4.50*
A. C. A.	78	52	26	
5. Would you take additional short course work in entomology if available?				
C. A.	69	65	4	0.15
A. C. A.	81	75	6	
6. Would you recommend additional entomology training for potential extension workers in lieu of or in addition to other subject matter areas?				
C. A.	69	65	4	1.76
A. C. A.	83	73	10	

NOTE: All chi-square values indicating significance at the .05 level but greater than .01 level have been marked with an asterisk (*). Chi-square values having significance at the .01 but greater than the .001 level are marked with a double asterisk (**). Those items having significance at less than the .001 level have been marked with a triple asterisk (***).

Agents and their associates were in very close agreement in recommending additional entomology for prospective extension agents and in their willingness to participate in additional entomology short course work.

Even though the difference between the number of agents and associates who had completed entomology short courses was not significant the ratio of negative responses was high.

Extension agents use various kinds of educational materials to assist them in county programs. These materials include bulletins, handbooks, leaflets, insect keys, radio tapes and movies. In Table IV, data are presented which compare county agents' and associate agents' responses to sixteen items on educational materials available and the need for additional material of this type.

A significant difference at the .05 level of confidence was recorded on item 13 where a higher ratio of county agents than associates indicated they use entomology radio tapes. This may reflect the fact that more agents than associates work with the adult programs for which most radio tapes are made.

Agents and associates were not in significant disagreement on 15 of the 16 items. A large per cent of positive responses were indicated on 11 of the 16 items, while high negative responses were recorded on four.

Responses to items in this table indicated that handbooks, insect leaflets, survey reports, entomology movies, and television work in entomology are important. Expansion of the agents' handbook of pest control, leaflet publications and television work was recommended.

A high per cent of negative responses showed agents were not in favor of large bulletins and that U.S.D.A. bulletins were not adequate for their needs.

Oklahoma's five extension districts are highly variable as to topography and climatic factors. Due to these variations, agricultural

TABLE IV

COMPARISONS BETWEEN COUNTY AGENTS' AND ASSOCIATE AGENTS' RESPONSES TO QUESTIONS ON AVAILABLE AND NEEDED INFORMATION AIDS OF AN ENTOMOLOGICAL NATURE

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Is U.S.D.A. Handbook 290, Insecticide Recommendations, filling a need?				
C. A.	69	69	0	1.81
A. C. A.	77	75	2	
2. Is U.S.D.A. Handbook 290, adequate for most situations?				
C. A.	68	54	14	2.69
A. C. A.	75	67	8	
3. Is Agent's Handbook of Pest Control filling a need?				
C. A.	69	66	3	0.04
A. C. A.	78	74	4	
4. If yes to previous question, would you recommend its expansion?				
C. A.	66	65	1	2.33
A. C. A.	74	69	5	
5. Are you using the insect pictorial keys?				
C. A.	64	33	31	1.68
A. C. A.	74	30	44	
6. Would more pictorial keys be helpful?				
C. A.	59	40	19	2.10
A. C. A.	63	50	13	
7. Are insect leaflets such as those on ant and brown spider helpful?				
C. A.	65	59	6	0.06
A. C. A.	75	69	6	
8. Would you recommend more insect leaflets?				
C. A.	64	54	10	1.50
A. C. A.	75	57	18	
9. Do you feel the weekly insect survey reports are valuable to you?				
C. A.	68	53	15	0.17
A. C. A.	78	63	15	
10. Would you recommend larger bulletin type publications?				
C. A.	67	24	43	0.26
A. C. A.	75	30	45	
11. Do you feel U.S.D.A. bulletins are adequate to take care of most bulletin needs?				
C. A.	66	17	49	2.85
A. C. A.	74	29	45	
12. Do you consider the entomology radio tapes valuable to you?				
C. A.	64	26	38	0.038
A. C. A.	59	25	34	
13. Do you use the entomology radio tapes?				
C. A.	58	24	34	4.39*
A. C. A.	60	14	46	
14. Would you recommend more radio tapes be made?				
C. A.	42	21	21	0.22
A. C. A.	38	21	17	
15. Would you consider entomology movies of value in your work?				
C. A.	65	49	16	2.21
A. C. A.	75	64	11	
16. Would more television work in entomology be of value?				
C. A.	57	35	22	0.08
A. C. A.	63	37	26	

practices are highly diversified. Data summarized in Table V are a comparison of the responses between county agents and associate agents to four items on the use of insecticides as an aid to production. There were no significant differences in response to any of the items in this area. A very high per cent of positive responses show agents agree that most producers believe insecticides are a necessity and will continue to use them. Agents felt there had been an increase in crop yields due to use of insecticides.

Table VI compares the opinions of county agents and associate agents on 16 items related to the safe and proper use of insecticides. The table reveals a significant difference at the .05 level of confidence in four of the 16 items. A significantly higher ratio of county agents than associates were aware of sources of information for treating insecticide poisoning cases, and a significantly higher ratio knew of poisoning cases. A higher ratio of agents indicated knowledge of gross misuse of insecticides and seemed to be better informed on legislation governing their use.

The table indicates a trend toward a high ratio of positive responses by both groups of agents on six of the 16 items. As a group, agents indicated they believe most people are aware of the need for reading labels and cautious handling of insecticides. At the same time, they feel most people are poorly informed on the need for protective clothing, proper disposal of surplus materials and legislation governing the use of insecticides.

Safe use of insecticides has become a national issue in recent years and many government and industry representatives feel the dilemma is partially due to the fact that only a small per cent of the public

in the United States has any knowledge of these chemicals or has had any chance to observe their effectiveness in large-scale applications. An article in Bio-Science in November of 1964 by a representative of the National Agricultural Chemicals Association stated that industry welcomed the opportunity to tell its story to the 90% of the public who know little about pesticides (Brinkley, 1964).

TABLE V

COMPARISONS BETWEEN COUNTY AGENTS' AND ASSOCIATE AGENTS' RESPONSES TO QUESTIONS ON USE OF INSECTICIDES AS AN AID IN AGRICULTURAL PRODUCTION

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Do most producers feel insecticides are a necessity in their farm operations?				
C. A.	69	67	2	0.54
A. C. A.	82	81	1	
2. Has insecticide usage increased in your county in the past fifteen years?				
C. A.	69	69	0	0.00
A. C. A.	78	78	0	
3. Have insecticides increased crop yields in your county?				
C. A.	69	69	0	2.81
A. C. A.	75	72	3	
4. Do most laymen feel insecticides will continue to be used as a production tool?				
C. A.	68	68	0	0.00
A. C. A.	78	78	0	

Data in Table VII compare county agents' and associate agents' responses to 10 items on extension's educational efforts to inform the public on the safe use of pesticides. The data reveal that county agents and associates are not in significant disagreement on seven of

TABLE VI

COMPARISONS BETWEEN COUNTY AGENTS' AND ASSOCIATE AGENTS' RESPONSES TO QUESTIONS ON SAFE USE OF INSECTICIDES

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Do you think most people are aware of the need for cautious handling of toxic insecticides?				
C. A.	67	56	11	3.42
A. C. A.	78	55	23	
2. Do most people read labels before using insecticides?				
C. A.	65	48	17	0.15
A. C. A.	79	56	23	
3. Is protective clothing usually worn by those who use the most toxic insecticides?				
C. A.	66	14	52	0.15
A. C. A.	75	18	57	
4. Do most people have an adequate storage area for insecticides?				
C. A.	67	11	56	0.33
A. C. A.	77	10	67	
5. Are used containers and surplus materials being properly disposed of?				
C. A.	65	13	52	0.85
A. C. A.	75	20	55	
6. Do you know where to get information for treating insecticide poisoning cases?				
C. A.	67	63	4	5.00*
A. C. A.	70	57	13	
7. Do you know of any specific cases of insecticide poisoning to either man or animals in your county?				
C. A.	69	25	44	6.50*
A. C. A.	79	14	65	
8. Do you feel any of these cases were a result of careless use of insecticides?				
C. A.	36	23	13	0.49
A. C. A.	22	12	10	
9. If not careless use, would you say the accidents were a result of inadequate knowledge of chemicals involved?				
C. A.	18	12	6	0.009
A. C. A.	23	15	8	
10. Do you know of any cases of gross misuse of insecticides leading to legal litigation in your county?				
C. A.	67	7	60	0.25
A. C. A.	75	6	69	
11. Do you feel most people are aware of their legal responsibility when using insecticides?				
C. A.	68	25	43	1.33
A. C. A.	79	22	57	
12. Do you know of any cases of gross misuse of insecticides causing damage to any kind of wildlife in your county?				
C. A.	69	9	58	5.96*
A. C. A.	77	2	75	
13. Are most producers aware of legislation affecting the use of chemicals on food and forage crops to be moved in interstate commerce?				
C. A.	66	22	44	1.22
A. C. A.	73	31	42	
14. Could you explain these laws if called on to do so?				
C. A.	64	28	36	6.59*
A. C. A.	77	18	59	
15. If no to the previous question, do you know where to get this information?				
C. A.	50	40	10	0.52
A. C. A.	62	46	16	
16. Have you had to answer questions relative to this legislation?				
C. A.	68	22	46	2.06
A. C. A.	78	17	61	

TABLE VII

COMPARISONS BETWEEN COUNTY AGENTS' AND ASSOCIATE AGENTS' RESPONSES TO QUESTIONS ON PRESENT EFFORTS TO INFORM THE PUBLIC CONCERNING THE SAFE USE OF INSECTICIDES

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Are you getting enough information to assist you in getting the safety story to people in your county?				
C. A.	68	51	17	1.43
A. C. A.	73	48	25	
2. Have you used any of the radio tapes on safety precautions for use of insecticides?				
C. A.	66	24	42	4.72*
A. C. A.	71	14	57	
3. Have you distributed any material on using insecticides safely?				
C. A.	65	58	7	9.37**
A. C. A.	74	50	24	
4. Have you used news stories on safe use of insecticides?				
C. A.	66	57	9	29.57***
A. C. A.	76	32	44	
5. Do you feel more work should be done on safe use of insecticides?				
C. A.	67	63	4	2.23
A. C. A.	75	74	1	
6. Would you use more safety publications or other types of educational aids on safety if available?				
C. A.	64	58	6	0.72
A. C. A.	72	68	4	
7. Do you feel most people are well informed on procedure for safe use of insecticides?				
C. A.	66	22	44	2.74
A. C. A.	72	15	57	
8. Are precautions for safe use of insecticides discussed in most meetings where insecticide usage is a part of the program?				
C. A.	67	62	5	0.43
A. C. A.	75	67	8	
9. Do you often have inquiries relative to safety precautions necessary in use of insecticides?				
C. A.	67	44	23	0.07
A. C. A.	74	47	27	
10. Do most questions come from rural areas?				
C. A.	63	30	33	0.05
A. C. A.	68	31	37	

ten items. The table shows that a higher ratio of agents than associates use radio tapes, and news articles and distribute educational materials on safe use of insecticides. There was a significant difference at the .05 level, .001 level and .01 level respectively on these items. The table reveals that in the opinion of most agents people are not well informed on safe use procedures, and more educational work on safety should be done.

Comparisons of the Responses Between Men and Women Extension Agents

Table VIII presents data as comparisons between county agents' and home demonstration agents' responses to three items pertaining to entomology training needed by extension personnel.

TABLE VIII

COMPARISONS BETWEEN COUNTY AGENTS' AND HOME DEMONSTRATION AGENTS' RESPONSES TO QUESTIONS ON ENTOMOLOGY TRAINING NEEDED BY EXTENSION PERSONNEL

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Would you recommend expanding entomology short course work?				
C. A.[a]	142	134	8	8.88**
H. D. A.[b]	44	35	9	
2. Would you take additional short course work in entomology if available?				
C. A.	151	137	14	45.20***
H. D. A.	81	42	39	
3. Would you recommend additional entomology training for potential extension workers in lieu of other subject matter?				
C. A.	151	137	14	2.22
H. D. A.	75	63	12	

[a]County Agents and Associates [b]Home Demonstration Agents and Associates

There is a significant difference in response by the two groups at the .01 level on the question of expanding entomology short course work. County agents indicated a high degree of interest in this area while most home demonstration agents would not recommend increasing entomology short course work. There was also a significant difference at well above the .001 level on the inquiry relative to individual participation in entomology short courses.

While home demonstration agents did not agree with county agents on the above items there was much closer agreement on recommending additional entomology work for potential extension workers and no significant difference between the two groups was indicated.

Most home demonstration agents apparently feel there is need for additional training, but are reluctant to involve themselves in this subject, usually considered the county agent's responsibility. As extension programs expand into urban areas the home demonstration agent may see a greater need for entomology subject matter.

Data in Table IX show a comparison between county agents' and home demonstration agents' responses to 11 items concerning entomology publications. Significant differences at the .01 level show a higher ratio of county agents than home demonstration agents feel U.S.D.A. Handbook 290 is adequate for most situations, and a significantly higher ratio of county agents are using insect keys. The ratio of responses by county agents and home demonstration agents on recommending expansion of agents handbook of pest control and the value of weekly insect survey reports show significant differences at the .001 level.

The combined groups show a ratio of high positive responses to questions on the value of handbooks, leaflets and insect keys. The

TABLE IX

COMPARISONS BETWEEN COUNTY AGENTS' AND HOME DEMONSTRATION AGENTS' RESPONSES TO QUESTIONS ON AVAILABLE AND NEEDED ENTOMOLOGY PUBLICATIONS

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Is U.S.D.A. Handbook 290 filling a need?				
C. A.	146	144	2	3.55
H. D. A.	67	63	4	
2. Is Handbook 290 adequate for most situations?				
C. A.	146	144	2	9.73**
H. D. A.	65	58	7	
3. Is Agent's Handbook of Pest Control filling a need?				
C. A.	147	140	7	0.59
H. D. A.	68	63	5	
4. Would you recommend expanding Agent's Handbook of Pest Control?				
C. A.	140	134	6	10.95***
H. D. A.	59	48	11	
5. Are you using the insect pictorial keys?				
C. A.	137	62	75	8.38**
H. D. A.	63	15	48	
6. Would more pictorial keys be helpful?				
C. A.	122	90	32	3.02
H. D. A.	42	25	17	
7. Are insect leaflets such as those on ants and brown spider helpful?				
C. A.	140	128	12	1.07
H. D. A.	66	63	3	
8. Would you recommend more leaflets?				
C. A.	138	110	28	0.25
H. D. A.	64	49	15	
9. Do you feel the weekly insect survey reports are valuable to you?				
C. A.	145	116	29	23.84***
H. D. A.	54	24	30	
10. Would you recommend larger bulletin type publications?				
C. A.	142	54	88	0.97
H. D. A.	57	26	31	
11. Do you feel U. S. D. A. bulletins are adequate to take care of most bulletin needs?				
C. A.	140	46	94	0.25
H. D. A.	63	23	40	

ratio of negative responses by combined groups was high on recommendations for larger bulletins and the adequacy of U.S.D.A. bulletins.

A comparison was made between county agents' and home demonstration agents' opinions on four items relative to use of insecticides as an aid in agricultural production. Table X reveals there is general agreement between the two groups on all items and no significant differences are recorded. The high ratio of positive responses indicate that both men and women agents feel insecticides have been valuable in agricultural production and will continue to be used.

TABLE X

COMPARISONS BETWEEN COUNTY AGENTS' AND HOME DEMONSTRATION AGENTS' RESPONSES TO QUESTIONS ON USE OF INSECTICIDES AS AN AID IN AGRICULTURAL PRODUCTION

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Do most producers feel insecticides are a necessity in their farm operation?				
C. A.	151	148	3	1.38
H. D. A.	69	69	0	
2. Has insecticide usage increased in your county in the past 15 years?				
C. A.	147	147	0	0.00
H. D. A.	67	67	0	
3. Have insecticides increased crop yields in your county?				
C. A.	144	141	3	0.34
H. D. A.	57	55	2	
4. Do most laymen feel insecticides will continue to be used as a production tool?				
C. A.	146	146	0	2.52
H. D. A.	58	57	1	

All county agents and home demonstration agents will be participating in various phases of the extension educational program on safe use of pesticides in the future. Table XI presents data comparing the responses by the two groups on 15 items related to safe use of insecticides. There was close agreement between the two groups on 10 of the 15 items with no significant differences indicated.

Significant differences were recorded on items 4, 5, 13, 14 and 15. A significantly higher ratio of county agents indicated surplus materials are not disposed of properly and knew where to obtain information on insecticide poisoning. County agents also indicated more knowledge of, and answered more questions on, legislation than did home demonstration agents. The trend of positive responses shows agents, as a group, feel people are aware of the need for caution while handling insecticides and that most people read labels before using these chemicals. They also indicated most people do not have adequate storage nor do they properly dispose of surplus materials. A relatively high per cent of all extension personnel felt most insecticide users were inadequately informed on pesticide legislation and that they were poorly informed themselves.

At the time of this study, the agricultural extension program on safe use of pesticides was treated as a part of the total entomology program. Agents have been supplied materials such as radio tapes and information on reading labels from the state staff; however, there has been no organized or concerted effort directed specifically to this problem. It was believed that agents' opinions on the effectiveness of these early efforts to inform the public on safe use of insecticides would be worthwhile. Table XII presents the data as a comparison

TABLE XI

COMPARISONS BETWEEN COUNTY AGENTS' AND HOME DEMONSTRATION AGENTS' RESPONSES TO QUESTIONS ON SAFE USE OF INSECTICIDES

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Do you think most people are aware of the need for cautious handling of toxic insecticides?				
C. A.	146	112	34	0.03
H. D. A.	78	59	19	
2. Do most people read labels before using insecticides?				
C. A.	143	103	40	0.70
H. D. A.	79	61	18	
3. Do most people have an adequate storage area for insecticides?				
C. A.	144	21	123	0.92
H. D. A.	71	14	57	
4. Are used containers and surplus materials being properly disposed of?				
C. A.	140	33	107	4.53*
H. D. A.	63	24	39	
5. Do you know where to get information for treating insecticide poisoning cases?				
C. A.	137	120	17	15.35***
H. D. A.	67	43	24	
6. Do you know of any specific cases of insecticide poisoning to either man or animals in your county?				
C. A.	148	39	109	3.73
H. D. A.	74	11	63	
7. Do you feel any of these cases were a result of careless use of insecticides?				
C. A.	58	35	23	0.03
H. D. A.	19	11	8	
8. If not careless use, would you say the accidents were a result of inadequate knowledge of the chemicals involved?				
C. A.	41	27	14	0.03
H. D. A.	19	13	6	
9. Do you know of any cases of gross misuse of insecticides leading to legal litigation in your county?				
C. A.	142	13	129	0.13
H. D. A.	65	7	58	
10. Do you feel most people are aware of their legal responsibility when using insecticides?				
C. A.	147	47	100	0.46
H. D. A.	71	26	45	
11. Do you know of any cases of gross misuse of insecticides causing damage to any kind of wildlife in your county?				
C. A.	144	11	133	0.14
H. D. A.	65	4	61	
12. Are most producers aware of legislation affecting the use of chemicals on food and forage crops to be moved in interstate commerce?				
C. A.	140	54	86	0.42
H. D. A.	65	22	43	
13. Could you explain these laws if called on to do so?				
C. A.	142	47	95	10.79**
H. D. A.	73	9	64	
14. Do you know where to get information if you answered no to the previous question?				
C. A.	112	86	26	22.13***
H. D. A.	65	27	38	
15. Have you had to answer questions relative to legislation affecting the use of chemicals on food and forage crops to be moved in interstate commerce?				
C. A.	146	39	107	21.23***
H. D. A.	74	1	73	

TABLE XII

COMPARISONS OF COUNTY AGENTS' AND HOME DEMONSTRATION AGENTS' RESPONSES TO QUESTIONS ON PRESENT EFFORTS TO INFORM THE PUBLIC CONCERNING THE SAFE USE OF INSECTICIDES

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Are you getting enough information to assist you in getting the safety story to people in your county?				
C. A.	141	99	42	1.88
H. D. A.	66	40	26	
2. Have you used any of the radio tapes on safety precautions for use of insecticides?				
C. A.	136	38	98	9.46**
H. D. A.	73	7	66	
3. Have you distributed any material on using insecticides safely?				
C. A.	139	108	31	17.19***
H. D. A.	69	34	35	
4. Have you used news stories on safe use of insecticides?				
C. A.	142	89	53	16.05***
H. D. A.	69	23	46	
5. Do you feel more work should be done on safe use of insecticides?				
C. A.	142	137	5	0.03
H. D. A.	75	72	3	
6. Would you use more safety publications or other types cf educational aids on safety if available?				
C. A.	136	126	10	0.17
H. D. A.	69	65	4	
7. Do you feel most people are well informed on procedure for safe use of insecticides?				
C. A.	138	37	101	0.90
H. D. A.	72	15	57	
8. Are precautions for safe use of insecticides discussed in most meetings where insecticide usage is a part of the program?				
C. A.	142	129	13	0.002
H. D. A.	64	58	6	
9. Do you often have inquiries relative to safety precautions necessary in use of insecticides?				
C. A.	141	91	50	10.18**
H. D. A.	70	29	41	
10. Do most questions come from rural areas?				
C. A.	131	64	67	2.15
H. D. A.	54	20	34	

between county agents' and home demonstration agents' responses to 10 items on extension educational efforts on safe use of insecticides.

Table XII reveals there is a significant difference at the .01 level in response to items two and nine and a significant difference at the .001 level on items three and four.

The table shows a significantly higher ratio of agents than home demonstration agents use radio programs and news stories. It also shows a significantly higher ratio of home demonstration agents distribute materials, while county agents answer more questions on safe use of insecticides than do home demonstration agents. Responses to most items in Table XII indicate extension agents believe educational efforts to inform the public on safe use of insecticides have been only moderately successful. Agents indicated more effort should be placed on the safety program and they themselves would use additional materials on safety, if available.

Comparisons of the Responses Between Extension Personnel and Extension Cooperators

Table XIII presents data comparing the responses between all extension agents and all extension cooperators on 10 items relative to safe use of insecticides.

There was little over-all agreement between laymen and agents. There was a significant difference at a point above the .001 level on six of the ten items and at the .01 level on one.

A higher ratio of agents than cooperators felt that most users of insecticides are aware of precautions needed and that most people read labels adequately.

A higher ratio of laymen felt that most people have safe storage

TABLE XIII

COMPARISONS BETWEEN EXTENSION COOPERATORS' AND EXTENSION AGENTS' RESPONSES TO QUESTIONS ON SAFE USE OF INSECTICIDES

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Are most users of insecticides aware of the precautions needed when using these chemicals?				
Laymen[a]	543	314	229	22.67***
Extension Agents[b]	222	169	53	
2. Do most people read labels adequately before using insecticides?				
Laymen	514	262	252	33.35***
Extension Agents	222	164	58	
3. Do most people who use relatively large quantities of insecticides have a safe storage area for them?				
Laymen	469	205	264	48.70***
Extension Agents	215	35	180	
4. Are most insecticide containers and surplus materials disposed of properly by burning, burying, etc.?				
Laymen	538	239	299	16.41***
Extension Agents	203	57	146	
5. Do you know where you could get information in emergency situations involving insecticides?				
Laymen	471	315	156	11.68***
Extension Agents	204	163	41	
6. Are most laymen aware of their legal responsibilities when using insecticides?				
Laymen	519	179	340	0.06
Extension Agents	218	73	145	
7. Do you know of any cases of misuse of insecticides in your area which resulted in poisoning wildlife?				
Laymen	541	76	465	6.67**
Extension Agents	209	15	194	
8. Are most laymen aware of legislation concerning the use of insecticides on food and forage crops?				
Laymen	540	273	267	10.84***
Extension Agents	205	76	129	
9. Do you think increased emphasis on safe use of insecticides is needed?				
Laymen	540	514	26	0.45
Extension Agents	217	209	8	
10. Will most laymen continue to use insecticides in the future?				
Laymen	534	529	5	0.27
Extension Agents	220	217	3	

[a]Laymen = all extension cooperators, male and female

[b]Extension Agents = all agents, male and female

for insecticides and that used containers and surplus materials are disposed of properly.

A higher ratio of agents indicated they knew where to get information in emergency situations.

The ratio of positive response by extension cooperators was higher on knowledge of wildlife poisoning cases and on laymen's awareness of legislation concerning the use of insecticides on food and forage crops.

There was no significant difference in responses by the two groups on laymen's awareness of legal responsibilities, the need for increased emphasis on safe use, nor on the probability of continued use of insecticides in the future.

Comparisons of the Responses Between Male and Female Cooperators

Table XIV presents data as a comparison between male and female laymen's responses to eight items on the safe use of insecticides. Significant differences were recorded on three of the eight items used in this category. The ratio of positive responses was higher by female respondents on each of the items where a statistically significant difference appeared. More female than male extension cooperators indicated they had safe storage for insecticides, disposed of surplus materials and containers properly, and knew of more cases of misuse of insecticides resulting in poisoning of wildlife.

Trends in response to various items show the respondents, as a group, feel most people are not aware of precautions necessary when using chemicals, do not have adequate storage and do not dispose of surpluses properly. While laymen are equally divided on the question of others reading labels, a high ratio indicate respondents feel they

read labels adequately themselves.

TABLE XIV

COMPARISONS BETWEEN MALE AND FEMALE LAYMEN'S RESPONSES TO QUESTIONS ON PROPER AND SAFE USE OF INSECTICIDES

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Are most users of insecticides aware of the precautions needed when using these chemicals?				
Male	301	180	121	1.07
Female	242	134	108	
2. Do most people read labels adequately before using insecticides?				
Male	289	152	137	0.69
Female	225	110	115	
3. Do you read lables?				
Male	295	270	25	2.76
Female	247	235	12	
4. Do you apply most of your own insecticides?				
Male	302	254	48	1.14
Female	245	214	31	
5. Do most people who use relatively large quantities of insecticides have a safe storage area for them?				
Male	271	119	152	0.01
Female	198	86	112	
6. Do you have such an area?				
Male	295	126	169	18.4***
Female	236	145	91	
7. Are most insecticide containers and surplus materials disposed of properly?				
Male	299	103	196	27.12***
Female	239	136	103	
8. Do you know of any cases of misuse of insecticides in your area which resulted in poisoning of wildlife?				
Male	300	31	269	7.69**
Female	241	45	196	

A 1958 survey by a special committee of Chemical Specialities Manufacturing Association reported 64.3% of the respondents reported they read all instructions when they used their last insecticide (Miller et al., 1958). In this study 93% indicated they read labels adequately. Differences in terminology used in the questions, the time difference and locality differences could account for this variation.

Knowledge of information available on insecticide usage by extension cooperators was desired as a guide for future program development. Table XV is a comparison between male and female laymen's responses to seven items in this category. Significant differences were recorded on two of the seven items. A higher ratio of males reported having seen printed materials on safe use of insecticides while more females than males said they had heard discussions on this subject.

Responses by the combined groups show positive trends on knowledge of sources of information in emergency situations, access to printed materials on safe use of insecticides and having heard recent discussions on this subject. Respondents indicated a negative trend to questions on laymen's knowledge of legal responsibilities and legislation governing insecticide usage. A high ratio of positive responses shows most laymen indicate there is a need for increased educational emphasis on safe use of insecticides.

Thirteen items were included in Table XVI as a comparison between male and female laymen's responses to inquiries on the present insecticide situation. Significant differences in responses by the two groups were recorded on five of the thirteen items. A significantly higher ratio of females think that insecticides are dangerous to man and animals, and indicated they will use control methods other than

TABLE XV

COMPARISONS BETWEEN MALE AND FEMALE LAYMEN'S RESPONSES TO QUESTIONS ON INFORMATION AVAILABLE ON INSECTICIDES

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Do you know where you could get information in emergency situations involving insecticides?				
Male	271	183	88	0.12
Female	200	132	68	
2. Are most laymen aware of their legal responsibilities when using insecticides?				
Male	290	96	194	0.55
Female	229	83	146	
3. Are you aware of this?				
Male	292	188	104	2.96
Female	235	134	101	
4. Are you aware of legislation concerning the use of insecticides on food and forage crops?				
Male	296	158	138	2.08
Female	244	115	129	
5. Have you seen any printed material on safe use of insecticides within the past year?				
Male	271	230	41	8.82**
Female	233	173	60	
6. Have you heard any discussions on safe use of insecticides in your area?				
Male	283	165	118	5.83*
Female	221	152	69	
7. Do you think increased emphasis on safe use of insecticides by educational and professional groups is needed?				
Male	295	277	18	2.34
Female	245	237	8	

chemicals even though they cost more. A significantly higher ratio of males indicated they felt justified in using insecticides, and that public opinion would support research on insect control methods other than chemicals.

Even though significant differences are recorded on four items in laymen's responses to questions in Table XVI, a high ratio of positive responses is indicated on all items in the table.

TABLE XVI

COMPARISONS BETWEEN MALE AND FEMALE LAYMEN'S RESPONSES TO THE PRESENT INSECTICIDE SITUATION

Respondent	Number Answered	Positive Response	Negative Response	Chi-Square Value
1. Do you think insecticides as used today are dangerous to the well being of man and animals?				
Male	285	153	132	20.33***
Female	227	166	61	
2. Have available insecticides solved most of your insect problems?				
Male	288	233	55	0.07
Female	224	179	45	
3. Would you use a method other than chemical control on insects if available?				
Male	261	132	29	1.05
Female	206	189	17	
4. Even if the method cost more?				
Male	227	125	102	13.71***
Female	159	117	42	
5. Would you use a method other than chemical control on insects if the costs were the same?				
Male	235	215	20	1.54
Female	180	158	22	
6. Will you continue to use insecticides in the future?				
Male	297	296	1	2.59
Female	237	233	4	
7. Do you think most individuals feel justified in using insecticides whenever insect problems arise?				
Male	290	284	6	0.49
Female	230	223	7	
8. Do you feel justified?				
Male	284	279	5	9.29**
Female	222	206	16	
9. Is it important that research continue on insecticides?				
Male	291	290	1	0.80
Female	233	233	0	
10. Do your neighbors agree with your view?				
Male	218	208	10	0.17
Female	163	154	9	
11. Would public opinion support research programs on insect control methods other than chemical control?				
Male	245	226	19	5.73*
Female	149	126	23	
12. Would you support such a program?				
Male	256	243	13	0.08
Female	157	148	9	
13. Even if it cost more?				
Male	211	148	63	14.57***
Female	214	183	31	

TABLE IV

EVALUATION OF DATA

Data From County Agents and Associate Agents

Data presented in the preceding chapter were subjected to the chi-square test as a means of evaluating those areas in which classified respondents either agreed or disagreed.

Additional information was accumulated from which inferences could be made by objective evaluation. This chapter presents data obtained primarily from county agents and associate agents. A limited amount of information from extension cooperators is included.

Most of the data represent information obtained from a high per cent of the agricultural extension agents in Oklahoma. Due to the high percentage of responses by agents used in these calculations, we have assumed the data are reasonably accurate estimates of the total population, and fairly specific conclusions can be made. The same assumption cannot be made for data which include only a sample of the population representing extension cooperators and only broad general assumptions were possible.

A 1956 study made in Oklahoma revealed only 18.2% of the county agricultural agents had been employed for ten years or more by the Oklahoma Extension Service (Adams, 1956). Table XVII is a comparison

between tenure of service of county agents and associate agents employed by the Oklahoma Extension Service. The table reveals county agents have a much longer tenure than associate agents. It further reveals the average tenure of all agents has risen sharply in the past ten years since 50.7% have eleven or more years of service. Among the 150 agents only 30 (20%) have five or less years of service. This trend toward longer length of service indicates a stabilizing effect on extension programs.

TABLE XVII

TENURE OF 150 COUNTY AGRICULTURAL AGENTS IN OKLAHOMA

Title	Years With Extension Service				
	1-5	6-10	11-20	Over 20	Median
C. A.	0	12	50	7	15.35
A. C. A.	30	32	17	2	8.15
Totals	30	44	67	9	11.46

Table XVIII is a comparison of the length of service between county agricultural agents and associate county agents in their present position. As would be expected, a high per cent of the associate agents have a short tenure. As shown in the table, 86.4% of the associate agents have been in their present county five or less years, while 72% of the county agents have been in their present position for six or more years. The average tenure for the 69 county agents is 10.08 years while the average for the 81 associates is 5.89 years. The length of service of Oklahoma agricultural agents at present indicates a much greater stability than was noted in a 1956 study when only 16.7% of all agents at that time had been in their county longer than ten years

(Adams, 1956). This table reveals 26.8% of all agents have been in their present position ten years or more.

TABLE XVIII

NUMBER OF YEARS 150 OKLAHOMA AGRICULTURAL AGENTS HAVE SERVED IN THEIR PRESENT POSITION

Title	Years in Present Position				
	1-5	6-10	11-20	Over-20	Median
C. A.	20	19	28	2	10.08
A. C. A.	50	21	8	2	5.89
Totals	70	40	36	4	7.81

The professional training of agricultural extension agents has been the concern of extension administrators for many years. A 1950 study revealed that of the 81 county agents and assistants employed between 1919-1920, 58 had completed a four-year course in college leading to a degree in agriculture. By 1950 the entire staff of county agents had bachelor of science degrees while only five had completed work for a master's degree, and twenty-four had taken some work beyond the B.S. degree (Brannan, 1950). A 1956 study showed that all agents had the B.S. degree, only six had completed the master's degree while all agents had done some work at the graduate level (Adams, 1956).

The professional training of Oklahoma's county agents is improving rapidly. Table XIX reveals all agents now hold the baccalaureate degree, 42.7% have the master's degree and 56.7% of all agents are now working on an advanced degree. A higher per cent of county agents hold advanced degrees than associate agents while the table reveals a higher per cent of associates are now working on an advanced degree.

TABLE XIX

PROFESSIONAL TRAINING OF 150 OKLAHOMA AGRICULTURAL AGENTS

Title	B.S. Degree	M.S. Degree	Per Cent With M.S. Degree	Working on M.S. Degree	Per Cent Working on M.S. Degree
C. A.	69	35	50.7	33	47.8
A. C. A.	81	29	35.8	52	64.2
Totals	150	64	42.7	85	56.7

Table XX shows Oklahoma county agents estimate approximately one-third of all questions they answer during the crop season require entomological information. It further reveals over one-fifth of all questions require knowledge of entomology.

A similar study including a sample survey of county agents in Iowa, Kansas, Kentucky, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin revealed that county agents in those states estimated entomology problems required 14.2% of their time during the crop season (Allen, 1964).

The high percentage of questions asked and relatively high per cent of time spent on entomology by agents and consequently their needs in this subject matter area lends support to the contention that most state extension entomology offices are inadequately staffed. Evidence reveals county agents prefer more training in entomology through short-course work, and educational efforts of the extension service should be intensified. These expressed needs by county agents suggest needed re-evaluation of extension programs with the view of supporting subject matter areas where agents indicate more help is needed.

TABLE XX

ESTIMATES BY OKLAHOMA AGRICULTURAL AGENTS OF THE PER CENT QUESTIONS ASKED OF THEM THAT REQUIRE ENTOMOLOGICAL INFORMATION

Title	10-20	21-30	31-40	41-50	Over 50	Median
			Entire Season			
C. A.	38	20	5	5	1	24.1
A. C. A.	43	22	5	4	3	19.9
Totals	81	42	10	9	4	21.1
			Cropping Season			
C. A.	5	23	11	6	10	34.3
A. C. A.	14	21	14	12	4	30.6
Totals	19	44	25	18	14	32.2

To provide extension entomologists with some guidelines as to areas where major emphasis in entomology should be centered, agents were asked to estimate the per cent of entomology questions which fall into the nine areas shown in Table XXI. This table shows that 84.5% of all questions on entomology are in the three broad categories of agronomy, livestock and horticultural insects. When all categories involving horticultural insects are grouped, agents estimate 39% of all questions are from these areas. This may be a reflection of the trend toward more assistance from county agents on problem-solving in urban populations.

Table XXII is a comparison of the number of semester credit hours of entomology completed by county agents and associate agents. Only 33.3% of the county agents and 13.3% of the associate agents had

completed more than six hours of entomology course work. Only 22.5% of all agents had more than six hours of formal training in entomology. Furthermore the average number of hours of entomology completed by all agents was less than six. In view of the information presented in Table XX showing the percentage of questions related to entomology, it would appear that agents' formal training in this area is far below a desirable level. County agents, on the average, show a slightly higher level of training than do associate agents. It is evident that agents' field experiences have demonstrated to them the need for more course work on insect problems. This was further substantiated when a higher per cent of agents indicated they had completed short-course work in entomology.

Agents were asked if they would take additional short course work in entomology. The data are summarized in Table XXIII. The per cent of agents who indicated a desire for additional entomology training was slightly higher than the associate agents; however, 92.8% of all agents indicated they would take additional entomology work, if available. The response by agents is highly consistent with other areas of this problem in that agents recognize their inadequacy in view of their lack of formal training.

In one area of this study, agents were asked: Would you recommend additional entomology training for potential extension workers in lieu of or in addition to other subject matter areas? The data are presented in Table XXIV. County agents' estimates of the needs in entomology work have been consistently higher than those of associate agents' and remained somewhat higher in response to this question. However, 90.8% of all agents indicated they would recommend additional entomology

TABLE XXI

ESTIMATES BY 145 OKLAHOMA AGRICULTURAL AGENTS OF THE PER CENT ENTOMOLOGY QUESTIONS IN THE FOLLOWING AREAS[a]

Area	69 C.A.	76 A.C.A.	All Agents
Crop Insects	27.00	25.00	26.00
Forest Insects	1.00	1.00	1.00
Fruit and Nut Insects	12.00	13.00	12.50
Household Pests	10.00	9.00	9.50
Livestock Pests	19.00	18.00	18.50
Ornamental Insects	13.00	15.00	14.00
Pets	2.00	2.00	2.00
Stored Products' Pests	2.00	2.00	2.00
Vegetable Insects	13.00	14.00	13.50
All Others	1.00	1.00	1.00
Totals	100.00	100.00	100.00

[a]Data taken from open-ended questionnaires

TABLE XXII

NUMBER SEMESTER CREDIT HOURS OF ENTOMOLOGY COMPLETED BY 150 COUNTY AGRICULTURAL AGENTS IN OKLAHOMA

Title	Three Hours	Six Hours	Nine Hours	Over Nine Hours	Median
C. A.	13	33	17	6	5.7
A. C. A.	33	37	9	2	4.2
Totals	46	70	26	8	4.9

training for potential new agents.

TABLE XXIII

EVALUATION BY 152 OKLAHOMA AGRICULTURAL AGENTS OF THEIR ADDITIONAL ENTOMOLOGY TRAINING NEEDS

Title	Would Take Training	Would Not Take Training	Per Cent Who Would Take Training
C. A.	65	4	94.20
A. C. A.	76	7	91.57
Totals	141	11	92.76

Three weeks of short course work in entomology was offered to county agents during the summer session at Oklahoma State University for eight years preceding the time of this study. In order to evaluate the possible need for additional entomology short courses, agents were asked if they would recommend expanding entomology short course work. Data are summarized in Table XXV. All agents responded and the county agents' recommendation averaged less than 1% above that of associate agents. As an overall response, 88.1% of the agents indicated they would recommend expanding entomology short course work. In a 1956 study, agents were asked to list, in order of preference, specific courses that would be most helpful to them if offered in summer courses at Oklahoma State University and organized especially for extension employees. Expressed preferences showed entomology exceeded all other courses by a large margin (Adams, 1956). This study shows a very high percentage of agents are still interested in additional entomology short course work.

TABLE XXIV

EVALUATION BY 152 OKLAHOMA AGRICULTURAL AGENTS OF THE NEED FOR ADDITIONAL ENTOMOLOGY TRAINING FOR NEW AGENTS

Title	Would Recommend Additional Training	Would Not Recommend Additional Training	Per Cent Recommending Additional Training
C. A.	65	4	94.20
A. C. A.	73	10	87.95
Totals	138	14	90.79

TABLE XXV

EVALUATION BY 152 OKLAHOMA AGRICULTURAL AGENTS OF THE NEED FOR EXPANDING ENTOMOLOGY SHORT COURSE WORK

Title	Recommend Expanding	Do Not Recommend Expanding	Per Cent Recommend Expansion
C. A.	61	8	88.40
A. C. A.	73	10	87.95
Totals	134	18	88.16

Further emphasis of the need for expanding entomology short course work was indicated by a 1964 analysis of the short course system in selecting facets of extension animal science teaching and program planning. At the conclusion, the 220 cooperators were asked to evaluate fourteen categories used and all cooperators were asked to indicate whether more or less time should have been given to the various divisions. In the category on diseases and parasites of livestock, 203 of the 220 (92.3%) participants indicated more time should have been given to this subject matter area (Taggart, 1964).

Many administrators feel that county agents are a useful source of information concerning areas the land-grant institution should stress in agricultural research projects. Table XXVI presents data from agents requested to recommend areas in which more entomology research would be helpful. A smaller number of agents responded to this request than any other area of the study. Only 71% of the county agents and 67.5% of the associate agents made suggestions. The response by all agents participating was 69%. The largest percentage suggested was 28.9% in the horticultural insects category. The second largest percentage was for new methods of insect control. In view of the recent publicity pertaining to the national pesticide situation, it is encouraging to realize that many county agents are aware of the situation and have requested additional research in this area.

A part of this study was designed to evaluate the insecticide situation in Oklahoma. Agents were asked to estimate the per cent of farmers now using insecticides. Data presented in Table XXVII show that an estimated 69.8% of all farmers are using insecticides. All county agents answered this request while only 89.2% of the associate agents answered. County agents' estimates, as an average, were higher than the associate agents'. The table shows 34 of 69 agents (49.3%) and 34 of 74 associates (46%) believe 76 to 100% of all farmers now use insecticides. The variation in estimates can possibly be attributed to the difference in types of agriculture in various sections of the state.

Agents were asked to estimate the per cent of insecticides used in nine broad use categories. The data are shown in Table XXVIII. Sixty-seven of 69 (97%) of the agents and 68 of 83 (82%) of the

TABLE XXVI

AREAS SUGGESTED BY 105 OKLAHOMA AGRICULTURAL AGENTS WHERE ADDITIONAL ENTOMOLOGICAL RESEARCH WOULD BE HELPFUL[a]

Areas Suggested	Times by 49 C.A.	Per Cent By C.A.	Times by 56 A.C.A.	Per Cent by A.C.A.	Per Cent by All Agents
New Control Methods	20	20.62	21	24.42	22.40
Crop Insects	20	20.62	13	15.12	18.03
Horticulture Insects	25	25.77	28	32.55	28.96
Household Pests	8	8.25	8	9.30	8.74
Livestock Pests	16	16.49	11	12.79	14.75
All Others	8	8.24	5	5.81	7.10
Totals	97	99.99	86	99.99	99.98

[a]Data taken from open-ended questionnaires

TABLE XXVII

ESTIMATES BY 143 OKLAHOMA AGRICULTURAL AGENTS OF THE PER CENT OF FARMERS USING INSECTICIDES

Title	Number Estimating Following Percentages 0-25	26-50	51-75	76-100	Median
C. A.	0	5	30	34	73.00
A. C. A.	3	10	27	34	66.95
Totals	3	15	57	68	69.82

associates responded. Crop insects, fruit and nut insects, livestock pests, stored products' pests and vegetable insects accounted for 81% of the estimated usage by county agents and 79% of the estimated usage by associate agents. These are all areas where pesticide usage is highly regulated by federal and state agencies to avoid contamination of food or feed. They also represent areas from which most of the farmer's income is derived. These areas of high estimated usage of pesticides are closely correlated with agents' indicated needs for information and help.

Data presented in Table XXIX compare county agents' and associate agents' responses when asked to estimate the per cent of crop acreage treated with insecticides in Oklahoma in 1963. All county agents responded while only 64 of 83 (77.1%) associate agents made estimates. Estimates made by all agents of insecticide usage in their county showed only 27.7% of the total crop acreage in Oklahoma was treated in 1963. This estimate by agents is lower than had been anticipated, though it possibly can be accounted for by various factors affecting the agents' opinions on this question. Oklahoma's largest crop acreage is in small grains, occupying over 70% of the total acreage in economic crops production. These crops including wheat, oats, rye and barley are attacked by insects at economic levels of infestation at approximately four or five-year intervals. Insect populations of economic importance fluctuate from year to year on crops in Oklahoma, and 1963 was a year of few insect infestations at economic levels.

One other factor that may have influenced agents is the position taken by the Oklahoma State University Entomology research and extension entomologists concerning insecticide usage. Both departments over the

TABLE XXVIII

ESTIMATES BY 135 OKLAHOMA AGRICULTURAL AGENTS OF THE PER CENT OF INSECTICIDES USED IN VARIOUS AREAS IN 1963

Areas	By 67 C. A.	By 68 A. C. A.
Crop Insects	30.0	31.0
Forest Insects	1.0	1.0
Fruit and Nut Insects	5.0	7.0
Household Pests	5.0	6.0
Livestock Pests	34.0	29.0
Ornamental Insects	9.0	11.0
Residual Sprays	4.0	3.0
Stored Products' Pests	3.0	2.0
Vegetable Insects	9.0	10.0
Totals	100.0	100.0

TABLE XXIX

ESTIMATES BY 134 OKLAHOMA AGRICULTURAL AGENTS OF THE PER CENT OF CROP ACREAGE TREATED WITH INSECTICIDES IN 1963

Title	Number Estimating Following Percentages				Per Cent by All Agents
	0-25	26-50	51-75	76-100	
C. A.	40	24	4	1	25.18
A. C. A.	32	19	11	2	30.39
Totals	72	43	15	3	27.70

years have encouraged agents to recommend insecticide applications only when economics will justify their use. Neither of these has subscribed to blanket insecticide applications based on seasonal timing, plant size, age, fruiting condition or similar factors.

Some government agencies and numerous organized groups have become quite concerned over the possible excessive use of insecticides in agricultural production. It was considered it would be helpful in evaluating such allegations if information could be obtained on the amount of repeated use of insecticides in crops production in Oklahoma. Table XXX is a comparison between county agents and associate agents as to the estimated number of insecticide applications to crops in their respective counties. All agents responded while 66 of 83 (79.5%) associate agents responded. County agents believed the average number of applications was slightly over two in 1963 while associate agents estimated slightly less than two applications were applied. As a group, agents' estimates averaged 1.99 insecticide applications on crops treated in 1963.

TABLE XXX

ESTIMATED NUMBER OF INSECTICIDE APPLICATIONS TO CROPS IN OKLAHOMA IN 1963 BY 135 OKLAHOMA AGRICULTURAL AGENTS

Title	Applications Estimated 1-2	3-4	5-6	7 or More	Median
C. A.	54	11	1	3	2.19
A. C. A.	48	13	5	0	1.89
Totals	102	24	6	3	1.99

The percentage of Oklahoma's crop acreage treated by commercial

applicators is important. It will help to evaluate who is most responsible for chemical placement (or misplacement) where insecticides are used in agricultural production. It may have a direct bearing on how much emphasis must be placed on reaching this group in future programming on safe use of agricultural chemicals. A recent check (February 12, 1966) with the State Department of Agriculture showed Oklahoma has 75 licensed aerial applicators. Additional licenses have been issued to 60 aerial applicators who reside outside Oklahoma and move their equipment into the state in special situations which require spraying of large acreages during seasonal emergencies. In addition to the licensed aerial applicators, some 60 licenses have been issued to commercial applicators who operate ground equipment. According to the state licensing officer, commercial ground equipment is used predominately in work on contracts for public service companies for herbicide applications, public parks and road right-of-ways.

Table XXXI presents the estimate made by Oklahoma agricultural agents of the per cent of insecticides applied by commercial applicators. Seventy-four of 138 (53.6%) indicated commercial applicators were responsible for 25% or less of all insecticides applied. However, the estimate for all agents was 31.1%.

Table XXXII summarizes data from 138 agricultural agents in Oklahoma relative to the percentage increase of insecticide usage during the preceding 15 years. Agents estimated 40.9% increase. Seventy-one per cent of the entire group believed the increase was in the 41 to 50% range.

This estimate is lower than expected in view of the expanded use of insecticides nationally. Wheat representing the largest crop acreage

in Oklahoma requires insecticide applications approximately one year in four. A high percentage of wheat farmers have used insecticides only when insect outbreaks warranted their use. Therefore, in all probability, the county agents' estimates are realistic.

TABLE XXXI

ESTIMATES BY 138 OKLAHOMA AGRICULTURAL AGENTS OF THE PER CENT INSECTICIDES APPLIED BY COMMERCIAL APPLICATORS

Title	Agents Estimating the Following Percentages				Median
	10-25	26-50	51-75	76-100	
C. A.	36	19	10	1	31.5
A. C. A.	38	24	10	0	30.7
Totals	74	43	20	1	31.1

TABLE XXXII

ESTIMATED PERCENTAGE INCREASE OF INSECTICIDE USAGE IN PRECEDING 15 YEARS BY 138 OKLAHOMA AGRICULTURAL AGENTS

Title	Agents Estimating the Following Percentages						Median
	5-10	11-20	21-30	31-40	41-50	Over 50	
C. A.	0	2	7	5	53	1	41.97
A. C. A.	1	1	10	13	45	0	39.81
Totals	1	3	17	18	98	1	40.88

One of the major factors contributing to the increased use of agricultural chemicals is the economic returns expected by improving quality or increasing yields of commodities produced by agriculturists. Insecticides, however, are only one group of a vast series of chemicals now used in agricultural production. Agents were asked to estimate the

percentage of increase in crop yields attributed to insecticide usage by Oklahoma farmers. Table XXXIII summarizes the data. The overall estimate by agents is 19.9% increase. As previously mentioned, a high percentage of Oklahoma's crop acreage is in nonintensive crop production. The use of insecticides in only one out of four years on this very large acreage of small grains adds emphasis to the conservative estimate by Oklahoma's county agents.

TABLE XXXIII

ESTIMATES BY 135 OKLAHOMA AGRICULTURAL AGENTS OF THE PER CENT INCREASE IN CROP YIELDS ATTRIBUTED TO INSECTICIDE USAGE

	Agents Estimating Following Percentages					
Title	0-10	11-20	21-30	31-40	41-50	Median
C. A.	9	35	16	9		19.12
A. C. A.	9	24	23	10		20.65
Totals	18	59	39	19		19.87

As a part of the economics of insecticide usage, agents were requested to estimate the average return per dollar invested in insecticides in Oklahoma. Estimates revealed the average return to be $4.93 return per dollar invested as shown in Table XXXIV. As indicated in the table, 38% estimated the return to be three dollars or less per dollar spent on insecticides while 61.9% estimated the return would be four dollars or more. The nationally accepted figure for savings from pesticide use is five dollars for every dollar invested and figures for California show approximately four and a half dollars return per dollar invested (Hornig, 1965). County agents' estimates in this study were slightly more conservative than those made by associate agents.

Oklahoma county agents' estimates are extremely close to the nationally accepted figure.

TABLE XXXIV

ESTIMATES BY 134 OKLAHOMA AGRICULTURAL AGENTS OF THE AVERAGE RETURN PER DOLLAR INVESTED IN INSECTICIDES

	Agents Estimated Return					
Title	1-3	4-6	7-9	10-12	Over 12	Median
C. A.	26	30	5	3	4	4.80
A. C. A.	25	24	9	6	2	5.06
Totals	51	54	14	9	6	4.93

For several years the extension entomologists in cooperation with the Oklahoma State University Entomology Department have been developing a series of pictorial keys to assist agents with insect identification.

Agents were surveyed on the usefulness of these keys and were asked if more pictorial keys were needed. Approximately 60% of all agents said more keys would be helpful. Those agents who responded in the affirmative were asked to list areas where they felt more keys were needed. Data from this request are summarized in Table XXXV. The highest percentages of requests for additional information in this area is closely correlated to agents' requests for additional types of information in other areas. Livestock pests, crop insects and horticultural pests were those most frequently listed.

Extension personnel are supplied various types of publications designed to assist them with entomological problems. In recent years, a number of one-page leaflets have been published which offer more

detailed information about a single insect species than is possible in the usual bulletin. The survey revealed that 91% of all agents thought these leaflets were helpful in their work, but only 80% said they would recommend more leaflets. Agents were further asked to list those areas where additional leaflets are most needed. Only 63% made suggestions in response to this request. These data are presented in Table XXXVI. Areas listed by agents for needed additional leaflets nearly duplicate the categories listed in other areas of the study where additional material would be useful.

TABLE XXXV

AREAS SUGGESTED BY OKLAHOMA AGRICULTURAL AGENTS WHERE ADDITIONAL PICTORIAL KEYS WOULD BE HELPFUL IN EXTENSION WORK[a]

Areas Suggested	Times Suggested by 76 Agents	Percentage Area Represents
Crop Insects	30	19.6
Fruit and Nut Insects	19	12.4
Household Pests	25	16.3
Livestock Pests	41	26.8
Ornamental Insects	22	14.4
Vegetable Insects	14	9.2
All Others	2	1.1
Totals	153	99.8

[a]Data taken from open-ended questionnaire

Since 1954, Oklahoma extension entomologists have participated in television programs on various phases of entomology work. Television stations in Oklahoma have been exceedingly cooperative and have offered

TABLE XXXVI

AREAS SUGGESTED BY 96 OKLAHOMA AGRICULTURAL AGENTS WHERE ADDITIONAL LEAFLET PUBLICATIONS WOULD BE HELPFUL[a]

Areas	Times by 50 C. A.	Percentages by C. A.	Times by 46 A. C. A.	Percentages by A. C. A.	Percentages by All Agents
Crop Insects	19	24.36	19	19	21.34
Fruit and Nut Insects	8	10.26	11	11	10.67
Household Pests	12	15.38	12	12	13.48
Livestock Pests	16	20.51	20	20	20.22
Ornamental Insects	13	16.66	14	14	15.11
Vegetable Insects	10	12.81	24	24	19.16
Totals	78	99.98	100	100	99.98

[a]Data taken from open-ended questionnaire

the entomologists special programs in emergency situations requiring dissemination of information in the shortest possible time. County agents were surveyed to determine whether additional television programs of an entomological nature would be helpful. Only 60% of all agents responding to the question answered in the affirmative. As a further part of the survey, those agents who answered positively to the first question were asked to list areas in which more television work would be helpful. Over 98% of the respondents suggested specific areas. Data are presented in Table XXXVII showing the percentage of all agents' suggestions in each category.

Cost of production has prevented the development of a good series of motion pictures in the entomology field. Some excellent commercial productions are available through the Oklahoma State University film library. In this study, 81% of the county agents said they considered entomology movies valuable. Those who considered movies of value were asked to suggest areas where more movies are needed. Eighty-eight per cent of those indicating the need for more movies responded. Data are summarized in Table XXXVIII showing areas suggested by county agents and associate agents. Livestock, crops, ornamental and vegetable insects far exceed all other areas suggested as they have in most parts of this study.

Each month Oklahoma State University's Public Information Department in cooperation with extension specialists and various department members produce a series of timely radio tapes. Extension and research entomologists have always been active participants in this service. County agents are sent titles of all tapes and are at liberty to order as many as they can use. In an effort to determine the use made of

TABLE XXXVII

AREAS SUGGESTED BY 71 OKLAHOMA AGRICULTURAL AGENTS WHERE TELEVISION WORK WOULD HELP ENTOMOLOGY PROGRAMS[a]

Areas	Times by 40 C. A.	Percentages by C. A.	Times by 31 A. C. A.	Percentages by A. C. A.	Percentages by All Agents
Crop Insects	18	20.93	19	17.12	18.79
Fruit and Nut Insects	8	9.30	12	10.81	10.15
Horticultural Insects	4	4.65	9	8.11	6.55
Household Pests	9	10.46	8	7.21	8.63
Livestock Pests	18	20.93	20	18.02	19.29
Ornamental Insects	12	13.95	15	13.51	13.71
Vegetable Insects	9	10.46	16	14.41	12.69
All Others	8	9.30	12	10.81	10.15
Totals	86	99.98	111	100.00	99.98

[a]Data taken from open ended questionnaire

TABLE XXXVIII

AREAS SUGGESTED BY 99 OKLAHOMA AGRICULTURAL AGENTS WHERE ENTOMOLOGICAL MOVIES WOULD HELP[a]

Areas	Times by 43 C. A.	Percentages by C. A.	Times by 56 A. C. A.	Percentages by A. C. A.	Percentages by All Agents
Crop Insects	29	25.0	27	22.3	23.6
Fruit and Nut Insects	10	8.6	10	8.2	8.4
Horticulture Insects	6	5.2	8	6.6	5.9
Household Pests	12	10.3	7	5.8	8.0
Livestock Pests	26	22.4	28	23.1	22.8
Ornamental Insects	17	14.65	17	14.0	14.3
Vegetable Insects	11	9.5	13	10.7	10.1
All Others	5	4.3	11	9.1	6.75
Totals	116	99.95	121	99.8	99.85

[a]Data taken from open-ended questionnaire

these programs, agents were asked if they considered entomology radio tapes of value. Data are summarized in Table XXXIX and show only 81% of all agents in the study answered this inquiry. Of those who responded, 41.5% said the radio tapes were of value. A slightly higher per cent of associate agents indicated tapes were of value.

TABLE XXXIX

EVALUATION BY 123 OKLAHOMA AGRICULTURAL AGENTS OF ENTOMOLOGY RADIO TAPES PRODUCED BY UNIVERSITY ENTOMOLOGISTS

Title	Said Tapes Are of Value	Said Tapes Not of Value	Percentage Said Tapes Are of Value
C. A.	26	38	40.6
A. C. A.	25	34	42.4
Totals	51	72	41.5

The response to this question would indicate a low interest in radio work by county agents. However, on checking with the Radio and TV Director of the Public Information Department of the University, it was found that only 38 (49.4%) of the counties in Oklahoma have local radio stations. By correlating this figure with that of those who said tapes were of value, a more realistic appraisal of the use of this medium can be made. Those agents who said they used these tapes also indicated they averaged using 15 entomology radio tapes per year. There are 66 radio stations located in 38 counties in the state that cooperate with extension.

Data From Extension Cooperators

In this section of the study all participants were asked to

indicate where they usually go for information on insecticides. Nine sources of information most readily available to the public were listed with an additional category offering the participant an opportunity to specify any other sources of information. Respondents were asked to check those areas which applied to them. Of the 560 who participated in this study, only 27 listed areas other than those in the instrument. The data are presented in Table XL.

The county agent's office was selected most often as the primary source of information on insecticides. The local insecticide dealers, drug stores and similar places and literature followed in this order.

Of importance is the number of times the local insecticide dealer, drug stores and similar places were selected as primary sources of information. These two sources combined were 29.1% of all selections made. The percentage of selections here shows two major areas for increased effort on the part of the Agricultural Extension Service on proper and safe use of insecticides. Some work has already been accomplished in these areas though not in proportion to their indicated importance.

Evaluation of information shown here indicates no major disagreement between male and female laymen as to the primary sources of information on insecticides. The greatest difference appeared in the category on literature which consisted of only 1.4% of the male cooperator's selections, but was 14.9% of the female selections. It would appear that information on use of insecticides has more significance in publications used by female cooperators than those used by male cooperators.

To evaluate the importance of various types of printed material

TABLE XL

LAYMEN'S SOURCES OF INFORMATION ON INSECTICIDES AS INDICATED BY 560 COOPERATORS IN THIS STUDY

Source	Male 305	Percentages of Total	Female 255	Percentages of Total	Total Number	Percentages of Total
Commercial Insecticide Dealer	46	6.4	19	2.6	65	4.5
C. A. Office	273	38.0	222	30.9	495	34.5
Drug Store Similar Places	56	7.9	82	11.4	138	9.6
Health Department	25	3.5	40	5.6	65	4.5
Literature	10	1.4	107	14.9	117	8.2
Local Dealer	149	20.7	130	18.1	279	19.5
Oklahoma State University	56	7.9	34	4.7	90	6.2
State Department Agriculture	44	6.1	29	4.0	73	5.0
Vocational Agriculture Instructor	46	6.4	39	5.4	85	5.9
Any Other	12	1.6	15	2.1	27	1.2
Totals	717	99.9	717	99.7	1,434	99.10

on safe use of insecticides, laymen were asked to check any of nine sources which emphasized chemical safety. Data are presented in Table XLI.

TABLE XLI

SOURCES OF PRINTED INFORMATION CITED BY 403 LAYMEN ON SAFE USE OF INSECTICIDES

Sources	Times Selected	Percentage of Selections
Books	49	3.4
Bulletins	304	20.8
Correspondence	55	3.8
Decals	43	2.9
Leaflets	253	17.3
Magazine Articles	376	25.8
News Stories	255	17.5
Photos	53	3.6
Stickers	73	4.9
Totals	1,461	100.0

Those sources most frequently selected were magazine articles, bulletins, news stories and leaflets in that order. These four represent 81.4% of the total number of selections. Sources most used by the Extension Service in educational programs (bulletins, leaflets and news stories) represent 55.6% of the selections. County agents and extension specialists contribute to magazine articles as well; however, no attempt was made to determine the extent of these contributions or their effect on cooperator's selection of this medium.

Sources of information about insecticides are important as this could have an effect on plans for future programming. Cooperators were asked to select sources from which they had heard discussion on safe use of insecticides. Data are shown in Table XLII.

The area selected most often was government offices representing 22.9%. Each of four other sources (meetings, radio, television and neighbors) represented slightly over 15% of all selections.

As a part of the safe use of insecticides study, laymen were asked to list sources of information pertaining to emergency situations. Only 315 of 560 (56.2%) indicated they knew where to get this information. Those who indicated they knew were asked to list the sources. Data in Table XLIII show the sources indicated by male and female cooperators and the percentage each category represents of the total selections made.

Those sources most often selected were the local doctor and the county agent's office. Labels were considered the third most important source of information while the Poison Control Center was selected by only 15 people representing only 3% of all suggestions. This does not in any way de-emphasize the importance of the poison control center as a source of information. All educational work of the Oklahoma Extension Service on seeking help in emergency situations has stressed the importance of contacting a physician. In most emergency cases a professionally trained individual will need to interpret the information.

To make some correlation between ideas expressed by county agents on areas where most insecticides are used and those expressed by cooperators, laymen were asked to estimate the percentage of insecticides used in nine broad areas. An additional category for listing other

areas was included.

TABLE XLII

SOURCES FROM WHICH 317 LAYMEN INDICATED THEY HAD HEARD DISCUSSION ON SAFE USE OF INSECTICIDES

Sources	Times Selected	Percentages of Selections
Civic Groups	28	2.8
Committees	27	2.7
Government Offices	223	22.9
Health Department	36	3.7
Meetings	153	15.7
Neighbors	149	15.3
Short Courses	26	2.7
Radio	152	15.6
Television	147	15.1
Doctor	34	3.5
Totals	975	100.0

Data on the percentage for each area have been listed to show estimates by male and female respondents and are presented in Table XLIV.

Female respondents estimated the percentage of insecticides used in the home exceeds the percentage used in any other area. Estimates made by male respondents showed the highest percent of insecticides were used on livestock.

A study in 1964 showed cattle numbers in Oklahoma have increased 3 to 4% annually since 1950 and on January 1, 1964 reached an all-time

high of 4,029,000 head (Taggart, 1964).

TABLE XLIII

SELECTIONS BY 315 LAYMEN AS SOURCES OF INFORMATION ON EMERGENCIES INVOLVING INSECTICIDES[a]

Source	By 183 Male	By 132 Female	Total Number	Percentage Totals
C. A. Office	112	66	178	34.8
Doctor	92	101	193	37.8
Distributor	11	28	39	7.6
Health Department	5	25	30	5.9
Labels	30	24	54	10.5
O. S. U.	2	0	2	0.4
Poison Control Center	8	7	15	3.0
Totals	260	251	511	100.0

[a]Data taken from open-ended questionnaire

With the utilization of 26 million acres of the state's total land area (44 million acres) for grazing purposes, it seems obvious that many extension cooperators would consider livestock vital to their agricultural enterprises and this, no doubt, influenced the estimate of insecticide usage in this category by male respondents. The fact that cattle are often treated many times each year for various pests could also have influenced respondents.

TABLE XLIV

THE PER CENT OF INSECTICIDES USED IN VARIOUS AREAS AS INDICATED BY 380 LAY COOPERATORS IN THIS STUDY

	All Estimates Made on Percentage Basis	
	Number Males	Number Females
Areas	233	147
Dairy Barns or Other Buildings	7.6	8.5
Forage Crops	9.2	3.4
Home	9.8	22.4
Livestock	43.0	21.0
Ornamentals	5.8	10.6
Pets	2.8	8.4
Range Land	3.0	1.5
Stored Products	2.8	2.4
Vegetables	6.2	15.2
Others	9.8	6.6
Totals	100.0	100.0

CHAPTER V

SUMMARY AND CONCLUSIONS

Increased use of pesticides in recent years has caused concern as to the potential hazards created when these chemicals are released into man's environment. As understanding of the problem increased, it became apparent that intensified efforts to enlighten the public might be more important than the more cryptic aspects of the problem. The Cooperative Extension Service of the U. S. Department of Agriculture has been designated as the federal agency responsible for conducting an educational program to increase public awareness of the potential dangers, while recognizing the value of pesticides.

This study was designed to obtain information to aid in the evaluation of the educational needs of Oklahoma's extension personnel relative to entomological problems, including the safe use of pesticides.

Data were accumulated from 250 questionnaires returned from a planned survey of 311 individuals representing Oklahoma's Extension Field Staff, in addition to 560 questionnaires returned from 665 selected lay-cooperators.

Data were tabulated from six groups representing: (1) county agents; (2) associate county agents; (3) home demonstration agents; (4) associate home demonstration agents; (5) male and (6) female lay-cooperators of the Oklahoma Extension Service.

The chi-square test was used to determine significant differences,

at the .05 level of confidence, in responses to several items by the various groups of respondents. Additional subjective and objective data were accumulated and are included.

Results of the study showed that county agents and associate agents were not in significant disagreement on 82.7% of the items they answered. A comparison of all men and all women extension workers' responses revealed that significant differences occurred on 35% of the items. A comparison of responses between all extension personnel and all lay-cooperators on the safe use of insecticides revealed significant differences on 57% of the items.

Significant differences appeared on 35.7% of male and female laymen's responses to various items on the safe use of insecticides and related information.

The data showed men agents estimated approximately one third (32.2%) of all questions directed to them during the cropping season were of an entomological nature. Estimates by agents showed 21.1% of all questions for the entire year were of an entomological nature, while entomology course work consisted of approximately 3% (4.9 hrs.) of their formal training.

Over 90% of all Oklahoma agricultural agents recommended more entomology training for potential new agents, and 92.8% indicated they would take additional entomology course work if available, while 88% recommended expanding entomology short course work.

By grouping agents' responses to questions on the value of entomology publications, 83.7% said these materials were useful and were filling a need. In response to similar items on the need for increasing or expanding entomology educational materials, 78.4% expressed a

a need for additional materials.

County agents and associate agents, as a group, estimated 84.5% of all insect questions were represented in one of five categories, including crop insects, livestock pests, ornamental insects, vegetable insects, and fruit or nut insects. These five categories were consistently listed by agents in various parts of the study as areas in which additional educational materials would be helpful.

Responses by agents to questions relative to insecticides as an aid to agricultural production showed 98.9% said insecticides were needed and would continue to be used.

In response to a series of items on safe use of insecticides, agents indicated most individuals were not well informed on handling, use, storage, disposal of surpluses, and legislation regulating the use of these chemicals. County agents' and associate agents' responses to questions showed 92.6% would use more publications on safe use of pesticide chemicals, and 96.5% said more educational work on safe use of insecticides was needed.

A comparison between responses by all men agents and all women agents revealed significant differences at the .05 level of confidence on 35% of the items in the instrument. While significant differences were shown on certain items, there was a trend toward general agreement on 90.7% of all questions.

In response to items on the need for additional entomology training for extension personnel, 51.8% of the home demonstration agents indicated they would take additional entomology work, while 79.5% recommended expanding short course work in entomology and 84% indicated potential new agents should have additional entomology training.

Home demonstration agents' responses to questions on the need for expanding published entomology materials showed 87.5% believed additional material was needed.

Over 79% of the home demonstration agents were of the opinion that most people were not well informed on safe use of insecticides and 94.2% indicated there was a need for more educational work on safe use of pesticides.

A comparison of responses by all extension personnel and all laymen on various items related to the safe use of insecticides revealed significant differences on 57% of the items. There were trends toward general agreement between these groups on 70% of all questions.

Responses by male and female lay-cooperators to 28 items on safe use of insecticides, information available on insecticides and the present insecticide situation were compared for significant differences. They were not in significant disagreement on 65% of all items.

While 62% of all laymen said they considered insecticides dangerous, 80.5% indicated chemicals available were adequate for most of their insect problems and 99% said they would continue to use them in the future.

In response to an inquiry on the importance of continued research on insecticides, 523 of 524 laymen said research should continue and 89% said they would support research methods other than chemical controls.

Responses to various items by lay-cooperators indicated they believed most people do not have adequate chemical storage, insecticide surpluses were not adequately disposed of, and most people were inadequately informed on pesticide legislation.

On the question of the need for more emphasis on the safe use of insecticides, 540 (95.2%) of those who responded indicated further effort was desirable.

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APPENDIX A

DEVELOPMENT OF THE COOPERATIVE EXTENSION SERVICE

In order to develop this study on the needs of extension personnel relative to entomological problems and safe use of pesticides, it is necessary to give some consideration to the development and philosophy underlying the Cooperative Extension Service as background information which serves as the foundation for program development within the extension organization.

The Cooperative Extension Service grew out of the land-grant college system which evolved from the idea of providing a more practical educational system for a broader segment of the population than was possible under the mostly private, traditional and classical type of institutions which were prevalent during the early development of higher education in this country. Early institutions were largely private and were established by churches, individuals or special interest groups. Most of these institutions were established with curriculums for those interested in the so-called learned professions of law, theology and medicine. The very nature of higher education during its early development restricted its access to only a few who were able to afford the high tuition necessary to support such systems.

While this situation existed during the first half of the 19th century, most of the population were engaged in professions which required training in trades, industry and agriculture. Since the classics taught in institutions of higher education were not supplying information being demanded by a high per cent of the population, many ideas

were proposed to offer training in the mechanical and liberal arts which would be available to all regardless of social or financial status.

As this feeling for change intensified, proposals to create some educational systems with financial assistance from the federal government began to take form. Attempts to introduce legislation to this effect failed until a land-grant bill was introduced in the House of Representatives on December 14, 1857, by Representative Justin S. Morrill of Vermont. The bill passed both houses but was vetoed by President Buchanan. The bill was introduced a second time by Representative Morrill on December 16, 1861, passed both houses, and was signed into law by President Lincoln on July 2, 1862.

This act provided that for each Representative or Senator a state had in the United States Congress, it was to receive 30,000 acres of public land. The monies received from the sale of this land was to be designated as an endowment fund for the establishment and maintenance of at least one college in each state provided the state expressed its acceptance of the benefits of the act through legislation within two years from the date of its approval by the President. As defined in the act, the purpose of these institutions would be the teaching of certain divisions of learning related to agriculture, mechanical arts and military tactics as prescribed by the various state legislatures (Kelsey and Hearne, 1949).

During these early developments, the United States population was predominantly agriculturally oriented and the natural trend was for new land-grant institutions to become "agricultural" colleges. In the short period of nine years following the passage of the Morrill Act,

36 states had accepted the provisions required by the Act for establishing institutions of higher education (True, 1928).

In spite of the rapidity with which states made provisions for establishing the land-grant institutions, the very justification for establishing the college created a dilemma. Scientific information related to the major purposes cited for these institutions, especially agricultural information, was inadequate to meet the needs of the time. The physical plant for teaching had been provided, but information available for teaching was very limited.

Leaders of the day were aware of the conditions, and several attempts were made to introduce new legislation to alleviate the situation. It was not until Representative William H. Hatch of Missouri introduced a bill which became law on March 2, 1887, that any additional federal monies became available to assist the land-grant institutions. This legislation, now known as the Hatch Act, provided federal assistance for the purpose of establishing agricultural experiment stations and dissemination of research findings. The experiment stations were required to make public research information through periodic bulletins and progress reports. The Adams Act in 1904 provided additional funds for original experimentation not provided by earlier legislation. Additional funds have been made available from time to time for expanding scientific experimentation in agricultural economics, home economics, and rural sociology. The second Morrill Act passed in 1890 provided additional funds for resident teaching. Money provided by this act was to be used only for expanding instruction in agriculture, the English language, mechanical arts and various branches of physical, mathematical, and economic sciences (Eddy, 1957).

The second Morrill Act created the relationship between the federal-state agricultural factions which eventually evolved into the present Cooperative Extension Service.

The rapid growth of the land-grant system of higher education was strongly influenced by the organization of these institutions under various association names.

In 1887 these institutions were organized as the Association of Agricultural Colleges and Experiment Stations. In 1919 the name changed to Association of American Agricultural Colleges and Experiment Stations. Revisions in the constitution of the organization were made to include appropriate sections of engineering, home economics, agricultural teaching, experiment station and extension work. In 1955 the name again changed to offer the possibility of membership to state universities not classified as land-grant institutions. The name selected for the revised organization was the American Association of Land-Grant Colleges and State Universities. The organization serves as an important influence in relation to exchange of ideas and as a clearinghouse medium for important matters of vital concern to its member institutions.

One other significant development occurred during the early part of the evolution of the land-grant system of education. Less than two months prior to the passage of the second Morrill Act, Congress passed legislation called the Organic Act establishing the United States Department of Agriculture. The general duties assigned to the department were to acquire and diffuse among the people useful information on subjects related to agriculture in the most general and comprehensive sense of the word (Brunner and Yang, 1949).

The organized agricultural extension concept had its beginning with the establishment of a committee on extension by the Association of Land-Grant Colleges and Experiment Stations in 1905. Under the chairmanship of Dr. K. S. Butterfield, president of the Massachusetts Agricultural College, the committee spent two years studying and evaluating extension activities of independent organizations as well as those conducted by colleges. The committee's first report in 1906 defined extension teaching to include

> "those forms of instruction, in subjects having to do with improved methods of agricultural production, and with the general welfare of the rural population, that are offered to people not enrolled as resident pupils in educational institutions" (True, 1929).

The committee's second report in 1907 showed that colleges in 39 states were conducting programs classified as extension activities, the greater part of which were of the nature of farmers' institutes. By 1908 the committee had formulated a proposal that the federal government assist with adult education by financing extension work through the land-grant colleges.

In 1909 a bill containing these recommendations was introduced to the Congress of the United States, but failed to pass. In the next five years, various bills and many hearings occupied the time of the proponents of federal appropriations for extension work. The National Grange, the American Bankers' Association, the National Soil Fertility League, the National Committee on Agricultural Education, and the American Federation of Labor all had a hand in the growing movement requesting government assistance for agricultural extension work (Kelsey and Hearne, 1949).

A second bill was introduced in 1912 by Congressman Lever and

Senator Smith outlining the provisions for the creation of the extension department of the land-grant colleges. It was not until May 8, 1914, that President Wilson signed the bill to make it law. The creation of the Cooperative Extension Service was thus finalized by the Smith-Lever Act of 1914, six years after the Land-Grant Colleges' committee recommendation.

Even though it is often said that the Smith-Lever Act marks the beginning of agricultural extension work in this country, it should be kept in mind that such legislation represents a product of the environment of the times. The need for scientific knowledge in agriculture in the early part of the nineteenth century was emphasized by the activities of many groups long before the Smith-Lever Act became law. These efforts are at least as old as the Philadelphia Society for the Promotion of Agriculture organized in 1785. A similar society was organized in Massachusetts in 1792. There were also early societies at Columbia University in New York City and Rensselaer Institute in Troy, New York which sent out trained people to give farmers and others instructions in science and its application to the common purpose of life. The Ohio State Board of Agriculture was created by the state legislature February 28, 1846. The United States Agricultural Spciety was organized in 1852 by representatives of 23 states and territories.

In 1854 the Secretary of the Massachusetts State Board of Agriculture said he believed farmers' institutes should supply the needs of agricultural education. Soon the Board was supplying publications and sponsoring discussions and lectures by leading agriculturists.

The Union Agricultural Society of Kansas held a farmers' institute in Manhattan November 14, 1868. Subjects discussed included "tree

borers," culture of fruit trees and economy on the farm. In 1872 Iowa conducted a series of farmers' institutes. About this time, New Hampshire, Vermont, New Jersey and Tennessee began to hold public meetings that soon became farmers' institutes. Michigan began a series of farmers' institutes which lasted 12 years. Nebraska, Pennsylvania and Alabama all began similar programs near 1880. In the following ten years, farmers' institutes were established on what was considered a permanent basis in 26 states. By the year 1899, institutes were reported in most states with a total attendance of over 500 thousand farmers. In 16 states, the institutes were supervised by the State Department of Agriculture. In 19 southern and western states, they were directly under supervision of the agricultural colleges or experiment stations. As funds became available to expand this work, farmers' institutes spread rapidly during this 15 years ending in 1915. At the close of this period, over 8,000 institutes were held annually with more than 3 million people attending (True, 1928). The procedures most commonly employed for conducting farmers' institutes consisted of organized lectures and exhibits which moved as a special train from town to town. The method was popular and was widely used as a valuable teaching device. Institutes continued to function in several states long after the Smith-Lever Act was passed and nine states officially conducted farmers' institutes as late as 1932. The introduction of the county agent system in 1914 marked the gradual decline of farmers' institutes as a method of teaching.

The origin of the Cooperative Extension Service has as its foundation those directives found in the Smith-Lever Act of 1914. The Act stipulates:

> . . . that in order to aid in the diffusing among the people of the United States useful and practical information on subjects relating to agriculture and home economics and to encourage the application of the same, there shall be inaugurated in connection with the college or colleges in each state, now receiving, or which may hereafter receive, the benefits of the land-grant act of 1862 and of the Morrill College Endowment Act of 1890, agricultural extension work which shall be carried on in cooperation with the United States Department of Agriculture. . .
>
> That cooperative agricultural extension work shall consist of the giving of instruction and practical demonstrations in agriculture and home economics to persons not attending or resident in said colleges in the several communities, and imparting information on said subjects through field demonstrations, publications, and otherwise; and this work shall be carried on in such manner as may be mutually agreed upon by the Secretary of Agriculture and the state agricultural college or colleges receiving the benefits of this Act (True, 1928).

The Smith-Lever Act stipulated that cooperative extension work was to be educational and that it was to be a function of the land-grant college system of higher education. The Act further authorized Congress to provide such funds as deemed necessary for the organization and development of the Cooperative Extension Service.

Several additional acts were passed by Congress between 1914 and 1946 providing for expansion of extension work. The Clark-McNary Act of 1924 appropriated funds specifically for extension forestry work. The 1928 Capper-Ketcham Act increased federal funds for the over-all extension program. In 1935 the Bankhead-Jones Act authorized funds for the expanding extension program; and in 1939, the "additional Extension Work Act" was passed and subsequently amended in 1941. The 1945 Bankhead-Flannagan Act allowed further development of county extension programs. The 1946 Research and Marketing Act extended extension activities in the marketing area. This array of legislation led to considerable confusion due to variation of handling funds and

interpretation of the bills. In 1953 Congress consolidated most of the preceding legislation by passing the Hope-Akin Act which repealed all the separate laws with the exception of the Clark-McNary Act and the Agricultural Marketing Act. The new law provided an open-end appropriation clause which allowed each session of Congress to allocate funds for extension work.

On August 11, 1955, the 84th Congress enacted Public Law 360 as an amendment to the Smith-Lever Act to provide for extending extension programs to disadvantaged farms. The Act provides for extending assistance in one or more of the following areas: (1) intensive on-the-farm educational assistance to the farm family in appriaising and resolving its problems; (2) assistance in counseling to local groups in appraising resources for capability of improvement in agriculture or induction of industry designed to supplement farm income; (3) co-operation with other agencies and groups in furnishing all possible information as to existing employment opportunities, particularly to farm families having underemployed workers; and, (4) in cases where the farm family, after analysis of its opportunities and existing resources, finds it advisable to seek a new farming venture, the providing of information, advice, and council in connection with making such change.

In 1964 the Economic Opportunity Act was passed by the 88th Congress for the purpose of expanding opportunities for youth, to stimulate initiation of local community programs to attack poverty, help low income rural families, assist in rehabilitation and small business activities in large cities, provide special educational programs for uneducated adults and to encourage more states to use public assistance

as a means of reducing poverty.

On September 14, 1965, the 89th Congress passed the State Technical Services Act. The Act provides that the Governor of each state shall designate an institution or agency to coordinate and administer the program provided for by the Act. The institution shall establish and maintain a state technical services program designed to enable business, commerce, and industrial establishments to acquire and use scientific and engineering information more efficiently. The nature of these programs is such that the Extension Service will be providing educational assistance in many phases of this work.

The Cooperative Extension Service developed as an intrinsic part of the land-grant college system and was charged with the responsibility of aiding in diffusing among the people of the United States useful and practical information relating to agriculture and to encourage the application of such information. The nature of legislation passed over the years has established the respective responsibilities of research, teaching and extension personnel in the land-grant institutions.

There must be a close working relationship between research and extension for either to reach maximum effectiveness. The relationship has probably nowhere been better expressed than a quote from Glenn Frank by Dr. Paul J. Kruse addressing a group of extension workers with the following statement:

> The future of America is in the hands of two men, the investigator and the interpreter. We shall never lack for the administrator, the third man needed to complete this trinity of social servants, and we have an ample supply of investigators. The practical value of every social invention or material discovery depends upon its being adequately interpreted to the masses. Science

> owes its effective ministry as much to the interpretative mind as to the creative mind. The knowledge of mankind is advanced by the investigator, but the investigator is not always the best interpreter of his discoveries. Rarely, in fact, do the genius for exploration and the genius for exposition meet in the same mind. The interpreter stands between the layman, whose knowledge of all things is indefinite, and the investigator whose knowledge of one thing is authoritative. The investigator advances knowledge. The interpreter advances progress. History affords abundant evidence that civilization has advanced in direct ratio to the efficiency with which the thoughts of the thinkers have been translated into the language of the workers. Democracy of politics depends upon democracy of thought. "When the interval between intellectual classes and the practical classes is too great," says Buckle, "the former will possess no influence, the latter will reap no benefit." A dozen fields of thought are today congested with knowledge that the physical and social sciences have unearthed, and the whole tone and temper of American life can be lifted by putting this knowledge into general circulation. But where are the interpreters with the training and the willingness to think their way through this knowledge and translate it into the language of the street? I raise the recruiting trumpet for the interpreters (Kruse, 1948).

During the early years of extension work, a strict interpretation of certain sections of the Smith-Lever Act led extension programs toward a concentrated effort on agricultural production techniques with the rural population only. It should be remembered that in the early history of extension approximately two-thirds of the population was rural. Today our population is over two-thirds urban. Rural farm population has dropped from 30% of the nation's people in 1920 to only 7.5% in 1960. The per cent of the United States labor force engaged directly in agriculture has plunged in the same period from 26% to 6.6%. Farms are going out of production at the rate of 120 thousand per year. The United States Department of Agriculture now estimates there are no more than 3 million bona fide farm operations in the United States (Beale and Bogue, 1963).

As the number of farms has declined, the size of those remaining has increased. The remaining farmers have continued to produce food and fiber at a rate that magnifies the mountains of surpluses already on hand. Viewed from this perspective, some observers have concluded that agricultural extension has outlived its usefulness and that the interdisciplinary mechanisms of extension should be directed toward helping find solutions to the problems vexing the urban population or that the program should simply be allowed to atrophy. It is the opinion of the writer that those who hold to the latter opinion could have only a superficial knowledge of the interrelationship between agriculture and the total national economy. It is further likely that such advocates have no knowledge of the fact that extension administrators have become increasingly aware of the need to re-examine the range of responsibilities as well as the long term objectives of the Cooperative Extension Service. The desires and needs of extension clientele themselves plus legislation subsequent to the Smith-Lever Act have caused a much broader interpretation of extension programs, and responsibilities than was originally believed possible.

The first significant attempt to examine the future of extension was made by a committee within the federal extension office. This committee formulated and submitted a report in January, 1946, entitled, "The Scope of Extension's educational Responsibility" (Kepner, 1946). This report stated that the educational needs of people are constantly changing and need frequent evaluation and readjustment. The committee report further stated that in actual operation the extension worker's responsibility extends to all the people in the United States having any interest in agriculture and home economics irrespective of

residence, age, economic status, group affiliation, or any other factor that might be used to differentiate the group.

In October, 1945, the Secretary of the United States Department of Agriculture submitted a proposal to the Association of Land-Grant Colleges and Universities suggesting that the Department and the Association formulate a joint committee to study and make recommendations on the programs, policies and goals of the Cooperative Extension Service. The proposal by the Secretary was unanimously approved by the Association and the joint committee was formulated in October 1946 (Hannah, 1948).

This committee examined some of the criticisms leveled at extension and reported they had no facilities with which to study the accuracy of the charges, or whether there was any justification for them. The committee further examined and issued opinions on the following: The place of extension in the land-grant institution; the objectives and scope of the extension organization; relationship of extension with other agencies and groups; the land-grant college and United States Department of Agriculture relationship in regards to extension work; extension methods and programs; training and professional status of extension personnel; and, trends that may affect the future responsibilities of the extension service.

In April, 1957, this committee appointed seven members to a Subcommittee on Scope and Responsibility. This group was assigned the responsibility of formulating a statement of the scope and responsibilities of the Cooperative Extension Service.

This committee's report, now known as the "Scope" report. reaffirmed the statement made by earlier studies that the primary function

of the Cooperative Extension Service was education.

One of the significant characteristics of the Extension Service has been the necessity and ability to shift program emphasis and teaching methods to meet rapid changes in conditions and demands of the times.

The "Scope" report emphasized nine areas that have had an effect on extension programming for nearly a decade and will likely have much to do with future programs. These areas include: Efficiency in agricultural production; efficiency in marketing, distribution and utilization of agricultural products; conservation, development and use of natural resources; management on the farm and in the home; family living; youth development; leadership development; community improvement and resource development; and, public affairs (Miller, et al., 1948).

Some of the major points made in this report will help shed light on the gradual migration of extension into activities of urban populations. Extension programs for many years have included information on landscaping, horticulture, home economics projects, home grounds improvement, floriculture, entomology and other areas of interest to urban audiences. Few guidelines are available to assist agents in developing programs for urban areas. The most common approach today is to use mass media techniques to reach urban populations seeking extension information. The use of local papers, regularly scheduled radio programs, and to a lesser degree use of television are methods most often employed.

Emory J. Brown, professor of rural sociology at Pennsylvania State University, outlines the following organizational components as

relevant in adapting extension activities to the urban environment: The objectives or goals of the Cooperative Extension; program content of the organization; personnel; resources available; supporting public and clientele; and, methods and techniques inherent within the organization (Brown, 1965).

One major strength of extension has been program development based on expressed needs of people. If the organization is to succeed in urban adult education, it will be necessary to make a sincere commitment to understanding the urban social organization.

Traditionally, extension rural audiences have been homogeneous with respect to occupation, socio-economic status and subject matter interests. Urban audiences will not present such well-defined patterns. This is a society of a more heterogeneous nature with respect to occupations as well as socio-economic status. The 1960 United States Census of Population depicts the urban population as being far more mobile than those in rural areas. In 1960, 71% of rural families had lived in the same house for five years, compared with only 48% of urban families (U. S. Census, 1960). The extension agent will find urban audiences more difficult to work with as a result of turnover in membership and leadership in organized groups. In 1960 Census also shows urban populations are somewhat better educated than rural populations. The average urban dweller had 11.1 years of schooling in 1960 as compared with 8.8 for rural adults. Programming and subject matter information will possibly have to be organized and taught on a slightly higher level to audiences in cities and towns.

From recent studies, committee reports, and trends, the Cooperative Extension Service is destined to expand its programming goals

and activities to include a very broad segment of the population. Hopefully, this approach will not seriously curtail extension activities in areas of traditional programming and educational work at the basic production level of the national economy. Food is still by far the largest single item in the American family budget, taking somewhat over a fifth of all consumer expenditures after taxes (Landsberg, et al., 1963). Population trends the world over would indicate that all presently known technology in agricultural production will need to be brought to bear to stem the tide of hunger, malnutrition and starvation in the underdeveloped areas of the world (Mudd, 1964). The problem is already a grave one in many areas of the world and most demographers believe it will intensify in the western hemisphere in the next 30 years. By the year 2,000, the United States population is expected to reach an estimated 300 million people or approximately a 50% increase over the present population in just 35 years. There is no reason to believe they will be satisfied with living stardards at a level below what is common today. Most will likely expect even higher standards in diets, housing and consumer goods of all kinds. Many serious thinking individuals, as well as organizations, are beginning to wonder if there will be enough agricultural production to provide the basis for a rising standard of living in the face of the present rapidly expanding population. A recent report by Resources for the Future, Inc., a non-profit research center supported by the Ford Foundation, had this to say:

> It can be said that continuing progress in agricultural technology and spread of skills and knowledge are the sine qua non of a continuing high standard of living based on ample food supply available at a reasonable percentage of personal income (Landsberg, et al., 1963).

If it is to assist in meeting the food and fiber needs of the United States in the year 2,000, they say agricultural extension must use all its skills in relocating producing areas, introducing new crop varieties, promoting the use of new crop varieties; increasing the use of fertilizers, improving weed control, attacking the ravages of insects and diseases, improving and expanding the use of machinery, and conserving the soil and forestry reserves.

Most authorities of world population and food supply agree that the potential definitely exists to substantially increase the world's food output. The possible means includes bringing new land into production and increasing the quantity and quality of present agricultural lands. According to one estimate, 20% of the unexploited red soils of Africa and South America might be brought under cultivation bringing 986,676,000 acres into production, another 109,640,000 acres in such areas as Sumatra, Borneo, New Guinea, Madagascar and other tropical areas could possibly be added as potential food producing acres (Salter, 1947). Although the execution of the mechanics in bringing these areas into production is technically possible, the limiting factors seem to be finances and technical "know-how". The Cooperative Extension Service of the United States Department of Agriculture has the working organization capable of extending knowledge into these areas.

Provided this premise is sound then agricultural extension will be accorded an essential role in the years ahead in bringing about substantial increases in food and fiber production necessary to satisfy the world's growing population. It will require all the skills and knowledge available to meet the needs of the world's population

whether rural or urban.

APPENDIX B

EVALUATION OF THE NEEDS OF OKLAHOMA EXTENSION
PERSONNEL RELATIVE TO ENTOMOLOGY PROBLEMS

County_____ Sex--Male___ Female___ Position_____

I. Formal Entomological Training

A. Number of college hours of entomology completed. (1) Three___ (2) Six___ (3) Nine___ (4) More than nine___

B. Where attained? (1) OSU___ (2) Other_____

C. When attained? (1) Before 1946_____ (2) 1946 to 1956_____ (3) After 1956_____

D. Have you had 513 Entomology short course? (1) Yes___ (2) No___

E. Have you had 453 Entomology short course? (1) Yes___ (2) No___

F. Would you recommend expanding Entomology short course work? (1) Yes___ (2) No___

II. Agent's Experience and Academic Qualifications

A. Number of years with extension. (1) 1 to 5___ (2) 6 to 10___ (3) 11 to 20___ (4) Over 20__

B. Number of years in present position. (1) 1 to 5___ (2) 6 to 10___ (3) 11 to 20___ (4) Over 20__

C. Degrees held (1) B.S.___ (2) M.S.___ (3) Ph.D.___

D. Last short course completed Name_____ Course No._____

E. Are you now working on another degree? (1) Yes___ (2) No___

F. If YES, when do you expect to complete? _____

G. Where will degree be completed? (1) OSU___ (2) Other___

III. Agent's Evaluation of Entomology Training Needs

A. Would you take additional short course work in Entomology if available? (1) Yes___ (2) No___

B. Would you recommend additional entomology training for potential Extension workers in lieu of or in addition to other subject matter areas? (1) Yes___ (2) No___

C. What per cent of the questions coming to your office are of an entomological nature, or closely related?

Entire Season
(1) 10 to 20__ (2) 21 to 30__
(3) 31 to 40__ (4) 41 to 50__
(5) More than 50_____

Cropping Season
(1) 10 to 20__ (2) 21 to 30__
(3) 31 to 40__ (4) 41 to 50__
(5) More than 50_____

D. Give the percentage that fall into the following: (Should total 100%)

(1) Crops insects____
(2) Household pests____
(3) Fruits and nuts____
(4) Ornamentals____
(5) Stored products____
(6) Livestock____
(7) Forest insects____
(8) Vegetable insects____
(9) Pets____
(10) Any other____

IV. Evaluation of Information Available and Needed Publications

A. Is USDA Handbook 120, Insecticide Recommendations, filling a need? (1) Yes___ (2) No___

B. Is Handbook 120 adequate for most situations? (1) Yes___ (2) No___

C. Is Agent's Handbook of Pest Control filling a need? (1) Yes___ (2) No___

D. If YES, would you recommend its expansion? (1) Yes___ (2) No___

E. Are you using the insect pictorial keys? (1) Yes___ (2) No___

F. If YES, which ones? (1)_____ (2)_____
(3)_____ (4)_____

G. Would more pictorial keys be helpful? (1) Yes___ (2) No___

H. If YES, in what areas? Ex. Livestock, household, etc.
(1) _____
(2) _____
(3) _____
(4) _____

I. Are insect leaflets (i.e., ants, brown spider) helpful? (1) Yes___ (2) No___

J. Would you recommend more leaflets? (1) Yes___ (2) No___

K. Areas where leaflets are needed most.
(1) _____
(2) _____
(3) _____
(4) _____
(5) _____

L. Do you feel the weekly insect survey reports are valuable to you? (1) Yes___ (2) No___

M. Would you recommend larger bulletin type publications? (1) Yes___ (2) No___

N. Do you feel USDA bulletins are adequate to take care of most bulletin needs? (1) Yes___ (2) NO___

O. In what areas would you recommend more research in entomology?
(1) _____
(2) _____
(3) _____
(4) _____

P. Do you consider the entomology radio tapes are valuable to you? (1) Yes___ (2) No___

Q. Do you use these tapes? (1) Yes___ (2) No___
How many times per year? _____
Would you recommend more tapes be made? (1) Yes___ (2) No___

R. Would you consider entomology movies of value in your work? (1) Yes___ (2) No___

S. If YES to preceding question, list areas where needed.
(1) _____
(2) _____
(3) _____
(4) _____

T. Would more television work in entomology be of value? (1) Yes___ (2) No___

U. If YES, list areas needed.
(1) _____
(2) _____
(3) _____
(4) _____

V. Agent's Evaluation of Insecticides as an Aid in Agricultural Production

A. Do most producers feel insecticides are a necessity in their farm operation? (1) Yes___ (2) No___

B. Has insecticide usage increased in your county in the past 15 years? (1) Yes___ (2) No___

C. Estimate the per cent of increase since 1945.
(1) 5 to 10__ (2) 11 to 20__
(3) 21 to 30__ (4) 31 to 40__
(5) 41 to 50__

D. What per cent of farmers are now using insecticides in some way?
(1) 0 to 25__ (2) 26 to 50__
(3) 51 to 75__ (4) 76 to 100__

E. Have insecticides increased crop yields in your county? (1) Yes___ (2) No___

F. Your estimate of the per cent increase in the past 15 years
(1) 0 to 10__ (2) 11 to 20__
(3) 21 to 30__ (4) 31 to 40__

G. What per cent of crop acreage in your county had one or more applications of insecticides applied in 1963?
(1) 0 to 25__ (2) 26 to 50__
(3) 51 to 75__ (4) 76 to 100__

H. Estimate the average number of applications
(1) 1 to 2___ (2) 3 to 4___
(3) 5 to 6___ (4) 7 or more__

Your estimate of the average return per dollar invested on insecticides
(1) $1 to$3__ (2) $4 to $6__
(3) $7 to $9__ (4) $10 to $12_
(5) Above $12__

J. Your estimate of the per cent of the total insecticide usage applied in the following areas: (should total 100%)
(1) Crops_____
(2) Livestock_____
(3) Stored products_____
(4) Forestry_____
(5) Vegetables_____
(6) Ornamentals_____
(7) Fruits and nuts_____
(8) Homes_____
(9) Residual Sprays (Bldg,etc.)

K. Of the insecticides used, what per cent are: (should total 100%)

(1) Chlorinated hydrocarbons?_____
DDT, Chlordane, BHC, Lindane, Aldrin, Dieldrin
(2) Organic phosphates?_____
Guthion, Malathion, Parathion, Diaznon, Vapona
(3) Carbamates?_____
Sevin
(4) Botanicals?_____
Rotenone, Pyrethrins, Sabadilla, etc.
(5) Arsenicals?_____
Lead arsenate, Calcium Arsenate, etc.
(6) All others_____

L. Do most laymen feel insecticides will continue to be used as a production tool? (1) Yes___ (2) No___

VI. Agent's Evaluation of Insecticide Usage

A. Do you think most people are aware of the need for cautious handling of toxic insecticides? (1) Yes___ (2) No___

B. Do most people read labels before using insecticides? (1) Yes___ (2) No___

C. Is protective clothing usually worn by those who use the most toxic insecticides? i.e., volatile phosphates, fumigants, etc. (1) Yes___ (2) No___

D. What per cent of insecticides is applied by commercial applicators in your county? (1) 10 to 25__ (2) 26 to 50__ (3) 51 to 75__ (4) 76 to 100_

Of the per cent shown here, what per cent is applied by
(1) Air equipment_____
(2) Ground equipment_____

E. Do most people have an adequate storage area for insecticides? (1) Yes___ (2) No___

F. Are used containers and surplus materials being properly disposed of? (1) Yes___ (2) No___

G. Do you know where to get information for treating insecticide poisoning cases? (1) Yes___ (2) No___
Where_____

H. Do you know of any specific cases of insecticide poisoning to either man or animals in your county? (1) Yes___ (2) No___

I. If YES to above questions, list those you know of
(1) _____
(2) _____
(3) _____
(4) _____

J. Do you feel any of these cases were a result of careless use of insecticides? (1) Yes___ (2) No___
If YES, how many? _____

K. If not careless use, would you say the accidents were a result of inadequate knowledge of the chemicals involved? (1) Yes___ (2) No___

L. Do you know of any cases of gross misuse of insecticides leading to legal litigation in your county? (1) Yes___ (2) No___

M. Do you feel most people are aware of their legal responsibility when using insecticides? (1) Yes___ (2) No___

N. Do you know of any cases of gross misuse of insecticides causing damage to any kind of wildlife in your county? (1) Yes___ (2) No___

O. If YES to above question, list:
(1) Material used_____
(2) Area treated--crops, forest, etc._____
(3) Wildlife affected_____
(4) How affected
(a) Mild poisoning_____
(b) Resulted in death___

P. If you list any case under question above, would you say this was a result of:
(1) Carelessness_____
(2) Inadeauate knowledge_____
(3) Neither_____

Q. Are most producers aware of legislation affecting the use of chemicals on food and forage crops to be moved in interstate commerce? (1) Yes___ (2) No___

R. Could you explain these laws if called on to do so? (1) Yes___ (2) No___

S. If NO to the previous question, do you know where to get this information? (1) Yes___ (2) No___

T. Have you had to answer questions relative to this legislation? (1) Yes___ (2) No___
Number of times per year _____

VII. Agent's Evaluation of Present Effort to Acquaint the Public with Safety in the Use of Insecticides

A. Are you getting enough information to assist you in getting the safety story to people in your county? (1) Yes___ (2) No___

B. Have you used any of the radio tapes on safety precautions for use of insecticides? (1) Yes___ (2) No___

C. Have you distributed any material on using insecticides safely? (1) Yes___ (2) No___
Number of times in 1963 _____

D. Have you used news stories on safe use of insecticides? (1) Yes___ (2) No___
How many? _____

E. List organizations you know of who are carrying out organized safety programs on use of insecticides.
(1) _____
(2) _____
(3) _____
(4) _____

F. Do you feel more work should be done on safe use of insecticides? (1) Yes___ (2) No___

G. Would you use more safety publications or other types of educational aids on safety if available? (1) Yes___ (2) No___

H. Do you feel most people are well informed on procedure for safe use of insecticides? (1) Yes___ (2) No___

I. Are precautions for safe use of insecticides discussed in most meetings where insecticide usage is a part of the program? (1) Yes___ (2) No___

J. Do you often have inquiries relative to safety precautions necessary in use of insecticides? (1) Yes___ (2) No___

K. Do most questions come from rural areas? (1) Yes___ (2) No___

APPENDIX C

SURVEY OF EXTENSION COOPERATORS AT THE COUNTY LEVEL

County_____ Sex--Male__ Female__ Occupation_____

I. Layman's Evaluation of Proper Insecticide Usage

A. Are most users of insecticides aware of the precautions needed in using these chemicals? (1) Yes__ (2) No__

B. Do most people read labels adequately before using insecticides? (1) Yes__ (2) No__

1. Do you read labels? (1) Yes__ (2) No__

C. Do you apply most of your own insecticides? (1) Yes__ (2) No__

D. Do most people who use relatively large quantities of insecticides have a safe storage area for them? (1) Yes__ (2) No__

E. Are most insecticide containers and surplus materials disposed of properly? (Burning, burying, etc.) (1) Yes__ (2) No__

F. Do you know of any case of misuse of insecticides in your area which resulted in poisoning of wildlife? (1) Yes__ (2) No__

If YES, please list:

(1) Chemical used _____

(2) Area treated (crops, range, etc.) _____

(3) Wildlife affected _____

(4) How affected?
(a) Mild poisoning_____
(b) Resulted in death___

G. How many times have you used insecticides this past year? (1) No._____

H. Indicate the per cent of usage in the following areas:

(1) In home_____
(2) On forage crops_____
(3) Vegetable crops_____
(4) Livestock_____
(5) Ornamentals_____
(6) Dairy barns or other buildings_____
(7) On range land_____
(8) Stored products_____
(9) Pets_____
(10) Others_____

I. Have insecticides available solved most of your insect problems? (1) Yes__ (2) No__

II. Laymen's Evaluation of Information Available on Insecticides

A. Do you know where you could get information in emergency situations involving insecticides? (1) Yes__ (2) No__

1. List where:
(1) _____
(2) _____
(3) _____
(4) _____

B. Are most laymen aware of their legal responsibilities when using insecticides? (1) Yes__ (2) No__

1. Are you aware of this? (1) Yes__ (2) No__

C. Are you aware of legislation concerning the use of insecticides on food and forage crops? (1) Yes__ (2) No__

D. Where do you usually go for information on insecticides? Check those which apply to you:

(1) County agent's office _____
(2) Vocational Agriculture Instructor_____
(3) Health Department _____
(4) State Department of Agriculture_____
(5) Oklahoma State University_____
(6) Local insecticide dealer_____

(7) Commercial insecticide dealer_____

(8) Drug store or similar place_____

(9) Literature (books, bulletins, magazines, papers)_____

(10) Any other_____

E. Have you seen any printed material on safe use of insecticides within the past year? (1) Yes__ (2) No__

1. If YES, check any you have seen:

(1) Stickers_____
(2) Decals_____
(3) Leaflets_____
(4) Bulletins_____
(5) News stories_____
(6) Books_____
(7) Direct correspondence _____
(8) Photos_____
(9) Magazine articles_____
(10) Other_____

F. Have you heard any discussion on safe use of insecticides in your area? (1) Yes__ (2) No__

1. If YES, check those which apply to you:

(1) Meetings_____
(2) Radio_____
(3) TV_____
(4) Committees_____
(5) Short courses_____
(6) Civic groups_____
(7) Neighbors_____
(8) Health Department_____
(9) Your doctor_____
(10) Government office_____

G. Do you think increased emphasis on the safe use of insecticides by educational and professional groups is needed? (1) Yes__ (2) No__

III. Laymen's Evaluation of the Present Insecticide Situation

A. Do you think insecticides as used today are dangerous to the well being of man and animals? (1) Yes__ (2) No__

B. Have insecticides available solved most of your insect problems? (1) Yes__ (2) No__

C. Will you continue to use insecticides in the future? (1) Yes__ (2) No__

D. Would you use a method other than chemical control on insects if available? (1) Yes__ (2) No__

1. Even if it cost more? (1) Yes__ (2) No__
2. If the cost were the same? (1) Yes__ (2) No__

E. Do you think most individuals feel justified in using insecticides whenever insect problems arise? (1) Yes__ (2) No__

1. Do you feel justified? (1) Yes__ (2) No__

F. Is it important that research continue on insecticides? (1) Yes__ (2) No__

1. Do your neighbors agree with your view? (1) Yes__ (2) No__

G. Would public opinion support research programs on insect control by methods other than chemical control? (1) Yes__ (2) No__

1. Even if it cost more? (1) Yes__ (2) No__
2. Would you support such programs? (1) Yes__ (2) No__

VITA

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Candidate for the Degree of

Doctor of Philosophy

Thesis: EVALUATION OF THE NEEDS OF OKLAHOMA EXTENSION PERSONNEL RELATIVE TO ENTOMOLOGY PROBLEMS

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