A Study of Learning Modules and the Traditional Lecture Discussion Method for Teaching Weed Control Practices to Small Vegetable Farmers.

Jesse Harness
Louisiana State University and Agricultural & Mechanical College

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A STUDY OF LEARNING MODULES AND THE TRADITIONAL LECTURE DISCUSSION METHOD FOR TEACHING WEED CONTROL PRACTICES TO SMALL VEGETABLE FARMERS

The Louisiana State University and Agricultural and Mechanical Col. PH.D. 1980

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A STUDY OF LEARNING MODULES AND THE TRADITIONAL LECTURE DISCUSSION METHOD FOR TEACHING WEED CONTROL PRACTICES TO SMALL VEGETABLE FARMERS

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy

in

The Department of Horticulture

by

Jesse Harness
M.A., University of Florida 1972
May 1980
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ABSTRACT

This study was conducted to develop and evaluate various uses of learning modules and to compare them with the traditional method of teaching weed control practices to small vegetable farmers.

One hundred forty eight small farmers were selected for the study from St. Landry Parish in Louisiana and from Copiah, Simpson and Jefferson Davis Counties in Mississippi. They were divided into four treatment groups at random. Treatment I consisted of 63 farmers who were exposed to the modules in a group under professional supervision. Treatment II consisted of 48 farmers who participated in the same weed control program under the supervision of a professional using the traditional lecture-discussion method. Treatment III consisted of 20 farmers exposed to the learning modules on weed control under the supervision of a para-professional. Treatment IV involved 17 farmers who were exposed individually to the modules.

The learning modules consisted of a series of slides synchronized with a tape recorded narrative. The programs for all farmers required two hours and ten minutes to complete. The modules were administered in two sixty-five minute sessions separated by a fifteen minute break. Farmers in the traditional or lecture-discussion group were exposed to the same subject matter for the same period of time as the module treatments.

Data for the study was collected using pre-test and post-test questionnaires. The pre-test was administered just before farmers were exposed to the weed control program. Seven days after completing the
the program a post-test was administered. Both pre and post-tests were graded and coded for analysis.

The following findings were observed: the comparison of the learning module and traditional treatments resulted in a highly significant difference in favor of the learning module treatments. A comparison of other module treatments indicated that farmers exposed to the modules in groups under professional supervision made significantly higher gains than farmers exposed to the modules in groups under para-professional supervision. It was also discovered that farmers exposed to modules in a group under para-professional supervision made significantly higher gains than farmers in the traditional treatment. When comparing mean gain of farmers exposed to the modules individually under para-professional supervision, with farmers exposed to the modules in groups under para-professional supervision, it was found that individual exposure under para-professional supervision was superior to the other treatments.
INTRODUCTION

One of the major problems facing vegetable specialists is the difficulty involved in modifying knowledge, skills and attitudes of small farmers so that they can evaluate new practices and adopt those that will improve their farm operation. The efforts of vegetable specialists are further hampered by rapid advances in modern technology. Increased production costs and the farmer's inability to keep pace with modern technology are keeping him in a price squeeze.

One of the major contributing factors to reduced yield and high production cost is poor weed control. Losses due to weeds are the largest single cost of all pest control in crop production. Losses caused by weeds in all crops in the United States each year are estimated to be over five billion dollars (See Table 1). Weed losses in nine of the southern states are estimated to be one and one-third billion dollars annually (44). Therefore, it is imperative that small farmers adopt means of reducing the cost caused by weeds.

Although much research has been done on weed control very little has been directed toward utilizing different approaches to teaching small farmers weed control practices. The research reported herein is concerned with the use of learning modules (Programmed Instruction) in teaching weed control practices to limited resource vegetable farmers. More specifically, it involves the development of a series of modules on weed control practices to be used in teaching limited
Table 1: Annual Cost of Plant Pests to Crop Production in U.S.

<table>
<thead>
<tr>
<th></th>
<th>LOSSES (x 1,000)</th>
<th>CONTROL (x 1,000)</th>
<th>TOTAL (x 1,000)</th>
<th>TOTAL %</th>
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<tr>
<td>Disease</td>
<td>$3,152,815</td>
<td>$115,000</td>
<td>$3,267,815</td>
<td>27.1</td>
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<tr>
<td>Insects</td>
<td>2,965,344</td>
<td>425,000</td>
<td>3,390,344</td>
<td>28.1</td>
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<td>Nematodes</td>
<td>372,355</td>
<td>16,000</td>
<td>388,335</td>
<td>3.2</td>
</tr>
<tr>
<td>Weeds</td>
<td>2,495,630</td>
<td>2,551,050</td>
<td>5,010,680</td>
<td>41.6</td>
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<tr>
<td>TOTAL</td>
<td>$8,950,124</td>
<td>$3,107,050</td>
<td>$12,057,174</td>
<td>100.0</td>
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resource vegetable farmers and a comparison of various uses of the learning module with the lecture-discussion method of teaching.

**IMPORTANCE OF MODULES TO VEGETABLE SPECIALISTS**

Successful use of learning modules would provide an alternative method for specialist, agents and para-professionals to assist small farmers.

The vegetable specialist could develop modules on many practices for each parish or county extension office. Extension agents could use the modules for group meetings and also place them in various areas in the county or parish for individual farmers to use. Vegetable producers in the area could then utilize the modules at their convenience. The modules would also be an additional tool for para-professionals employed by extension. Para-professionals would be able to use the learning module for small group meetings and when making home visits to do individualized instruction.

The learning module would give specialists an alternative to traditional teaching methods. In other disciplines, the Learning Module has been extensively developed particularly for use in elementary and secondary schools. However, almost nothing has been done toward developing this teaching method for use with small vegetable farmers. Therefore, the findings of this study would be helpful to extension specialists in developing future programs for use with vegetable farmers.

**IMPORTANCE OF MODULES TO THE FARMER**

There is a wide variation in educational levels of vegetable producers attending training meetings. Therefore, some farmers learn
at a much slower rate than others. The Learning Module would provide instruction in the absence of an instructor for one or more farmers simultaneously, which would permit them to work at their convenience and at their own pace. It would permit immediate feedback to the farmers and agents, giving them an instant indication of the farmers' understanding of the subject. It would allow individual farmers the opportunity to repeat each module as much as necessary before proceeding to the next module and enhance their chances of successful understanding of the subject matter.

STATEMENT AND ANALYSIS OF THE PROBLEM

It was established earlier that vegetable production is an important source of income for low income farmers in the study areas. It has also been established that weed control is one of the most expensive practices in vegetable production. This research was conducted to (1) develop learning modules on weed control for limited resource vegetable farmers, (2) compare the learning modules with the traditional method of teaching limited resource vegetable farmers and (3) evaluate various methods of presenting the learning modules to farmers.

The four treatments used were: Treatment I, farmers exposed to modules in a group setting with professional supervision; Treatment II, farmers taught weed control using traditional methods with professional supervision. Treatment III, farmers exposed to modules in group settings with para-professional supervision; and Treatment IV, farmers exposed to the modules individually under para-professional supervision.
REVIEW OF LITERATURE

Much research has been compiled in the past twenty years on methods of controlling weeds. Yet, very few studies have been conducted on methods for teaching small farmers the application of this research. This review will concentrate on three aspects of the literature. It will deal with the importance of weed control, characteristics of small farmers, and a brief review of research on related work with learning modules.

WEED CONTROL

Weed control remains one of the major production problems facing small vegetable farmers. The problem becomes more and more complex as technology increases and small vegetable farmers strive to improve their production program. The losses caused by weeds are the largest single cost of all pest control in crop production. Each year farmers lose more than five billion dollars because of weeds (See Table 1). Losses due to weeds in nine of the southern states are estimated to be one and one-third billion dollars annually (41). One half of the one and one-third billion dollars could be thought of as a potential increase in income with improved weed control practices due to higher yields, better quality, less replanting, and because of improved weed control (41, 29).

History of Weed Control

Man has been contending with weeds in food production since the beginning of recorded history (28). Man first fought weeds by hand, sharp sticks, hoes, animal powered cultivators, mechanical power and finally chemicals (28).

The effects of chemicals on weeds were noted as long ago as the
time of Socrates. Chemicals were noted on a more practical basis in 1896. However, it was not until 1940 with the development of 2-4-D that the first herbicide was made available (27).

It was still another fifteen years before other chemicals were made available. Even now most limited resource farmers haven't learned to use them.

**CHARACTERISTICS OF LIMITED RESOURCE FARMERS**

Many agriculturists and sociologists have struggled with the small farm or limited resource farm concept. However, because of the variability found among farms it is difficult to develop a general definition of a small limited resource farmer. Woodworth, Comer and Edwards (54) defined a small or limited resource farmer as a person who is the head of the household, male or female, who works full-time on the farm and where gross farm sales are less than $20,000. They defined full-time operator as one who works less than 1,000 hours off the farm for wages.

Orden (32) defined a small farmer as a farm operator whose gross farm sales are insufficient to provide an adequate family income. Recognizing that no general definition could be agreed upon, a more specific definition was established by The Census of Agriculture (7). It defined a small farm operator as an "individual operating a farm with an annual gross sale of less than $20,000 and an off-farm income of less than $5,000." The definition established by The Census of Agriculture was accepted for the purpose of this study.

Very little research has been published on the plight of small vegetable farmers in the south. Yet, specialists in the area of vegetable crops and in extension education have suggested various solutions to the problems; most agree that the key is **better**
education of producers (17).

Cooperative Extension Service has fulfilled an important role in assisting vegetable farmers to adopt new technology, and to increase production and efficiency. However, Landenug and Edmondson (22) reported research findings which indicate that persons with low educational attainment utilized the services offered by governmental agricultural agencies such as the Cooperative Extension Service much less than did persons with higher incomes, larger farms, and higher educational attainment. This seems to be one reason why many farm families have not been staying abreast of new technology, and therefore, have been earning less than they might from their farming operations. According to Rogers (40) attendance at educational programs conducted by the Extension Service shows that the smaller farmers with lower income and less education tend to participate in training less than larger farmers with higher income and higher educational levels.

Lewis (24) conducted a study on educational participation of low socioeconomic status (SES) adults in educational programs and found a high level of interest in education and job training among low SES adults. However, they also found that there was far less actual participation than interest in participation. Lewis suggested that the lack of participation in the educational and job training programs was due to the program not being compatible with the needs of the clientele and that the facilities were in locations that discouraged participation from the SES communities.

County agents have been using many ways to reach farmers, but not all of them are used by all farmers because each appeals to a slightly different group. Some objective characteristics such as age and education help explain part of the variation in the farmer's use
of information sources.

Still, Dickinson (12) describes another characteristic alienation, "The alienated farmer is one who feels a breakdown in his sense of attachment to society. He may see himself as being alone, unwanted and unvalued". According to Dickinson, the feeling of alienation or distance from others may prevent people from seeking contact with agencies or individuals who distribute technical information. In addition, the alienated have more difficulty than the unalienated in learning new material once contact is established. Thus, farmers who are more alienated may have fewer contacts with Extension Services and learn less from these contacts when they do occur. As a result they are slower to adopt new practices (26). This is consistent with observations made by county agents and Extension Specialists interviewed regarding the participation of small vegetable farmers in educational programs (17). Small low-income farmers are heterogeneous. They represent a wide range of educational levels, aptitudes and motivations. These characteristics of farmers have definite implications for the method used to teach technical practices such as weed control. This condition necessitates studies into special types of teaching methods, such as the Learning Modules.

One problem for extension agents and specialists is how to reach producers from various backgrounds and educational levels. If horticultural specialists are to provide the needed technical know-how to low-income vegetable farmers, they must find ways to effectively reach vegetable producers from various backgrounds and educational levels.
Learning modules have been used successfully in teaching many different types of subjects in public schools. They have been particularly popular in special courses where students need individual attention.

The modules used in this study were developed especially for low-income vegetable farmers in the study area, and were designed to reach even those farmers who neither read nor write. They were also designed to require continuous feedback from the farmer and allow him to progress at his own rate. Advocates of the modules contend that when properly designed they are useful to farmers regardless of the class or enterprise.

**LEARNING MODULES**

The "Learning Module" is a relatively new concept in educational technology. However, since learning modules have been developed and used by many school systems and universities, no common definition can be formulated. Robinson and Crittenden (39) described the learning module as a package of teaching materials consisting of behavioral objectives, a sequence of learning activities, and provisions for evaluation. The sequence of learning activities is designed to provide instant feedback to the learner on his achievement and to proceed from lower to higher cognitive levels. The module should provide an optional and recycling path for the learner to achieve the program objective. One of the main advantages of the learning module is that it provides individualized instruction and team learning and permits learning to take place outside of the presence of a teacher. The module allows the learner to proceed at his own rate without pressures.
History of the Learning Module

The evolution of the Learning Module is very sparsely covered in research literature. Robinson and Crittenden (39) were the first to experiment with the development of learning modules during the 60's. Later, Creswell (8) developed a package he called "Modules-of-learning" packages. They were also referred to as "Unipacks", "Teaching Kits", and "Edikits". Learning modules have evolved as a subsequent technique to programmed instruction and contain many of the same characteristics.

Programmed instruction has been used in a prominent way in business, industry, and education for more than thirty years. However, it had its beginning in the 1600's.

Programmed instruction has been utilized to teach a wide variety of subjects and skills. It has been used to teach spelling, reading, English, machine operation, electronics, mathematics, genetics, psychology, and foreign languages. It has been used in a variety of forms: flash cards and filmstrips fully automated, semi-automated and simple roll-type teaching machines, and programmed textbooks.

Pressey (35) reported that elementary school pupils learned spelling words better when using the program than a comparable group taught by conventional methods. He reported that the greatest gains in spelling were recorded by students in the program with lower IQ's, and the least gain by individuals in the comparable group taught by the conventional classroom instructional method.

Thompson (30) reported the use of a programmed mathematical review to train the lowest twenty percent of four successive incoming
classes for a communication electronics principles course. Although the results indicated that the programs did not produce a statistically significant gain on a mathematics pretest, it was noted that the programmed materials were completed in about one-half the time of conventional mathematical reviews. This indicated that programmed material served as a time saving device. Furthermore, the group using programmed material was significantly superior on a subject matter retention test administered nine weeks after treatment.

Hughes (18) reported using a teaching machine that combined visual and auditory stimuli in presenting information to the student. Using this machine instruction was presented on a tape and synchronized with such visual aids as 35 mm color slides, filmstrips, and aperture cards. It has been used successfully in training production assembly workers and other machine operators.

B. F. Skinner (42,30) is considered the "Father of Programmed Instruction and Teaching Machines" because of his work in the late 40's and early 50's. However, the earliest teaching machine was the one developed by Pressey (35) and first exhibited in 1924. In this device, the program consisted of a series of questions and multiple-choice answers mounted on a revolving drum; each frame was viewed through a window in a shield covering the drum. On one side of the drum were four keys that students pressed to select an answer to the question appearing in the window. When the student pressed the right key, the drum would rotate. If the students pressed the wrong key, however, the drum would not move.
Most of the work on programmed instruction was done in the late 50's and 60's. Some of the theory projected during those years has been disproved, but many basic principles are still used in other methods. These principles have led the way to computer assisted instruction, learning modules and the applications of other instructional techniques (27).

Developing Modules

According to Robinson (39), "learning modules should be developed by the local change agents". He suggested that modules be prepared specifically to fit the unique needs and interests of particular learners and that they should be field tested in small groups, revisions should be made after observing the learners and their reaction to the modules. Results of post-tests should be assessed and improvement should be built into each module.

To the knowledge of the author, no research has been conducted on the use of learning modules to teach small farmers. However, many studies have been conducted in other disciplines. The modules developed for this study represent a first in vegetable crops but the mechanics in its development are very similar to those described by Robinson (39), Brower (1), and others.

Kryspin (21) conducted a study to establish the effectiveness of three modules dealing with behavioral objectives, test construction, and interaction analysis. Other objectives were whether difference in sex had any effect on the relative effectiveness of the modules. The subjects participating in the study were undergraduate students.
enrolled in educational psychology courses offered at Purdue University. The validating samples for the behavioral objectives, test construction and interaction analysis consisted of 178, 138, and 78 students respectively. Data for the studies were collected using a pre and post-test.

Results obtained from the pre and post-test indicated that all three of the self instructional packages (modules) were effective teaching devices. He also found that female students learned significantly more from each of the packages (modules) than did male students.

Windell (53) conducted a study in 1975 to develop a self instructional teacher training module and to test the effectiveness of the module. The developmental stage of the module consisted of performing empirical need assessment to identify teaching skills to be taught through the module; performing a skill analysis to determine the essential skills; and developing a structure based on the skill analysis.

The experimental sample used in the evaluation phase was made up of sixty-two students enrolled in special education methods classes taught at Indiana University. Students in each of the three groups were randomly assigned to either an experimental or control group. The experimental group received the module and post-test during the first week of evaluation, while the control trainees received only the post-test at the end of one week. During the second week the treatments were crossed over. The control group was exposed to the modules. The post test was again administered to both groups at the end of the second week.
A comparison of the mean test score for the experimental and control group at the end of the first week revealed that the experimental group made a significantly higher mean score. When the treatment was crossed over during the second week and administered to the control group a comparison of the means post treatment test scores for the experimental and control groups revealed that the group was approximately equal. A final post-test administered to the treatment group did not prove to be significantly different from the post treatment measure which was administered to that group directly after treatment.

From these results it can be concluded that the modules produced a significant change in the student's knowledge, and skills.

Pultokah (37) developed and field tested a laboratory module for instruction in vascular plant taxonomy to aid undergraduate biology students in understanding both traditional and contemporary activities of plant taxonomists. To determine the effectiveness of the laboratory modules, three community colleges participated as host institutions. The module was evaluated by both students and teachers. Results of the study indicated that students preferred this method over the traditional types of biology laboratory.

Brawley (3) conducted a study of multi-media instructional modules with mentally retarded children and similar results were obtained.

Merwin (28) conducted a study at the University of Georgia on the effectiveness of self-instructional modules in preparing secondary-level social studies teachers to plan questions and tests for higher cognitive processes.
The study employed a randomized block design. Based on the pretest, a total of forty social studies teacher-trainees were blocked into twenty equivalent pairs and randomly assigned to treatment groups. The treatment consisted of four self-instructional modules (SIMS) for the experimental group and twenty-one hours of conventional classroom instruction for the control group.

The study employed two instruments to measure the independent variable. The cognitive quality rating system, and the student achievement test.

Achievement test data and the cognitive quality rating data indicated that the experimental group was significantly more effective than the control group.

Hatcher, (16) conducted a study using audiotutorial modules in the preparation of college biology teachers. This study was designed to develop, revise and evaluate modules for individualized self-instruction in areas pertinent to the teaching performance of graduate assistants in micro-biology. Six modules presenting competencies and skills of teaching were designed and developed. Eighteen teaching assistants were randomly assigned to one of two treatment groups. One group participated in a seminar workshop and worked through the modules. The other group was subject to the seminar workshop only. Graduate assistants exposed to the modules evaluated each one of them. All eighteen graduate assistants completed a test over the material covered and an attitude test as a measure of the teacher's attitude toward teaching.
Comparisons were made between the two groups as to (1) cognitive achievement, (2) attitude toward teaching and performance as a laboratory teaching assistant. A significant difference was found between the groups on cognitive achievement and some of the dimensions tested for attitude toward teaching and performances as laboratory teaching assistants.

**COMPARATIVE STUDIES OF LEARNING MODULES AND OTHER INSTRUCTIONAL METHODS**

Many comparative studies have been conducted with learning modules and other instructional methods. The results obtained from these studies have been quite variable. However, most studies tend to favor the learning module.

Disher (13) compared students in undergraduate reading methodology courses who were taught by proficiency modules with those who were taught by traditional methods. The major objective was to discover differences, if any, in the two groups in terms of their knowledge of the subject matter and their perceptions of the instructions.

The sample used in the study was made up of undergraduate students in the College of Education at the University of Georgia. A total of 117 students, 57 in the two traditional classes and 60 in the two module classes participated in the study. Students in the module section received all of their instruction from proficiency modules. Students in the traditional classes gained information about the course-content primarily through class lecture, group discussion and text assignment. The results of the five tests
indicated a significant difference between the two groups. The modules were more effective on four out of five of the subtests and for the total test. Only the subtest on the evaluation of classroom organization for reading instruction favored the traditional instructional group.

Caucci (10) compared the effectiveness of the module method of teaching to a lecture-discussion method of instruction. Eighty-two students assigned to three classes participated in the two week study. Thirty-five (35) students in the experimental group received the module method, twenty-three students in the control group received the lecture-discussion method and a second control group of twenty-four students provided a measure of pretest equivalence. A unit test provided an entry level for the experimental group and control group I. When the unit was completed, a post-test was administered to the experimental group and the control group.

Study results indicated that the module and the lecture-discussion methods of instruction did not differ in effectiveness. Freedom to vary the program and sequence of study within the module resulted in students learning different subject matter as compared to the lecture-discussion method.

Weber (5) conducted a study to compare the utilization of programmed instructional material in college remedial mathematics courses. Two treatments were used with the same programmed material. Students in treatment I, the experimental group, received individual tutoring when requested. The second group was taught during the
regular class period using a structured lecture-discussion method. The sample consisted of 99 students randomly assigned to four sections of a non-credit mathematics course offered during the fall semester at the University of Maryland. Two teachers participated in the study. The instructional period lasted for fifteen weeks. The post-test was administered to 91 students.

The test analysis revealed no significant difference between the two uses of programmed material. However, it was found that individual tutoring made better use of the teaching time than a lecture-discussion technique when using programmed material.

Strickland (45) conducted a study to compare the achievement of junior college biology students taught by programmed material with those taught by traditional lecture methods. The study was conducted at Copiah-Lincoln Junior College using two general biology classes as Experiment I and as Experiment II groups. Experiment I was chosen to use the programmed textbooks while Experiment II used traditional material. The biological achievement test was given to both groups as a pre-test and as a post-test. Test results indicated that the group using programmed instruction improved significantly on the biological achievement test as compared to the group using the traditional textbook. The work of Strickland (45) also substantiates the fact that students achieved higher level when using programmed materials.
Johnston (19) made a comparison of conventional teaching with systematically supplemented programmed teaching. Scores of the tests administered prior to, during, and after the experiment were analyzed for retention. The analysis of test scores showed no significant difference between the groups before the experiment began. Covariance analysis was made using the scores obtained from the examination given at the end of the experiment as the criterion and intelligence test as control. This analysis also showed no difference. Therefore, Johnston concluded that no significant difference could be found between programmed instruction and conventional teaching.

Brown (4) compared self-instructional modules with the traditional lecture for teaching a meat unit in food science. In this study he compared achievement, retention of subject matter and attitudes of students participating in self instruction with those same factors of students in a traditional lecture for meats in an advanced course in food science. Achievement in the courses was measured by a test administered immediately following the completion of the unit. A retention test was also given three months following the completion of the unit. Test results indicated that there was no significant difference between the two teaching methods. Test scores for graduate students were higher than for undergraduate students. There was no significant difference found between the two teaching methods when test scores were compared for retention. However, college juniors retained more information than seniors or graduate students.
No research has been conducted, to the knowledge of the author, in the use of learning modules to teach weed control practices to small farmers. Therefore, the following section of the literature review will deal with a discussion on the general use of learning modules, using visual aids and other related instructional methods.

Santelman (44) in 1972 reported on the use of a series of slide sets along with a tape recorded strip to teach chemical nomenclature to a weed science class at Oklahoma State University. The slide and tape recording started out with the simplest structures such as methane, and proceeded to the more complicated ring structures and eventually into a few herbicides. These slide sets were developed as a means of reviewing information covered prior to organic chemistry courses.

Nesheim (31) reported using a slide series synchronized to tape recorded instructions to conduct a training program for both private and commercial pesticide applicators in Oklahoma. The slide presentation consisted of 280 slides with about 80 minutes of narration. The program was presented in two 45 minute segments with an intermission after the first. The material covered included a brief discussion of application equipment, pesticides, pesticide safety, pesticide label, and pesticides and the environment. Nesheim cited the advantages of this instructional method as being: the fact that (1) it can be used when needed by each county, and
(2) it eliminates the demand on subject matter specialists' time for contact teaching.

Nesheim also reported using a self-study manual. The manual covered the same materials covered in the slide tape program and had a series of review questions at the end of each chapter. Both the slide set with synchronized tape recorded instruction and the self study book were somewhat similar to the learning modules developed by Robertson and Crittenden (39). Lewis (23) also reported using a similar slide tape series to train pesticide applicators in North Carolina.

Goodzey and Michael (15) developed a learning module for use on microfiche. The module was used to teach students in a landscape materials class. The microfiche was developed because of the success realized from the use of visual aids in past plant materials classes. According to Goodzey (15) the average person remembers fifty percent of what he sees and hears compared to just twenty percent of what he hears. In this study he found that microfiche provided a convenient and inexpensive alternative to the use of traditional methods.

William, Korschning, Tielkeemeier and Thorne, (51) developed a slide-tape set and printed guide on sweet potato production to use in communicating crop production principles. The slide-tape set was developed for use with small farmers with limited reading ability. Nineteen persons interested in sweet potatoes helped evaluate the success of the slide-tape set in communicating the learning
objectives. After a nine minute section of the program was administered, a thirty-two percent increase in correct responses was measured.

A complete library and computer search indicated that no research had been conducted using learning modules to teach small vegetable farmers. However, the results of studies discussed in this review provides implication for possible use of learning modules with small farmers. The results of Strickland (45), Disher (13), Pultokak (37), Merwin (28) and others indicated that subject performance favored learning modules over traditional teaching methods. Studies by Caucci (10), Weber (50) found no significant difference in the performance of subjects on test administered following the program. However, it was found that it had other advantages.
MATERIALS AND METHODS

A study of various uses of a series of learning modules and the lecture-discussion method of communicating weed control practices to limited resource vegetable farmers was conducted in the fall of 1978 and summer of 1979.

The study was divided into two phases, a developmental phase and a test phase. The developmental phase was conducted during the summer and fall of 1978 and pilot tested in the late spring of 1979. The comparative study was conducted in late summer and fall of 1979. Data was analyzed with the assistance of the Department of Statistics at LSU. The study was conducted in St. Landry Parish in Louisiana and in the Copiah, Jefferson Davis, and Simpson County area in Mississippi.

THE HORTICULTURAL SITUATION IN THE STUDY AREA

In selecting the study area, seven different areas were considered. West Carroll, Morehouse, Ascension, and St. Landry Parishes in Louisiana and Copiah, Jefferson Davis and Simpson Counties in Mississippi. These areas were selected because they had a large concentration of low income farmers who were producing a wide range of vegetables.

St. Landry Parish

St. Landry Parish is part of a mixed farming area located in central Louisiana as shown in Figure 1. According to the 1974 Census of Agriculture (7), there were 1,324 farms in the parish with less than one hundred acres of farm land and nine hundred and thirty-six with
Figure 1: Location of St. Landry Parish in Louisiana
with less than fifty acres. Fifty-nine percent of the farms had retail sales of less than $2,500. There were 5,281 vegetable farmers and home gardeners in the parish who produced 1,225 acres of vegetables (See Table 2). The average age of farmers in the parish is 52.6 with the median school year completed being 5.9 years (34).

Copiah, Jefferson Davis, and Simpson Counties

Copiah, Jefferson Davis and Simpson counties are located in south central Mississippi as shown in Figure 2. This is a diversified farming area that consists of a large number of small farmers who are traditionally cotton farmers. This area was selected because vegetable farmers were participating in a concentrated training program financed by the Department of Labor.

According to the Census of Agriculture (7) there were 1,178 farms in the area that were less than 100 acres and 905 that were less than 50 acres. There were 1,517 farmers in the area with retail sales less than $2,500. Although many small farmers are just being introduced to commercial vegetable production there were more than 6,400 acres of vegetables being produced in the area (see Table 3).

DEVELOPMENT OF THE LEARNING MODULE

The modules for this study were developed using the methods advocated by Hatcher (16) and by Robinson and Crittenden (39). In Hatcher's study emphasis was on student learning rather than teaching and on student pacing rather than lockstep scheduling. Both Robinson and Crittenden stressed the importance of modules being developed by local change agents such as Specialists in Cooperative Extension so that they are relevant to the needs and abilities of the clients. Therefore, in order to meet these needs the author followed a pattern similar to
Table 2: Estimated Vegetable Acreage for St. Landry Parish for 1977

<table>
<thead>
<tr>
<th>Crops</th>
<th>Farmers</th>
<th>Total Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potatoes</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Okra</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>Cabbage</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>Watermelon</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>Irish Potatoes</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>225</td>
<td>750</td>
</tr>
<tr>
<td>Strawberries</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Home Gardening</td>
<td>5,000</td>
<td>250</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5,281</td>
<td>1,225</td>
</tr>
</tbody>
</table>

Figure 2: Location of Copiah, Jeff Davis and Simpson Counties, Miss.
Table 3: Estimated Commercial Acreage of Vegetable Crops in Copiah, Jefferson Davis, and Simpson Counties in Mississippi in 1976 and 1977

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Beans, Green</td>
<td>25</td>
<td>25</td>
<td>250</td>
<td>250</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>Beans Lima</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>60</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td></td>
<td></td>
<td>650</td>
<td>650</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>125</td>
<td>150</td>
<td>10</td>
<td>25</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Collards</td>
<td></td>
<td></td>
<td>10</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn, Sweet</td>
<td></td>
<td></td>
<td>25</td>
<td>60</td>
<td>60</td>
<td>25</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>250</td>
<td>250</td>
<td>175</td>
<td>175</td>
<td>500</td>
<td>385</td>
</tr>
<tr>
<td>Eggplants</td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td>25</td>
<td>15</td>
<td>20</td>
<td>40</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Okra</td>
<td>20</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Onions</td>
<td>5</td>
<td>5</td>
<td>15</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peas</td>
<td>150</td>
<td>175</td>
<td>170</td>
<td>200</td>
<td>350</td>
<td>200</td>
</tr>
<tr>
<td>Pepper, Bell</td>
<td>2</td>
<td>5</td>
<td>100</td>
<td>75</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Pepper, Hot</td>
<td></td>
<td></td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>--------------------</td>
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<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Pepper, Pimiento</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potatoes, Irish</td>
<td>100</td>
<td>50</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Potatoes, Sweet</td>
<td>100</td>
<td>100</td>
<td>130</td>
<td>100</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Pumpkins</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>10</td>
<td>55</td>
<td>5</td>
</tr>
<tr>
<td>Spinach</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squash</td>
<td>5</td>
<td>15</td>
<td>30</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td>25</td>
<td>35</td>
<td>250</td>
<td>250</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Turnips</td>
<td>35</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td>34</td>
<td>10</td>
</tr>
<tr>
<td>Watermelon</td>
<td>900</td>
<td>1600</td>
<td>50</td>
<td>50</td>
<td>1400</td>
<td>975</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>1837</td>
<td>2540</td>
<td>2106</td>
<td>1966</td>
<td>2563</td>
<td>1742</td>
</tr>
</tbody>
</table>

Tyler's (49) model for developing educational objectives where he obtained information from contemporary life, the clientele, and subject matter specialists.

The researcher conducted an analysis of the research study area to study major production problems and to identify weed control practices currently being used by farmers in the study area. The language spoken by farmers in Louisiana is a mixture of French and English, and the language spoken in Mississippi is English. Therefore, an attempt was made to write the modules using a terminology that would be pertinent to farmers in both Louisiana and Mississippi.

During the situation analysis the researcher visited several vegetable farms in the study area. The researcher held informal interviews with 18 farmers and 11 extension agents (see results in Appendix C). Both farmers and extension agents were asked to state in the order of importance their most important production problems. Twelve farmers and eight agents stated weed control as their most important production problem. Four farmers and two agents stated insect control as their most important problem and also stated weed control as being their second most important problem.

Other problems were evaluated for possible use in developing the module. However, the researcher decided to use weed control because of its wide spread interest, and year round application.

The modules were designed in such a way that they could be used independently of highly trained subject matter specialists. The flow-
chart in (Figure 4) was developed as a guide in writing the contents of the modules.

The first step in writing each module was the formulation of goals that were to be reached. Behavior objectives were then formulated for each of the goals. Each objective was analyzed to determine the kind of learning experience necessary in order to accomplish the objectives. After writing the narrative for the modules, the appropriate slides were developed.

In the development of the slides for the program an attempt was made to develop slides that would involve some of the farmers in the study area. Therefore, several trips were made to the research area during major production seasons to make slides that would reflect the problems being encountered by the farmers.

Initially the weed control program consisted of 450 slides and constituted seven modules. The narrative for each module was recorded on tape and each slide was synchronized to the recorded instruction. The seven weed control modules were designated by letters and titles as follows:

Module A: Weed Classification
Module B: Weed Identification
Module C: Basic Weed Control Methods
Module D: Chemical Weed Control
Module E: Herbicide Sprayers and Nozzles
Module F: Sprayer Calibration
Module G: Herbicide Safety and Herbicide Recommendation
Figure 3: Flowchart for Module Development
Farmers participating in the study completed all modules. The series of modules required two hours and ten minutes to complete and were administered in two 65 minute sessions separated by a fifteen minute break.

Each module ended with ten review questions. Farmers were asked to give a true or false response to each question. After responding to the questions farmers were given a key to check their answers. When an incorrect answer was given they were asked to go back and review that section of the module before proceeding to the next module. The modules as prepared in their original format were each pilot tested and later revised. A copy of seven modules is presented in Appendix A.

THE QUESTIONNAIRE

Data for the study was obtained by using a prepared pre-test and post-test. The complete questionnaire is presented in Appendix B. The pre-test and post-test were designed to assess the knowledge gained by the vegetable farmers as a result of participating in the weed control program. The pre-test contained three main sections: (1) Personal Variables; (2) Sources of information and prior learning experiences, and (3) Weed control practices.

Personal Variables

This section of the questionnaire was designed to obtain selected data on personal, social and situational factors: (1) age, (2) tenure, (3) educational attainment, (4) sex, (5) size of farm, and (6) vegetable acreage. This information was used to determine the effect each of the
above dependent variables had on the major hypotheses.

**Source of Information and Prior Learning Experiences**

This section of the questionnaire was designed to obtain data that would indicate the farmers' source of information on vegetable production. The information was acquired from a chart on the questionnaire which included the resource persons, organizations, and governmental agencies in the area. The farmers were asked to select the sources they felt were most important by indicating how often they relied on the advice of these individuals, organizations and agencies.

**Weed Control Practices**

The section of the questionnaire on weed control practices was designed to test the farmers' knowledge of weed control. This section of the questionnaire consisted of seven subtests on weed control. Each subtest was scored individually. The subtests were designated by letters and by titles as follows:

- **Subtest A**: Weed Classification (Total points 8)
- **Subtest B**: Weed Identification (Total points 10)
- **Subtest C**: Basic Weed Control Methods (Total points 20)
- **Subtest D**: Chemical Weed Control (Total points 30)
- **Subtest E**: Herbicide Sprayers (Total points 12)
- **Subtest F**: Spray Calibration (Total points 10)
- **Subtest G**: Herbicide Safety and Herbicide Recommendation (Total points 10)

**Post-test.** The questions asked in the post-test questionnaire were identical to the pre-test questionnaire except the sections on personal variables and sources of information and prior learning experiences
were eliminated. The questionnaire was pilot tested and revised. A complete copy of the revised questionnaire is provided in Appendix B.

PILOT TEST OF THE QUESTIONNAIRE AND LEARNING MODULE

The researcher conducted a pilot-test of the preliminary questionnaire and the learning module by administering the program to six vegetable farmers in the study area. As a result of the pilot test, several modifications were made. Portions of two modules were eliminated. The terminology used in some modules was further simplified and the number of questions on the pre-test and post-test was reduced. The number of slides was reduced from 438 to 318. A complete copy of the revised questionnaire is provided in Appendix B.

EXPERIMENTAL DESIGN

The experimental design used in this study was a complete randomized design.

Four treatments were used. In Treatment I, a Vegetable Specialist used modules to teach weed control practices to a group of 75 small farmers. In Treatment II, the same Vegetable Specialist taught weed control practices to a group of 75 small farmers using traditional teaching methods. In Treatment III, Para-Professional used the modules to teach weed control practices to a group of 30 small farmers, and in Treatment IV, Para-Professionals used the modules to train 30 farmers individually.

From these four treatments comparisons were made of (a) modules vs. traditional instruction, (b) professional administering modules vs. para-professionals administering modules, and (c) group instruction with modules vs. independent instruction with modules.
A diagram of the four treatments along with the number of participants is presented in Figure 4.

<table>
<thead>
<tr>
<th>Treatment I: N = 75</th>
<th>Treatment II: N = 75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Administered by Professional to Group of Farmers</td>
<td>Traditional Lecture-Discussion Taught by Professional to Group of Farmers</td>
</tr>
<tr>
<td>Treatment III: N = 30</td>
<td>Treatment IV: N = 30</td>
</tr>
<tr>
<td>... Module Administered by Para-Professional to Group of Farmers</td>
<td>Module Administered by Para-Professional to Individual Farmers</td>
</tr>
</tbody>
</table>

Figure 4: Description of Research Design

Selecting the Sample

Two hundred and ten small farmers were selected to participate in the study. They were selected from two major areas, St. Landry Parish in Louisiana and Copiah, Jefferson Davis, and Simpson Counties in Mississippi. Seventy farmers were selected from Louisiana and 140 from Mississippi.

The criteria for inclusion in the study were as follows:
(1) that farmers be actively engaged or preparing to be engaged in the
production of vegetables, and (2) that they meet the definition of a small farmer as defined by the 1974 Census of Agriculture. All 70 farmers in Louisiana and 140 farmers in Mississippi were participating in an on-going small farmer training program.

Collection of Data

The data for the study were collected with a pre and post-test questionnaire. In Treatments I and II the program was administered and data collected by the researcher. Treatments III and IV were administered by three para-professionals under the direction of the researcher. The weed control program consisted of seven modules. The modules consisted of 318 color slides, and were accompanied by a synchronized cassette tape recording. The modules were designed to be used as a series of lessons which began with very basic weed control methods and proceeded to more complex weed control technology. The seven modules were two hours and ten minutes long and were administered in two 65 minute sessions separated by a 15 minute break.

At the end of each module a series of questions were asked to assist the farmers' understanding of the objectives presented in the module.

DESCRIPTION OF PROCEDURES FOLLOWED IN TREATMENT I
(Learning Module Group)

The farmers participating in Treatment I were divided into four groups, two in Mississippi and two in Louisiana. Therefore, the study could not be conducted with all farmers at the same time. Yet, the same procedure and time frame was duplicated with each group.
During the first meeting day with farmers in Treatment I, a pre-test was administered. Immediately following the pre-test, the training program on weed control was conducted using the learning modules. Seven days following the training program a post-test was administered. Eleven of the original 75 farmers assigned to Treatment I failed to return for the post-test and were dropped from the treatment. The remaining pre and post-tests were graded and coded for analysis.

DESCRIPTION OF PROCEDURES FOLLOWED IN TREATMENT II
(Traditional Teaching)

The farmers participating in Treatment II were divided into four separate groups in the same manner as farmers in Treatment I. There were seventy-five farmers selected to participate in the treatment. Farmers in Treatment II were taught by the researcher using the lecture-discussion method of instruction, some slides and an overhead projector. Farmers in this treatment were taught the same subject matter as farmers in Treatment I.

The subject matter taught to farmers in Treatment II was covered in two 65 minute sessions separated by a 15 minute break. During the first meeting a pre-test was administered to all participants. Immediately following the pre-test the same training program conducted for farmers in Treatment I was conducted for farmers in Treatment II using the lecture-discussion method.

Seven days after the farmers completed the weed control program a post-test was administered. Only 49 farmers out of the original
75 farmers selected for Treatment II completed the post-test. Both pre and post-tests were graded, and coded for analysis.

**DESCRIPTION OF PROCEDURE FOLLOWED IN TREATMENT III**

Treatment III was made up of 30 farmers selected at random from 140 farmers in Mississippi. Farmers in this treatment were trained in group sessions conducted by para-professionals using the learning modules.

During the first meeting day with the farmers in Treatment III, a pre-test was administered. Immediately following the pre-test, the training program on weed control was conducted using the modules. Seven days following the training program, a post-test was administered. Only 20 of the 30 farmers completed the post-test. The test was graded, and the data coded for analysis.

**DESCRIPTION OF PROCEDURE FOLLOWED IN TREATMENT IV**

Treatment IV was conducted by three para-professionals who made appointments with 30 randomly selected small vegetable farmers. These farmers made individual appointments with para-professionals and came to view the modules at their convenience. The program was located at sites convenient to the farmers in the area and was administered to individual farmers by para-professionals.

Farmers in Treatment IV were given a pre-test prior to participating in the program and were exposed to the modules in the same manner as in Treatments I and III. As with the other three treatments, the post-tests were administered seven days after the farmers were exposed to the learning modules. Of the 30 farmers selected to participate in this treatment only 17 completed both pre and post-tests. The tests were graded and the data coded for analysis.
DATA PROCESSING

Upon completion of both pre and post-tests for all treatments, a master code system was developed. All data, including personal and social factors obtained in the questionnaire were categorized and coded. The Louisiana State University Computer Center was utilized to process the raw data.

In analyzing the data from the pre-test and post-test, scores for each subtest and for the total tests are expressed as mean gains. Mean gain is the mean difference between scores made on the pre-test and those made on the post-test. The number of questions and therefore, the potential score on each of the seven subtests is presented below:

<table>
<thead>
<tr>
<th>Subtests</th>
<th>Possible Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Weed Classification</td>
<td>8</td>
</tr>
<tr>
<td>B. Weed Identification</td>
<td>10</td>
</tr>
<tr>
<td>C. Cultural and Mechanical Weed Control Methods</td>
<td>20</td>
</tr>
<tr>
<td>D. Chemical Weed Control</td>
<td>30</td>
</tr>
<tr>
<td>E. Herbicide Sprayers</td>
<td>12</td>
</tr>
<tr>
<td>F. Sprayer Calibration</td>
<td>10</td>
</tr>
<tr>
<td>G. Herbicide Safety and Recommendation</td>
<td>10</td>
</tr>
</tbody>
</table>

Mean gains for each of the seven subtests and the total test were compared for each experimental variable.
The statistical techniques used to test each of the proposed hypotheses was the analysis of variance. Due to unequal cell size, the general linear module (GLM) of the statistical analysis system (SAS) was used to analyze the data.

The research design used for this study was a complete randomized design for the major hypothesis and a complete randomized block design for the minor hypotheses. Major hypotheses were posed to answer major questions regarding the learning modules while minor hypotheses were posed to answer questions about independent variables.
RESULTS AND DISCUSSION

The major objective of this study was to compare the traditional method of teaching weed control to small vegetable farmers with a set of learning modules presented to farmers in various ways. The minor objectives were to teach the relationship of these learning experiences to certain personal characteristics such as age, educational level, farm size and farm tenure. Specifically, the null hypothesis posed to answer the major questions were as follows:

1. There will be no significant difference in the mean gain in scores made on the pre-test and post-test for each of the seven subtests and the total test for subjects in Treatments I, II, III and IV.

2. On the seven subtests and on the total test, the performance of subjects in Treatments I where subjects were exposed to the module under professional supervision does not differ significantly from the performance of farmers in Treatment II in which subjects were exposed to traditional lecture-discussion instruction.

3. On the seven subtests and on the total test, there will be no significant difference in the performance of subjects in Treatment I, module group with professional supervision and Treatment III, learning module group with para-professional supervision.
4. On the seven subtests and on the total test there will be no significant difference in the performance of subjects in Treatment I, group exposure to the module, and subjects in Treatment IV, individual exposure to the module.

5. On the seven subtests and on the total test, the performance of farmers in Treatment II, in which farmers were given traditional lecture-discussion instruction by a professional, will not differ significantly from the performance of farmers in Treatment IV, in which farmers were taught individually by para-professional using the learning module.

6. On the seven subtests and on the total test the performance of farmers in Treatment III, in which groups of farmers were exposed to the module by para-professional, will not differ significantly from the performance of farmers in Treatment IV, in which individual farmers were exposed to the modules by para-professionals.

The minor hypotheses posed in this study are presented below:

1. Age will have no significant effect on the performance of farmers in any of the four treatments.

2. Educational level will have no significant effect on the performance of subjects in Treatments I through IV.

3. Farm size will have no significant effect on the performance of subjects in any of the four treatments.

4. Farm tenure will have no significant effect on the
performance of subjects in any of the four treatments.

6. There will be no significant difference in the performance of subjects by sex on any of the four treatments.

**MEAN GAINS**

The mean gains in scores for the seven subtests, the total test, and the four treatments are presented in Table 4. The analysis of variances used in testing the major hypotheses below are based on these data.

**MAJOR HYPOTHESIS ONE**

The first major hypothesis is that there would be no significant difference among the mean gains made on the seven subtests and the total test for the four treatments.

The F-Ratios for the four treatments are presented in Table 5. A highly significant difference was found among the mean gains for the four treatments. Thus we can conclude that there is a difference among the four treatments.

A highly significant difference in mean gains among treatments was found for five of the seven subtests and a significant difference was found for one of the subtests. Only one subtest failed to show a significant difference among treatments.
<table>
<thead>
<tr>
<th>Sub-Tests</th>
<th>Treatment I Learning Module Group Admin. by Professional N = 63</th>
<th>Treatment II Lecture-Discussion Group Admin. by Professional N = 48</th>
<th>Treatment III Learning Module Group Admin. by Para-Professional N = 20</th>
<th>Treatment IV Individual Exposure to Learning Modules Admin. by Para-Professional N = 17</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Weed Classification</td>
<td>1.2857</td>
<td>0.5000</td>
<td>-1.000</td>
<td>0.9412</td>
</tr>
<tr>
<td>B. Weed Identification</td>
<td>1.0635</td>
<td>0.2917</td>
<td>1.9500</td>
<td>1.1766</td>
</tr>
<tr>
<td>C. Cultural and Mechanical Weed Control</td>
<td>1.2254</td>
<td>0.0417</td>
<td>-4.0000</td>
<td>4.4706</td>
</tr>
<tr>
<td>D. Chemical Control</td>
<td>4.2317</td>
<td>1.7917</td>
<td>2.6000</td>
<td>7.9411</td>
</tr>
<tr>
<td>E. Herbicide Sprayer</td>
<td>3.0777</td>
<td>1.2021</td>
<td>1.9059</td>
<td>1.9059</td>
</tr>
<tr>
<td>F. Sprayer Calibration</td>
<td>2.8365</td>
<td>0.9458</td>
<td>5.2000</td>
<td>3.7059</td>
</tr>
<tr>
<td>G. Herbicide Safety and Recom-</td>
<td>1.6015</td>
<td>0.9167</td>
<td>0.6000</td>
<td>1.0588</td>
</tr>
<tr>
<td>mendation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5: Analysis of Variance of Mean Gain in Score on Pre- and Post Test for the Seven Subtests and on the Total Test for Treatments I, II, III, and IV.

<table>
<thead>
<tr>
<th>Subtests</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Squares</td>
<td>27.42</td>
<td>14.16</td>
<td>238.75</td>
<td>174.06</td>
<td>41.72</td>
<td>96.86</td>
<td>7.18</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>2.30</td>
<td>2.25</td>
<td>5.73</td>
<td>6.21</td>
<td>3.06</td>
<td>3.15</td>
<td>2.64</td>
</tr>
<tr>
<td>F-Ratio</td>
<td>5.20**</td>
<td>2.80*</td>
<td>7.26**</td>
<td>4.51**</td>
<td>4.45**</td>
<td>9.74**</td>
<td>1.03 NS</td>
</tr>
</tbody>
</table>

*Significant at the .05 level
**Significant at the .01 level
NS - Nonsignificant

Subtest A - Weed Classification
Subtest B - Weed Identification
Subtest C - Cultural and Mechanical Weed Control
Subtest D - Chemical Weed Control
Subtest E - Herbicide Sprayer
Subtest F - Sprayer Calibration
Subtest G - Herbicide Safety and Recommendation
MAJOR HYPOTHESIS TWO

The second major hypothesis states that on the seven subtests and on the total test the mean gain will not differ significantly between Treatment I in which the farmers were exposed to the learning module in a group by a professional instructor and Treatment II in which subjects were exposed to the traditional lecture-discussion method of instruction in a group by a professional instructor.

The results of the analysis of variances as summarized in Table 6 revealed a highly significant difference for the total test. Therefore, the null hypothesis was rejected. An examination of the mean gain for the total test favored farmers in Treatment I. The mean gain for Treatment I was 15.32 as compared to 5.69 for Treatment II. A highly significant difference between the two treatments was found for subtests E and F and a significant difference between the two treatments was found on subtest D. All differences favored the learning module over the traditional lecture-discussion method of instruction. Although subtests A, B, C, and G did not indicate a significant difference at the .05 level the mean gains for these four subtests favored Treatment I, the learning module group with professional supervision over Treatment II, the traditional lecture-discussion method of instruction. The mean gains for Treatment I and II and the subtests and total test are presented in Table 4. The results are consistent with the finding of Dishener (13) who conducted a study comparing proficiency modules with traditional instructional methods.
Table 6: Analysis of Variances of Mean Gains in Score on Pre and Post test for Farmers Exposed to the Learning Modules in Groups and Farmers Exposed to Traditional Lecture-Discussion Instruction. Analysis was conducted for the Seven Subtests and for the Total Test.

<table>
<thead>
<tr>
<th>Subtests</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Total Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Squares</td>
<td>16.81</td>
<td>16.22</td>
<td>38.17</td>
<td>162.205</td>
<td>95.85</td>
<td>97.39</td>
<td>12.78</td>
<td>2527.84</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>2.25</td>
<td>2.225</td>
<td>6.04</td>
<td>6.375</td>
<td>2.99</td>
<td>3.26</td>
<td>2.82</td>
<td>14.72</td>
</tr>
<tr>
<td>F-Ratio</td>
<td>3.32+</td>
<td>3.28+</td>
<td>1.05</td>
<td>3.99*</td>
<td>10.70**</td>
<td>9.19**</td>
<td>1.60ns</td>
<td>11.66**</td>
</tr>
</tbody>
</table>

+ Approaching Significance
* Significant at the .05 level
** Significant at the .01 level
ns Nonsignificant

Subtest A. Weed Classification
Subtest B. Weed Identification
Subtest C. Cultural and Mechanical Weed Control
Subtest D. Chemical Weed Control
Subtest E. Herbicide Sprayer
Subtest F. Sprayer Calibration
Subtest G. Herbicide Safety and Recommendation
In this study the performance of students taught by proficiency modules was significantly higher than students taught by traditional methods.

Strickland (43) and Merwin (28) also received similar results. Observation made by researcher during the study indicated that farmers who participated in the module treatments exhibited a more positive attitude toward the weed control program because of their ability to respond to questions asked at the end of the modules. One reason for the reduction in the sample size for Treatment II, was due to their lack of enthusiasm toward the training program.

**MAJOR HYPOTHESIS THREE**

The third hypothesis states that on the seven subtests and on the total of the subtests there will be no significant difference in the mean gains between scores on the pre-test and post-test for Treatment I in which the farmers were exposed to the learning module under Professional supervision and Treatment III in which the farmers were exposed to the learning module under para-professional supervision. The mean gains for Treatments I and III and for the subtests and total test are presented in Table 4.

The F-ratio from the analysis of variances in Table 7 indicates a significant difference between the two treatments for the total test. This difference in mean scores favors the learning modules presented to the farmers in a group by a para-professional. The analysis of variances also reveals a significant difference in favor
Table 7: Analysis of Variance of Mean Gains in Score on Pre- and Post-test by Farmers Exposed to the Learning Modules by Para-Professionals and Farmers exposed by Professional Extension Specialist. Analysis was conducted for each of the Seven Subtests and the Total Test.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Subtests</th>
<th>Total Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Mean Squares</td>
<td>79.31</td>
<td>11.93</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>2.16</td>
<td>2.24</td>
</tr>
<tr>
<td>F-Ratio</td>
<td>16.96**</td>
<td>2.36</td>
</tr>
</tbody>
</table>

*Significant at the .05 level  
**Significant at the .01 level  
ns Nonsignificant at the .01 level

Subtest A. Weed Classification  
Subtest B. Weed Identification  
Subtest C. Cultural and Mechanical Weed Control Methods  
Subtest D. Chemical Weed Control  
Subtest E. Herbicide Sprayers  
Subtest F. Sprayer Calibration  
Subtest G. Herbicide Safety and Recommendations
favor of professional administration for four of the seven subtests. Only two of the seven subtests favored para-professional administration of the learning modules. The reason subtest 7 favored administration of the modules by para-professionals may be due to the fact that the section on sprayer calibration was more technical than other portions of the weed control program and required more interaction with the person administering the program. According to Rogers (40) more effective communication occurs and more learning occurs when source and receiver are homophilous and because of the homophilous relationship which exist between para-professionals and small farmers. Small farmers performed better on the sprayer calibration section of the weed control program.

**MAJOR HYPOTHESIS FOUR**

The fourth major hypothesis states that on the seven subtests and on the total test the mean gain will not differ significantly between Treatment I in which the farmers were exposed to the learning module in a group by a professional instructor and Treatment IV in which subjects were exposed to the module individually under para-professional supervision.

The test of significance was conducted using the analysis of variances and the results are presented in Table 8. The F-ratio revealed no significant difference in the performance of subjects on the total test nor was there a significant difference for the seven subtests. An examination of the mean gain for the total test favored farmers in Treatment IV. The mean gain for Treatment IV was
Table 8: Analysis of Variance of Mean Gain in Scores made on Pre- and Post-test for Farmers exposed to the Learning Modules individually and those exposed to the Learning Modules in Groups. Analysis of Variance was conducted for the Seven Subtests and the Total Test.

<table>
<thead>
<tr>
<th>Source of Variations</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Total Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Squares</td>
<td>1.589</td>
<td>0.170</td>
<td>140.99</td>
<td>184.21</td>
<td>18.39</td>
<td>10.12</td>
<td>3.94</td>
<td>462.451</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>2.24</td>
<td>2.233</td>
<td>6.00</td>
<td>6.87</td>
<td>3.078</td>
<td>3.03</td>
<td>2.67</td>
<td>15.87</td>
</tr>
<tr>
<td>F-Ratio</td>
<td>0.32^{ns}</td>
<td>0.03^{ns}</td>
<td>3.92^{+}</td>
<td>3.90^{+}</td>
<td>1.94^{ns}</td>
<td>1.10^{ns}</td>
<td>.055^{ns}</td>
<td>1.84^{ns}</td>
</tr>
</tbody>
</table>

+ Approaching Significance
ns Nonsignificant

Subtest A. Weed Classification
Subtest B. Weed Identification
Subtest C. Cultural and Mechanical Weed Control
Subtest D. Chemical Weed Control
Subtest E. Herbicide Sprayer
Subtest F. Sprayer Calibration
Subtest G. Herbicide Safety and Recommendations
was 21.20 as compared to 15.32 for Treatment I.

The high total mean gain for the two treatments indicated that both were effective teaching methods, yet there was no significant difference in the two treatments. The mean gains for Treatments I and IV and for the seven subtests and total test are presented in Table 4.

MAJOR HYPOTHESIS FIVE

The fifth major hypothesis states that on the seven subtests and on the total test the mean gain will not differ significantly between Treatment II in which the farmers were exposed to the lecture-discussion method of instruction in a group by a professional instructor and Treatment IV in which the farmers were exposed to the learning module individually under para-professional supervision. The mean gains for Treatments II and IV and for the subtests and total test are presented in Table 4.

The results of the analysis of variances as summarized in Table 9 reveal a highly significant difference in the two instructional methods on the total test and three of the seven subtests. Therefore, the null hypothesis was rejected. An examination of the mean gain for the two treatments favored Treatment IV, individual use of the learning module. There was no significant difference in the gains made by subjects on Subtests A, B, E and G. Farmers in Treatment II, the traditional or lecture-discussion method of teaching, made nearly the same mean gain on all seven subtests while farmers in Treatment IV made much higher gain on Subtests C, Cultural and Mechanical Weed Control; Subtest D, Chemical Weed Control; and Subtest F, Sprayer Calibration.
Table 9: An Analysis of Variance of Mean Gain in Score made on Pre-test and Post-test for Farmers Exposed to the Learning Modules Individually by a Para-professional and Farmers Exposed to the Lecture-Discussion Method of Instruction by a Professional. Analysis of Variance was conducted on the Seven Subtests and the Total Test.

<table>
<thead>
<tr>
<th>Subtests</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Total Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean Square</strong></td>
<td>2.44</td>
<td>9.828</td>
<td>246.25</td>
<td>447.74</td>
<td>6.218</td>
<td>95.63</td>
<td>0.2536</td>
<td>3020.116</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>2.46</td>
<td>2.255</td>
<td>5.594</td>
<td>6.077</td>
<td>2.935</td>
<td>3.470</td>
<td>2.638</td>
<td>13.435</td>
</tr>
<tr>
<td><strong>F-Ratio</strong></td>
<td>0.40&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.93&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>7.87**</td>
<td>12.85**</td>
<td>0.72&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>7.94**</td>
<td>0.04&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>16.73**</td>
</tr>
</tbody>
</table>

** Significant at the .05 level
<sup>ns</sup> Nonsignificant

Subtest A. Weed Classification
Subtest B. Weed Identification
Subtest C. Cultural and Mechanical Weed Control
Subtest D. Chemical Weed Control
Subtest E. Herbicide Sprayers
Subtest F. Sprayer Calibration
Subtest G. Herbicide Safety and Recommendations
MAJOR HYPOTHESIS SIX

The sixth major hypothesis states that on the seven subtests and on the total test the mean gain would not differ significantly between Treatment III in which the farmers were exposed to the learning module in a group by para-professional supervision and Treatment IV in which subjects were exposed to the learning module individually under para-professional supervision. The mean gains for Treatments I and II and for the subtests and total test are presented in Table 4.

The results of the analysis of variances are summarized in Table 10 revealed a highly significant difference for the total test. Therefore, the null hypothesis was rejected. An examination of the mean gain for the total test favored farmers in Treatment IV. The mean gain for Treatment IV was 21.20 as compared to 6.31 for Treatment III. A highly significant difference between the two treatments was found for Subtests C and D and a significant difference between the two treatments was found on Subtest A. The mean gain for Subtests A, C, D, E, and G favored Treatment IV. Subtest B - Weed Identification and Subtest F - Sprayer Calibration favored Treatment III.

It was stated earlier that the communication link between farmer and para-professional facilitated the learning process even when para-professionals used learning modules to direct learning experiences. It can be concluded from the comparison of farmers who were exposed to the modules in groups under para-professional supervision and those exposed to the modules individually under para-professional supervision learned skills such as sprayer calibration better when they are
Table 10: An Analysis of Variance of Mean Gain in Scores Made on Pretest and Posttest for farmers exposed to the Learning Modules Individually by Para-professional and those exposed to the Learning Modules in Groups by Para-professionals. Analysis of Variances was conducted on the Seven Subtests and on the Total Test.

<table>
<thead>
<tr>
<th>SUBTESTS</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Total Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Square</td>
<td>34.63</td>
<td>5.50</td>
<td>659.33</td>
<td>262.15</td>
<td>8.22</td>
<td>20.51</td>
<td>1.935</td>
<td>2037.35</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>2.43</td>
<td>2.33</td>
<td>4.67</td>
<td>5.67</td>
<td>3.27</td>
<td>2.81</td>
<td>1.97</td>
<td>12.184</td>
</tr>
<tr>
<td>F-Ratio</td>
<td>5.86*</td>
<td>1.02ns</td>
<td>30.20**</td>
<td>8.15**</td>
<td>0.77ns</td>
<td>2.59ns</td>
<td>0.50ns</td>
<td>13.72**</td>
</tr>
</tbody>
</table>

*Significant at the .05 level  
**Significant at the .01 level  
ns Nonsignificant

Subtest A. Weed Classification  
Subtest B. Weed Identification  
Subtest C. Cultural and Mechanical Weed Control  
Subtest D. Chemical weed control  
Subtest E. Herbicide Sprayers  
Subtest F. Sprayer Calibration  
Subtest G. Herbicide Safety and Recommendation
exposed to modules in groups.

In Treatment III negative mean gains were made for Subtest A - Weed Classification and for Subtest C - Cultural and Mechanical Weed Control. These negative scores are difficult to justify, however, they can best be explained by the attitude exhibited by subjects during the post-test. Generally farmers exhibited a degree of enthusiasm toward the modules, yet exhibited a negative attitude toward test when it was administered by para-professionals.

Farmers exposed to the modules individually with para-professional supervision exhibited a more positive attitude toward both the modules and post-test administered after being exposed to the modules.

MINOR HYPOTHESIS ONE

The first minor hypothesis stated that age will have no significant effect on the performance of subjects nor for the total test.

The F-ratios for the seven subtests and total test indicate that age had no significant effect on the performance of subjects in the four Treatments nor was there a significant interaction of age and method of instruction. The F-ratios for age and the interaction of age and instructional methods are presented in Table 11.

An examination of the mean gains by age groups indicated that farmers 30 years old and younger made mean gains of 18 points on the total test while ages 31 to 60 only made a mean gain of about 5.50. However, older farmers 60 to 65 scored slightly higher than middle age farmers. An examination of the mean gains by age groups is presented in Table 12. The variability in mean scores by age groups is
Table 11: F-Ratio for Age, Instructional Method and the Interaction of Age and Instructional Method

<table>
<thead>
<tr>
<th>Subtest</th>
<th>R-Ratio Instructional Method</th>
<th>R-Ratio Age</th>
<th>R-Ratio Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weed Classification</td>
<td>3.75*</td>
<td>1.10&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.74&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Weed Identification</td>
<td>6.32*</td>
<td>1.69&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.69&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cultural and Mechanical</td>
<td>4.27**</td>
<td>0.61&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.31&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Weed Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical Weed Control</td>
<td>2.56</td>
<td>1.52&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>9.41&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Herbsicde Sprayers</td>
<td>4.49**</td>
<td>0.36&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.97&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sprayer Calibration</td>
<td>5.93**</td>
<td>0.68&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.30&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Herbicide Safety and</td>
<td>0.47</td>
<td>0.73&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.74&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Recommendation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Test</td>
<td>5.19**</td>
<td>1.30&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.49&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Significant at the .05 level  
**Significant at the .01 level  
<sup>ns</sup> Nonsignificant
Table 12: Analysis of Variance Mean Gain in Scores made on Pre and Post-Tests by Age Group for the Seven Subtests and the Total Test

<table>
<thead>
<tr>
<th>Subtests</th>
<th>Age Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25 or N = 27</td>
</tr>
<tr>
<td>Mean Difference</td>
<td></td>
</tr>
<tr>
<td>Weed Classification</td>
<td>1.111</td>
</tr>
<tr>
<td>Weed Identification</td>
<td>1.000</td>
</tr>
<tr>
<td>Cultural and Mechanical Weed Control Method</td>
<td>2.000</td>
</tr>
<tr>
<td>Chemical Weed Control</td>
<td>7.407</td>
</tr>
<tr>
<td>Herbicide Sprayers</td>
<td>2.326</td>
</tr>
<tr>
<td>Sprayer Calibration</td>
<td>2.148</td>
</tr>
<tr>
<td>Herbicide Safety</td>
<td>1.888</td>
</tr>
<tr>
<td>------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Total Test</td>
<td>17.881</td>
</tr>
</tbody>
</table>

*Significant at the .05 level
**Significant at the .01 level
related to farmers felt needs. Farmers 60 and older are in their retirement age generally had a more serious attitude toward vegetable farming and depended primarily on the farm. A large percentage of the younger farmers depended on either part-time or full time employment off the farm for a major portion of the family income and didn't demonstrate the interest that older farmers demonstrated. Farmers 30 years and younger accepted the program as a challenge more than the other groups.

MINOR HYPOTHESIS TWO

The second hypothesis stated that there will be no significant difference in the performance of subjects by sex.

The results of the analysis of variances as summarized in Table 13 indicate that there is no significant difference in the performance of subjects by sex for the total test. However, there was a significant interaction of sex and treatments for subtest F. Table 14 presents a summary of the mean gain by sex within treatments. The mean gains for subtest F, Sprayer Calibration, reveal a higher mean gain for males in learning modules groups. Females made higher mean gains when exposed to the learning modules individually, and lower scores when exposed to the modules in groups. These results were only obtained in subtest F.

Subtest D, Chemical Weed Control, was significant at the .05 level for sex. An examination of the mean gains by sex in Table 13 indicated that the significant F-ratio for sex favored females with a mean gain of 5.24 as compared to 2.18 for males. Although, there was no significant difference in the performance of subjects by sex, females made slightly higher mean gains on four of the seven subtests and for the total test.
Table 13: F-Ratio for Instructional Method Sex and the Interaction of Age and Instructional Method

<table>
<thead>
<tr>
<th>Subtests</th>
<th>F-Ratio Instructional Method</th>
<th>F-Ratio Sex</th>
<th>F-Ratio Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weed Classification</td>
<td>3.26*</td>
<td>0.14ns</td>
<td>0.39ns</td>
</tr>
<tr>
<td>Weed Identification</td>
<td>4.79**</td>
<td>0.04ns</td>
<td>1.82ns</td>
</tr>
<tr>
<td>Cultural and Mechanical Weed Control</td>
<td>6.31**</td>
<td>0.07ns</td>
<td>0.98ns</td>
</tr>
<tr>
<td>Chemical Weed Control</td>
<td>2.87ns</td>
<td>3.24*</td>
<td>0.52ns</td>
</tr>
<tr>
<td>Herbicide Sprayers</td>
<td>5.62**</td>
<td>0.26ns</td>
<td>2.28ns</td>
</tr>
<tr>
<td>Sprayer Calibration</td>
<td>9.03**</td>
<td>0.01ns</td>
<td>3.54ns</td>
</tr>
<tr>
<td>Herbicide Safety and Recommendation</td>
<td>0.81ns</td>
<td>0.10ns</td>
<td>1.32ns</td>
</tr>
<tr>
<td>Total Test</td>
<td>7.20**</td>
<td>0.42ns</td>
<td>0.13ns</td>
</tr>
</tbody>
</table>

* Significant at the .05 level  
** Significant at the .01 level 
ns Nonsignificant
Table 14: Mean Gains in Scores made on Pre- and Post Tests by Sex Within Treatment Groups

<table>
<thead>
<tr>
<th>Subtests</th>
<th>N</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Module</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>32</td>
<td>1.0625</td>
<td>1.7500</td>
<td>2.1312</td>
<td>2.6125</td>
<td>2.3343</td>
<td>3.8969</td>
<td>1.3406</td>
<td>15.1281</td>
</tr>
<tr>
<td>Females</td>
<td>27</td>
<td>1.5185</td>
<td>0.5555</td>
<td>0.0740</td>
<td>5.9629</td>
<td>3.9111</td>
<td>1.3704</td>
<td>1.6296</td>
<td>15.0222</td>
</tr>
<tr>
<td>Individual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>11</td>
<td>0.8181</td>
<td>0.1818</td>
<td>2.9090</td>
<td>7.2727</td>
<td>1.9636</td>
<td>2.6364</td>
<td>1.3636</td>
<td>18.1454</td>
</tr>
<tr>
<td>Females</td>
<td>5</td>
<td>0.4000</td>
<td>2.0000</td>
<td>5.6000</td>
<td>6.8000</td>
<td>0.9600</td>
<td>5.8000</td>
<td>-0.2000</td>
<td>21.3600</td>
</tr>
<tr>
<td>Traditional Method</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>30</td>
<td>0.5666</td>
<td>0.5000</td>
<td>0.8666</td>
<td>0.2000</td>
<td>1.7266</td>
<td>1.0333</td>
<td>0.4000</td>
<td>5.2933</td>
</tr>
<tr>
<td>Females</td>
<td>17</td>
<td>0.3529</td>
<td>-0.1176</td>
<td>-1.5294</td>
<td>4.1176</td>
<td>0.4176</td>
<td>0.7294</td>
<td>1.7058</td>
<td>5.6764</td>
</tr>
<tr>
<td>Para-Professional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>12</td>
<td>-1.0833</td>
<td>1.8333</td>
<td>-4.5000</td>
<td>1.3333</td>
<td>0.8000</td>
<td>5.2500</td>
<td>0.9166</td>
<td>4.5500</td>
</tr>
<tr>
<td>Females</td>
<td>5</td>
<td>-1.200</td>
<td>3.2000</td>
<td>-4.000</td>
<td>3.6000</td>
<td>0.2400</td>
<td>5.2000</td>
<td>0.2000</td>
<td>8.2400</td>
</tr>
</tbody>
</table>

Subtest A. Weed Classification    Subtest E. Herbicide Sprayers
Subtest B. Weed Identification    Subtest F. Sprayer Calibration
Subtest C. Cultural and Mechanical Weed Control Subtest G. Herbicide Safety and Recommendations
Subtest D. Chemical Weed Control
Table 15: Analysis of Variance Mean Gain in Scores made on Pre- and Post Tests by Sex for the Seven Subtests and for the Total Test.

<table>
<thead>
<tr>
<th>Subtests</th>
<th>Sex Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male N = 85</td>
</tr>
<tr>
<td></td>
<td>Mean Gain</td>
</tr>
<tr>
<td>Weed Classification</td>
<td>0.5529</td>
</tr>
<tr>
<td>Weed Identification</td>
<td>1.2470</td>
</tr>
<tr>
<td>Cultural and Mechanical Weed Control Methods</td>
<td>0.8494</td>
</tr>
<tr>
<td>Chemical Weed Control</td>
<td>2.1835</td>
</tr>
<tr>
<td>Herbicide Sprayers</td>
<td>1.8552</td>
</tr>
<tr>
<td>Sprayer Calibration</td>
<td>2.9141</td>
</tr>
<tr>
<td>Herbicide Safety &amp; Recommendations</td>
<td>0.0517</td>
</tr>
<tr>
<td>Total Test</td>
<td>10.5541</td>
</tr>
</tbody>
</table>
These results are similar to the results reported by Kryspin (13). He compared the performance of male and female students dealing with modules on behavior objectives. He obtained results which indicated that females learned significantly more from modules than males.

**MINOR HYPOTHESIS THREE**

Minor hypothesis three states that education level will have no effect on the performance of subjects on the seven subtests or for the total test.

The F-Ratio from the analysis of variances in Table 16 reveals a nonsignificant F-Ratio for the seven subtests and for the total test. Further analysis for possible interaction of education and treatment indicated that no significant interaction existed in seven subtests or for the total test. An evaluation of the mean gain for three different educational levels revealed a slightly higher mean gain for farmers with thirteen or more years of formal education. However, since no significant F-Ratio was obtained for any of the subtest or for the total test, it was concluded that the educational levels of the farmers were so homogeneous that no significant difference in their performance existed.

**MINOR HYPOTHESIS FOUR**

Minor hypothesis four states that farm tenure will have no significant effect on the performance of subjects on any of the seven subtests and on the total test, nor will there be any significant interaction between treatment groups.
Table 16: F-Ratio for Education and the Interaction of Education and Instructional Method

<table>
<thead>
<tr>
<th>Subtests</th>
<th>F-Ratio Education</th>
<th>F-Ratio Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weed Classification</td>
<td>1.37&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.33&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Weed Identification</td>
<td>2.19&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.04&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cultural and Mechanical Weed Control</td>
<td>0.96&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.68&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chemical Weed Control</td>
<td>0.04&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.30&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Herbicide Sprayers</td>
<td>1.69&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.10&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sprayer Calibration</td>
<td>1.65&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.20&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Herbicide Safety and Recommendations</td>
<td>0.64&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.62&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total Test</td>
<td>0.17&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.67&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>ns</sup> Nonsignificant
Table 17: Analysis of Variance for Mean Gain in Scores Made on Pre- and Post Tests by Educational Group and F Value for Education and the Interaction of Method by Education

<table>
<thead>
<tr>
<th>Subtests</th>
<th>Educational Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 years or less</td>
</tr>
<tr>
<td></td>
<td>N = 55</td>
</tr>
<tr>
<td>Weed Classification</td>
<td>0.3818</td>
</tr>
<tr>
<td>Weed Identification</td>
<td>0.8182</td>
</tr>
<tr>
<td>Cultural and Mechanical</td>
<td>1.1673</td>
</tr>
<tr>
<td>Weed Control Method</td>
<td></td>
</tr>
<tr>
<td>Chemical Weed Control</td>
<td>2.7018</td>
</tr>
<tr>
<td>Herbicide Sprayers</td>
<td>1.4890</td>
</tr>
<tr>
<td>Sprayer Calibration</td>
<td>2.9582</td>
</tr>
<tr>
<td>Herbicide Safety and Recommendations</td>
<td>1.2890</td>
</tr>
<tr>
<td>Total</td>
<td>10.8054</td>
</tr>
</tbody>
</table>
The results of the analysis of variances as summarized in Table 18 agreed with the null hypothesis. The F-Ratio for farm tenure and the interaction of farm tenure and treatments indicated that farm tenure had no significant effect on the performance of the subjects nor was there a significant interaction within treatment groups on any of the seven subtests nor for the total test. The mean gain for all groups was 12, except for farmers with more than 30 years of tenure. Farmers with more than 30 years of tenure made slightly lower mean scores than younger tenured farmers. A summary of the mean gains by educational group is provided in Table 19.

In 1971, Bradford (75) compared farmers' knowledge of forestry concepts with the adoption of forestry practices. He found that farmers with less tenure also made higher scores.

**MINOR HYPOTHESIS FIVE**

Minor hypothesis five states that prior use of herbicides will have no significant effect on the performance of subjects on the pre and post test or any of the seven subtests nor for the total test.

The F-Ratio from the Analysis of variance used to test this hypothesis is presented in Table 20. Prior use of herbicides had no significant effect on the performance of subjects on any of the subtests or for the total test. One hundred twenty three subjects responded to the questions or prior use of herbicides. Fifty eight said they had not used herbicides. A summary of the mean gain for farmers with or without prior use of herbicides is provided in Table 20.
Table 18: F-Ratio for Farm Tenure and the Interaction of Farm Tenure, and Instructional Method for the Seven Subtests and the Total Test

<table>
<thead>
<tr>
<th>Subtests</th>
<th>R-Ratio Farm Tenure</th>
<th>R-Ratio Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weed Classification</td>
<td>1.368&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>.3319&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Weed Identification</td>
<td>2.187&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.042&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cultural and Mechanical Weed Control</td>
<td>.95&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.68&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chemical Weed Control</td>
<td>.04&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>.30&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Herbicide Sprayers</td>
<td>1.60&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.10&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sprayer Calibration</td>
<td>1.65&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>1.20&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hebercide Safety and Recommendations</td>
<td>0.64&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.62&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total Test</td>
<td>0.17&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>0.67&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>ns</sup> Nonsignificant
Table 19: Analysis of Variance for Mean Gain in Scores Made on Pre- and Post Tests by Farm Tenure for the Seven Subtests and Total Test

<table>
<thead>
<tr>
<th>Subtests</th>
<th>Tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 yrs. or less N = 82</td>
</tr>
<tr>
<td></td>
<td>Mean Gain</td>
</tr>
<tr>
<td>Weed Classification</td>
<td>0.8536</td>
</tr>
<tr>
<td>Weed Identification</td>
<td>0.6463</td>
</tr>
<tr>
<td>Cultural and Mechanical Weed Control Method</td>
<td>1.2560</td>
</tr>
<tr>
<td>Chemical Weed Control</td>
<td>3.4878</td>
</tr>
<tr>
<td>Herbicide Sprayers</td>
<td>1.7829</td>
</tr>
<tr>
<td>Sprayer Calibration</td>
<td>2.3780</td>
</tr>
<tr>
<td>Herbicide Safety and Recommendations</td>
<td>1.6707</td>
</tr>
<tr>
<td>Total Test</td>
<td>12.0756</td>
</tr>
</tbody>
</table>
Table 20: Analysis of Variance for Mean Gain in Scores made on Pre- and Post-tests by Farmers who had prior use of Herbicide and F Value for use of Herbicides and Method X Herbicide for the Seven Subtests and Total Test

<table>
<thead>
<tr>
<th></th>
<th>Use of Herbicides</th>
<th>F Use of Herbicides</th>
<th>F I.M.X. Herbicide</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>N = 58</td>
<td>N = 65</td>
<td>N = 58</td>
<td>N = 65</td>
</tr>
<tr>
<td>Mean Gain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weed Classification</td>
<td>0.8793</td>
<td>0.6923</td>
<td>0.02&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Weed Identification</td>
<td>1.2586</td>
<td>0.7846</td>
<td>0.00&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cultural and Mechanical Weed Control Methods</td>
<td>0.4139</td>
<td>0.3261</td>
<td>0.18&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chemical Weed Control</td>
<td>3.4310</td>
<td>3.2553</td>
<td>0.22&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Herbicide Sprayers</td>
<td>1.9120</td>
<td>2.3153</td>
<td>0.95&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sprayer Calibration</td>
<td>2.8103</td>
<td>2.3092</td>
<td>0.01&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Herbicide Safety</td>
<td>0.6551</td>
<td>1.3984</td>
<td>1.18&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total Test</td>
<td>11.3603</td>
<td>11.0815</td>
<td>0.69&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

ns - Nonsignificant
MINOR HYPOTHESIS SIX

Minor hypothesis six states that farm size will have no significant effect on the performance of subjects within instructional groups on the seven subtests and on the overall test nor will there be a significant interaction between farm size and treatment group. The results of the analysis of variances are provided in Table 21. The F-Ratio for farm size and the interaction of farm size and instructional method indicates that farm size had no effect on the performance of subjects on the seven subtests nor on the total test. The interaction of farm size and instructional method was not significant for the total test. However, subtest A, Weed Classification, was significant at the .05 level with a F-Ratio of 3.83. An examination of the mean gain by size of vegetable farm within treatments indicated that an inverse relation existed between instructional groups and farm size. In all module group- farmers producing less than five acres had the highest mean gain while farmers in the traditional groups producing more than six acres of vegetables made a higher mean gain. A summary of the subtest means are provided in Table 21. No logical reason could be ascertained for the response of farmers in subtest A. The performance of farmers on other subtests failed to follow this pattern. A summary of the mean gain made by farmers within treatments is provided in Table 22.
<table>
<thead>
<tr>
<th>Table 21: Analysis of Variance for Mean Gain in Scores made on Pre and Post Tests by Size of Vegetable Farm and F-Ratio for Vegetable Acreage and the Interaction of Vegetable Acreage and Instructional Method for the Seven Subtests and the Total Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size of Vegetable Farm</strong></td>
</tr>
<tr>
<td>5 acres or less</td>
</tr>
<tr>
<td>N = 90</td>
</tr>
<tr>
<td>Mean Gain</td>
</tr>
<tr>
<td>Weed Classification</td>
</tr>
<tr>
<td>Weed Identification</td>
</tr>
<tr>
<td>Culture and Mechanical Weed Control Method</td>
</tr>
<tr>
<td>Chemical Weed Control</td>
</tr>
<tr>
<td>Herbicide Sprayers</td>
</tr>
<tr>
<td>Sprayer Calibration</td>
</tr>
<tr>
<td>Herbicide Safety and Recommendations</td>
</tr>
<tr>
<td>Total Test</td>
</tr>
</tbody>
</table>

<sup>ns</sup> Nonsignificant
Table 22: Mean Gains in Score Made on Pre- and Post Tests by Farm Size Within Treatment

<table>
<thead>
<tr>
<th>Method of Instruction</th>
<th>N</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Total Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Module Group (5 acres or less)</td>
<td>49</td>
<td>1.5510</td>
<td>1.0204</td>
<td>0.6367</td>
<td>4.8385</td>
<td>3.2959</td>
<td>2.8714</td>
<td>1.3857</td>
<td>15,5897</td>
</tr>
<tr>
<td>(6 acres or more)</td>
<td>14</td>
<td>0.3571</td>
<td>1.2143</td>
<td>3.2857</td>
<td>2.1428</td>
<td>2.3143</td>
<td>2.3571</td>
<td>2.3571</td>
<td>14.3857</td>
</tr>
<tr>
<td>Learning Module (Individual) (5 acres or less)</td>
<td>10</td>
<td>1.3000</td>
<td>0.6000</td>
<td>5.2000</td>
<td>7.3000</td>
<td>2.1600</td>
<td>1.0000</td>
<td>1.0000</td>
<td>22.0600</td>
</tr>
<tr>
<td>(6 acres or more)</td>
<td>7</td>
<td>0.4285</td>
<td>2.0000</td>
<td>3.4285</td>
<td>8.8571</td>
<td>1.5428</td>
<td>1.1428</td>
<td>1.1428</td>
<td>19.9714</td>
</tr>
<tr>
<td>Traditional Method (5 acres or less)</td>
<td>21</td>
<td>-0.3809</td>
<td>0.6190</td>
<td>-1.5238</td>
<td>0.9524</td>
<td>1.2333</td>
<td>0.7619</td>
<td>0.7619</td>
<td>3.1571</td>
</tr>
<tr>
<td>(6 acres or more)</td>
<td>27</td>
<td>1.1851</td>
<td>0.0370</td>
<td>1.2592</td>
<td>2.4444</td>
<td>1.777</td>
<td>1.0370</td>
<td>1.0370</td>
<td>7.6592</td>
</tr>
<tr>
<td>Learning Module (Para-Professional) (5 acres or less)</td>
<td>10</td>
<td>-1.8000</td>
<td>2.0000</td>
<td>-5.0000</td>
<td>3.4000</td>
<td>0.3600</td>
<td>-0.2000</td>
<td>-0.2000</td>
<td>4.2600</td>
</tr>
<tr>
<td>(6 acres or more)</td>
<td>10</td>
<td>-0.2000</td>
<td>1.9000</td>
<td>-3.0000</td>
<td>1.8000</td>
<td>1.5600</td>
<td>1.4000</td>
<td>1.4000</td>
<td>8.3600</td>
</tr>
</tbody>
</table>
IMPLICATIONS

In view of the results of this study, the following implications are presented:

1. The use of learning modules resulted in an increase in farmers knowledge and understanding of weed control technology. Therefore, learning modules appear to be an effective method of communicating modern technology to low income vegetable farmers.

2. Farmers who were exposed to the modules made higher scores on the post-test than farmers in the traditional classes. Generally, farmers in the module groups viewed the modules as a challenge and exhibited a more positive attitude toward the modules. Therefore, the use of learning modules to teach horticultural technology to low-income vegetable farmers may provide specialists, agents, and para-professionals an effective alternative to traditional teaching methods.

3. The modules appeared to be flexible such that they can be effectively adopted for individual or group learning situations.

4. The learning modules as developed by the researcher appear to be an effective means for vegetable specialists to provide learning experiences without the presence of the specialist.

5. The results obtained from use of the modules by para-professionals indicate that they can be an effective teaching tool for para-professionals in making home visits to train farmers as well as providing training programs for small groups.
6. The results obtained by para-professionals after making individual appointments with farmers to participate in the weed control program indicates that the learning module can be an effective source of information for part-time vegetable farmers who find it difficult to attend training meetings because of working hours.
RECOMMENDATION

From the results obtained in this study, the author proposes the following recommendations:

1. Since very little research has been conducted on learning modules developed for small vegetable farmers, the researcher recommends that further studies be conducted that will contribute to and confirm or corroborate results of existing studies.

2. In developing modules for future study with small farmers, consideration should be given to reducing the amount of information presented in each module.

3. Writers developing new modules should give careful consideration to developing modules that take into account the characteristics of the farmers for which the program is intended.

4. Future studies with para-professionals should investigate the relationship between para-professionals' knowledge and the actual performance of the farmers.

5. When conducting future studies researchers should consider using larger sample sizes and develop a system that would insure equal sample sizes.

6. A cost analysis study should be conducted to determine the difference in the operation of a module vs. traditional teaching methods for county extension agents and/or para-professionals.
SUMMARY AND CONCLUSION

This study sought to compare the performance of small vegetable farmers trained by the traditional lecture-discussion method of teaching weed control practices with farmers trained by learning modules and to study various ways of using the learning modules. The minor objective of the study was to evaluate the differences, if any, in learning information presented by a learning module by farmers with different ages, educational levels, farm sizes, farm tenure, prior use of herbicides and sexes.

The study began during the summer of 1978 and was completed during the latter part of the fall of 1979. It was divided into two stages, a developmental stage which was conducted during the late summer of 1978 and spring of 1979, and the testing stage which was conducted in late summer and fall of 1979.

The subjects participating in the study were small vegetable farmers in St. Landry Parish in Louisiana, and Copiah, Jefferson Davis, and Simpson Counties in Mississippi. These vegetable farmers were participating in small farmer training programs funded by CETA. The farmers who participated in this study were selected at random and divided into four treatments which included the following:

Treatment I, farmers exposed to module in groups under professional supervision.

Treatment II, farmers exposed in a group to traditional lecture-discussion instruction under professional supervision.
Treatment III, farmers exposed to module in groups under para-professional supervision.

Treatment IV, farmers exposed to the modules individually under para-professional supervision.

A total of 148 small vegetable farmers participated in the study, 58 from St. Landry Parish and 90 in the three county areas in Mississippi.

Farmers participating in the module treatments received all of their instructions from the learning modules developed by the researcher. Subjects in the traditional treatment received all of their instructions in lecture-discussion groups using traditional visuals.

Program content for the two groups consisted of units of instruction which emphasized: (1) the importance of weed control and weed classification, (2) weed identification, (3) cultural weed control methods, (4) chemical weed control, (5) herbicide sprayers, (6) sprayer calibration and (7) herbicide safety and recommendations.

Data for the study was collected using pre- and post questionnaires. The pre-test was administered just before farmers were exposed to the weed control program. The post-test was administered seven days after completing the program. Both pre- and post-tests were graded and coded for analysis. The following results were obtained. The comparison of Treatments I, III, and IV the learning module treatments and Treatment II the traditional teaching method resulted in a highly significant difference in favor of the learning
modules treatments. Farmers in the module treatments made significantly higher mean gains than the traditional treatment on all seven subtests of the weed control program and for the total test. A comparison of other module groups indicated that farmers exposed to the learning modules in groups under professional supervision performed significantly better than farmers exposed to the learning modules in groups under para-professional supervision. A comparison of farmers exposed to the modules individually with those in groups under para-professional supervision indicated that farmers exposed to the module individually performed significantly better than all other module treatments.

Based upon the results previously discussed, the interaction of sex and treatment group and farm size and treatment group had very little bearing on the relative effect of the four instructional methods. The interaction of sex and instructional method and farm size and instructional method were true on only one subtest. Subtest E, Sprayer Calibration, was the site of interaction for sex while Subtest A, Weed Classification, was the site of interaction for farm size. The interaction of instructional method by sex was significant only for Subtest F. It had no effect on the outcome of the total test. The F-ratio for instructional method by sex interaction for the total test was only 0.42. The F-ratio for the interaction of instructional method by farm size was significant only for Subtest A. No other subtest approached significance. The F-ratio for the total test was non-significant, only 0.45. It was, therefore, concluded that
the interaction of the two factors discussed above had little if any
bearing on the relative effects of the instructional methods.

The first major comparison of learning modules and traditional
teaching produced a highly significant difference in favor of the
learning modules. Subsequent hypothesis sought to compare various
uses of learning modules for possible uses with small vegetable
farmers. In this study it was concluded that farmers exposed to the
modules individually under the supervision of para-professionals were
superior to all other methods. Group exposure to the modules under
professional supervision was also very effective, yet somewhat
inferior to individual exposure. Farmers exposed to the learning
modules in groups under para-professional supervision made lower
mean gain than the other module groups. However, even the module
group under para-professional supervision was still significantly
more effective than the traditional methods.
BIBLIOGRAPHY
BIBLIOGRAPHY


35. Pressey, S. L. 1962. Basic Unresolved Teaching Machines Problems. Theory Into Practice,


APPENDIX A

LEARNING MODULES
1. General Objective:

Farmers will become more proficient, in the knowledge and understanding of the importance of weed control and weed classification.

2. Specific Objective:

Farmers will demonstrate their understanding of the importance of weed control by giving a correct response to each of the ten questions at the end of the module.
1. PICTURE OF PLANTS
   All plants have some useful purpose in nature. They may add a bit of natural color to the landscape.

2. SOIL EROSION
   They may prevent soil from being washed away in heavy rain.

3. ORGANIC MATTER IN SOIL
   When plants die they add rich organic matter to the soil.

4. WEED IN FIELD
   A plant becomes a weed when it begins to compete or interfere with our attempt to grow crops.

5. NUTRIENT, WATER, LIGHT
   Weeds become an expensive nuisance when consideration is given to the amount of nutrients, water and light they take away from crops.

6. 5 BILLION DOLLARS
   The lost due to weed is the largest single cost to all pest control in crop production. Each year farmers loose more than 5 billion dollars because of weeds.

7. 12 BILLION DOLLARS
   The total cost to agriculture as a result of best is slightly over 12 billion dollars. Of this amount, the annual cost resulting from plant disease is about 27%, insects 28%, nemotodes 3% and weeds 42%, almost one half of the cost.

8. ONE-HALF
   About half of the cost of weed control is due to decreased yield. Losses due to weeds in vegetable crops can easily mean the difference between success and failure.

9. GROFT ON CARROT WEED CONTROL
   Several studies has been conducted to determine the effects of weed on the yield of vegetables. In one study fields of carrots was allowed to grow with 100% weed control. 85% weed control and 50% weed control.

   EFFECTS OF WEEDS ON CARROT YIELD
   In the field where 100% weed control was obtained the total return was $1000. Where 85% weed control was obtained the returns
were reduced to $220. And where only 50% weed control was obtained the total return was reduced to just $91.

10. GOOD WEED CONTROL

Therefore, in vegetable production it is impossible to produce a good crop without good weed control.

11. WEED IDENTIFICATION

Successful weed control requires a positive identification of weeds and understanding of their life history, because weeds that live for only one year maybe controlled by one practice while those that live for a number of years require an entirely different type of control practice.

12. MAN IDENTIFYING WEEDS

A thorough knowledge of when and how weeds grow and reproduce will help us decide on what method of control to use. No one can be expected to know every weed by name, therefore, it is necessary to group weeds into those categories that are alike in some way.

13. STUDYING MANUAL ON WEED IDENTIFICATION

The first step in any weed control program is the recognition of weeds and their life cycle.

14. LIFE CYCLE

A life cycle is the time required for a plant to grow from a seed, produce flower and seed then die.

15. ANNUAL BIENNIAL PERENNIAL

Plants are divided into three classes according to the type of life cycle: annual, biennial, and perennial.

16. ANNUALS

First, are the annuals. These plants are called annual plants because they complete their life cycle in one year.

17. CHICKWEED

The chickweed is a good example of an annual plant.
<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.</td>
<td>Year Cycle</td>
<td>It sprouts, produces seed, and dies in one year.</td>
</tr>
<tr>
<td>19.</td>
<td>Winter Annuals and Summer Annuals</td>
<td>Annual weeds begin their life cycle at two different times of the year and are divided into two groups — summer annuals and winter annuals.</td>
</tr>
<tr>
<td>20.</td>
<td>Giant Ragweed</td>
<td>The Giant Ragweed is an example of the summer annual.</td>
</tr>
<tr>
<td>21.</td>
<td>Life Cycle Summer Annuals</td>
<td>It sprouts in early spring when the soil is warm, produces flowers during the summer, sets seeds in the fall, and dies in early winter. The seeds spend the winter in the soil, and start the cycle over when the spring arrives. Therefore, we call them summer annuals.</td>
</tr>
<tr>
<td>22.</td>
<td>Winter Annuals</td>
<td>Winter annuals usually sprout in the fall during the cool season and make much of their growth during the winter. They flower in the spring, set seeds and die in early summer.</td>
</tr>
<tr>
<td>23.</td>
<td>The Sow Thistle</td>
<td>The Sow Thistle is an example of a winter annual.</td>
</tr>
<tr>
<td>24.</td>
<td>Control of Annual Weeds</td>
<td>In controlling annual weeds, the major objective is to prevent the weed from competing with crop and to prevent them from going to seed.</td>
</tr>
<tr>
<td>25.</td>
<td>Dacthal</td>
<td>In vegetable crops, annual weed may be controlled with chemicals such as Dacthal or with tillage. However, any method of weed control that will prevent them from going to seed is effective. The best control method is one that will kill them while they are germinating or as soon as germinating as possible.</td>
</tr>
<tr>
<td>26.</td>
<td>Biennial</td>
<td>A second group of weeds is the biennials. Biennials require two years to complete their life cycle.</td>
</tr>
<tr>
<td>27. FIRST YEAR BIENNIAL</td>
<td>The first year they come up and grow but produce no fruit.</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>28. SECOND YEAR BIENNIAL</td>
<td>During the second year, the biennial flowers, produces seeds and dies.</td>
<td></td>
</tr>
<tr>
<td>29. PLANT BEFORE AND DURING SEEDING</td>
<td>Biennial weed can be controlled anytime before they produce seeds. However, they are best controlled while they are germinating or as soon after germinating as possible.</td>
<td></td>
</tr>
<tr>
<td>30. PERENNIAL</td>
<td>Perennial weeds make up a third group. Perennial weeds live for more than two years. They often lose their leaves in winter and die back to their main stem or to the ground and then put out new foliage in the spring.</td>
<td></td>
</tr>
<tr>
<td>31. DANDELION</td>
<td>A good example of a perennial weed is the dandelion.</td>
<td></td>
</tr>
<tr>
<td>32. RHIZOMES, STOLONS, TUBERS</td>
<td>Annuals and biennials grow only from seeds, but perennials may grow from seeds or from rhizomes, stolons and tubers.</td>
<td></td>
</tr>
<tr>
<td>33. PERENNIAL—SIMPLE, CREEPING, BULB</td>
<td>Perennials fall into three subgroups: Simple perennials, creeping perennials, and bulbous perennials.</td>
<td></td>
</tr>
<tr>
<td>34. SIMPLE PERENNIAL</td>
<td>Simple perennials spread by seed only, but if the plant's roots are broken into pieces each piece can produce another plant.</td>
<td></td>
</tr>
<tr>
<td>35. CREEPING PERENNIAL, SEED RHIZOMES, STOLONS</td>
<td>A second subgroup is called creeping perennials, these perennials spread by seed, rhizomes and stolons.</td>
<td></td>
</tr>
<tr>
<td>36. RHIZOMES</td>
<td>For example, rhizomes are flesh stem found under soil surface that are capable of sprouting new plants.</td>
<td></td>
</tr>
<tr>
<td>37. STOLONS</td>
<td>These creeping perennials may also spread by above ground stems called stolons.</td>
<td></td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>38. BULBOUS PERENNIALS</td>
<td>The third subgroup is the bulbous perennials. Bulbous perennials reproduce by bulbs, bulblets and seeds.</td>
<td></td>
</tr>
<tr>
<td>REPRODUCED BY BULBS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BULBLETS SEEDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39. SEED</td>
<td>These perennials spread by seed.</td>
<td></td>
</tr>
<tr>
<td>40. NUTGRASS</td>
<td>Bulbs or nut-like structures which form on the roots of some weeds such as Nutsedge.</td>
<td></td>
</tr>
<tr>
<td>41. SIGNAL GRASS</td>
<td>In controlling perennial weeds, care must be taken to use methods that will kill the weed rather than cutting up pieces of roots and spreading the weed in the field. Some shallow rooted perennials can be controlled by tillage. The root of the plant is cup up and pulled to the top of the soil surface where it dies as a result of drying out. A good example of this type of perennial is the signal grass.</td>
<td></td>
</tr>
<tr>
<td>42. ROUND-UP</td>
<td>Perennial weeds can best be controlled with a good herbicide that will kill the roots as well as the top of the plant. Such as round-up.</td>
<td></td>
</tr>
<tr>
<td>43. WEED CLASSIFICATION</td>
<td>We can also divide weeds into the grasses, the broad-leaves and the sedges.</td>
<td></td>
</tr>
<tr>
<td>44. GRASSES AND BROADLEAF</td>
<td>In vegetable production, we are concerned mainly with the grasses and the broad-leaves.</td>
<td></td>
</tr>
<tr>
<td>45. CHARACTERISTICS</td>
<td>They both have distinctive characteristics.</td>
<td></td>
</tr>
<tr>
<td>46. ROOTS OF GRASSES</td>
<td>The roots of grasses are fiberous and form a thick network of roots in the soil.</td>
<td></td>
</tr>
<tr>
<td>47. ROOTS OF BROADLEAF</td>
<td>The broadleaf weeds have one main root called a tap root with secondary rootlets attached to it.</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>48. STEM OF GRASSES AND BROADLEAF</td>
<td>Grasses have many single stems. Broadleaf weeds tend to be branched and have the appearance of small trees.</td>
<td></td>
</tr>
<tr>
<td>49. FLOWERS OF GRASSES AND BROADLEAF</td>
<td>Grasses have inconspicuous flowers. The flowers of the broadleaves are usually bright and showy. Morning glory is a good example of a broadleaf flower.</td>
<td></td>
</tr>
<tr>
<td>50. STEMS OF GRASSES VS. BROADLEAF</td>
<td>If we cut through the stems of grasses, we find that the grasses are usually hollow stems. When the stems of broadleaves are cut, it is discovered that the stems are solid.</td>
<td></td>
</tr>
<tr>
<td>51. NODES OF GRASSES</td>
<td>The nodes of the grasses are jointed and this is where the leaves arise.</td>
<td></td>
</tr>
<tr>
<td>52. NODES OF BROADLEAF</td>
<td>The nodes of broadleaves differ. Both branches and leaves originate from nodes.</td>
<td></td>
</tr>
<tr>
<td>53. GRASSES GERMINATING</td>
<td>When grasses germinate, the true leaves emerge from the ground first.</td>
<td></td>
</tr>
<tr>
<td>54. BROADLEAF LEAVES</td>
<td>In contrast, when broadleaf plants sprout, their seed leaves emerge first. True leaves appear somewhat late.</td>
<td></td>
</tr>
<tr>
<td>55. TYPES OF WEEDS ANNUAL BIENNIALS PERENNIALS</td>
<td>We've learned the life cycle and growth habits of weeds (Annuals, Biennials, and Perennials) and know the stage of growth when they are best controlled.</td>
<td></td>
</tr>
<tr>
<td>56. CONTROL METHOD</td>
<td>For annual and biennial weeds as well as simple perennials, almost any method is satisfactory before the plant produces seeds. However, the best control method is one that will kill the weed while it is germinating or as soon after as possible.</td>
<td></td>
</tr>
</tbody>
</table>
57. NUTS - BULBS  
STOLONS - RHIZOMES

Other types of perennials such as nuts, bulbs, stolons and rhizomes, require special methods of control.

58. WEED CONTROL METHOD

The exact method to use for a particular weed problem will depend on many factors. But now we are concerned only with the basic of weeds and weed control.

59. REVIEW

Now that we have discussed weed classification, let's pause and briefly review what we have discussed.

FIRST

First, Listen to the questions.

Respond to the question by answering true or false next to the appropriate number under Section I on the answer sheet given you at the beginning of the program.

REVIEW I

1. A PLANT BECOMES A WEED WHEN IT BEGINS TO COMPETE OR INTERFER WITH THE CROPS WE ARE GROWING FOR HOME OR MARKET.

__________ TRUE   _________ FALSE

2. THE LARGEST SINGLE COST FOR PEST CONTROL IN CROP PRODUCTION IS WEED CONTROL, BUT WITHOUT CONTROL, WEEDS GREATLY REDUCE CROP YIELD.

__________ TRUE   _________ FALSE

3. WEEDS COMPETE FOR NUTRIENTS, FERTILIZER, WATER, AND LIGHT WITH THE CROPS WE GROW.

__________ TRUE   _________ FALSE

4. CULTIVATION IS ONE OF THE BEST METHODS OF CONTROLLING PERENNIAL WEEDS.

__________ TRUE   _________ FALSE

5. THE LIFE CYCLE OF A WEED IS THE TIME REQUIRED FOR IT TO GERMINATE, GROW, PRODUCE SEED AND DIE.

__________ TRUE   _________ FALSE
6. **PLANTS ARE DIVIDED INTO THREE CLASSES ACCORDING TO THEIR LIFE CYCLES. THEY ARE ANNUALS, BIENNIALS, PERENNIALS.**

   ________TRUE  ________FALSE

7. **ANNUAL PLANTS COMPLETE THEIR LIFE CYCLE IN ONE GROWING SEASON. THEY ARE DIVIDED INTO TWO GROUPS: SUMMER ANNUALS AND WINTER ANNUALS.**

   ________TRUE  ________FALSE

8. **ANNUALS AND BIENNIALS GROW FROM SEED BUT PERENNIALS MAY GROW FROM SEED, RHIZOMES, STOLONS, TUBERS, BULBS, AND SUCKERS.**

   ________TRUE  ________FALSE

9. **IN CONTROLLING PERENNIAL WEEDS, CARE MUST BE TAKEN TO USE METHODS THAT KILL THE WEED RATHER THAN THOSE WHICH CUT THE ROOT AND STEMS INTO PIECES AND SPREAD THEM IN THE FIELD. THEY CAN BEST BE CONTROLLED WITH A GOOD HERBICIDE THAT WILL KILL THE ROOT SYSTEM OF THE PLANT AS WELL AS THE TOP.**

   ________TRUE  ________FALSE

10. **WHEN BROADLEAF PLANTS COME UP, THEIR SEED LEAVES SPREAD FIRST. TRUE LEAVES APPEAR SOMewhat LATER, BUT WHEN GRASS FIRST COME UP THEIR TRUE LEAVES APPEAR FIRST.**

    ________TRUE  ________FALSE

**KEY TO REVIEW I**

1. True 6. True
2. True 7. True
3. True 8. True
4. False 9. True
5. True 10. True

If you failed to answer any of the questions correctly you should go back and review Section I. However, if all questions were answered correctly, you are ready to go on to Section II.
1. **General Objective:**

Farmers will become more proficient in the knowledge and understanding of weed identification.

2. **Specific Objective:**

Farmers will demonstrate their understanding of weeds by correctly identifying ten common weeds.
So far we have discussed weed classification. We have learned that weeds can be divided into groups depending on their life cycle. They are annuals, biennials, and perennials.

The annuals complete their life cycle in one year, and are classified as either summer or winter annuals.

The biennials complete their life cycle in two years. They produce seeds only in the second year.

The perennials live for several years and can spread by seed or by rhizomes, stolons or bulbs.

We have discussed only the grasses and the broadleaves, each of which has its own characteristics. But with a basis understanding of the types of weeds and the principles of controlling them, we are now ready to learn the identification of particular weed species.

Most weeds have common names such as Cocklebur or Crabgrass. The problem with common names is that people in different places often use different names for the same plant.

However, there are standardized common names that are used by most people and will avoid the confusion that occurs with using names that are only common to your community, for example, cocogras.

The proper name for Cocogras is Nutsedge.
Recommendation on herbicide labels and in research publications generally use standardized common names. You need to be able to identify weeds by standardized common names so you can choose the proper herbicide and find control information in weed control manuals.

Let's take a look at some common weeds that interfere with the production of Horticulture crops in Louisiana and Mississippi. First let's look at the broad-leaf annual weed such as the carpetweed.

The carpetweed is a summer annual because it germinated in the spring or early summer, produce seeds and die in early fall. The stem of the carpetweed is green and smooth. The plant branches along with the ground in all directions to form a flat mat. The leaves are small and tongue-like with five to six leaves at each joint. The carpetweed has small flowers and orange-red seeds. This weed is found on almost all cultivated soil.

The redroot pigweed is a summer annual. Notice that it's stem stands erect and grows as high as six feet tall. The stems of the redroot pigweed are rough textured and produces many branches. The plants have rather large dull green leaves. The pigweed has small green flowers located between the upper leaves and stems. The plant is found growing in cultivated fields, barnyards, fence rows and waste areas.
13. COMMON LAMBSQUARES

Common lambsquarters is a summer annual. The stem is erect with vertical ridges often with red or light green lines. The plant will grow one to six feet tall. The leaves are grayish-green with ragged tooth shaped edges. The young leaves are usually pouring-coated white. The plant has small green flower without petals. Common lambsquarters is spreaded by shiny black seeds with gray hulls. It is found in fields where most vegetables are grown.

14. RAGWEEED

The ragweed is a summer annual. It will grow one to six feet tall. The plant has smooth leaves that are deeply cut into several tooth shaped portions. The flowers are produced in slender clusters at the tip of the branches. Ragweeds are found in all kinds of cropland.

15. HAIRY GALINSOGA

Hairy Galinsoga is a summer annual. The plant has hairy branched stems that are 4 to 20 inches tall. The leaves are opposite with oval shape and a wavery margin. This plant produces small flowers with white petals. This weed is often found growing in most vegetable production areas.

16. COMMON COCKLEBUR

The common Cocklebur is a summer annual and is one of the most common weeds in vegetable production. It has a stout top root which makes it well adapted to drought conditions. It has a woody stem that will grow from one to six feet tall. The leaves are alternated on the stem. They are also rough-hairy dark to yellowish-green with a variable left margin. The mature seed is very hard and covered with hooked spines. The cockleber is found in almost all cultivated land except where control measures have been used.
17. TALL MORNINGGLORY
The Tall Morningglory is an annual weed. It has a twinning or trailing hairy stem. Its leaves are broad and heart-shaped. The flowers are funnel-like and they are in clusters of 3 to 5. The flowers are red, purple, blue, or white, with brown to black seeds. It is similar to the bigroot morning glory, but has larger leaves.

18. CYRESSVINE MORNINGGLORY
The Cypressvine Morningglory is a summer annual. It has a twinning vine with smooth stems. The leaves are divided and look feather-like. The cypressvine morning glory produces scarlet flowers that are funnel shaped. This weed is found growing in all cultivated fields. The leaves on this plant look similar to a Cypress.

19. SUNFLOWER MORNINGGLORY
The Sunflower Morningglory is a (Tievine) is a summer annual. It grows upright, or on the ground rapping around any plant in its path. The leaves are attached to the plant by long hairy leaf stems (petioles). Small white and blue flowers are closely crowded between the leaves at the top of the branches forming a tight cluster on the end of the branch. Sunflower Morningglory is often a problem in fields where vegetables are grown.

20. WOOLLY CROTON
Woolly Croton is a summer annual. The plant will grow one to three feet tall. Notice the plant has many branches with narrow leaves. Both the stem and leaves are hairy and grayish-green in color. The flower is produced in tight clusters at the end of the branches.
21. HEMP SESBANIA

Hemp Sesbania is a summer annual. It is found growing in most areas of the state where vegetables are grown. It is particularly plentiful in cultivated fields with wet fertile soil. The stem is green and becomes woody with age. It grows from three to eight feet tall. The leaves are long but divided into many small sections giving the appearance of a fern. The flowers are yellow and dotted with purple. The seed pods are cylindrical and look similar to a bean pod.

22. COMMON PURSLANE

Common Purslane is a summer annual. It can be found growing in most cultivated fields where control measures are not used. Common purslane has a very succulent reddish stem with many branches. The leaves are light green and in clusters on both of the main stems and branches. Notice the color, size, and shape of the leaves. Common purslane can withstand dry conditions for an extended period without being damaged. It is hard to kill.

23. FLORIDA PURSLANE

Florida Purslane is a summer annual. It has weak stems with many branches. All branches of the plant grow slanted upward. The leaves on the stems grow opposite each other on the stem. The leaves are yellow to dark green. Notice the white flowers that are crowded between leaves at the end of the stems. Florida purslane is found extensively in all sections of the state where vegetables are grown. Now that we have learned the broadleaf annual weeds let's take a look at the narrow leaf or grasses. The first is:
24. BROADLEAF SIGNAL GRASS

Broadleaf signalgrass is a summer annual. It is found growing in most fields where vegetables are grown. The stems grow upward forming an angle at the second or third joint (Node). Roots will develop at lower joints (Nodes). The leaf blades are relatively short but wide and smooth. The flowers are produced on an elongated shoot at the apex of the stem. Signalgrass will grow approximately two feet tall.

25. CHICKWEED

The chickweed is a winter annual. It is found growing in gardens, lawns, fields and nurseries. The plant has vigorous branching stems. Most of the stems grow along the ground while some branches grow upright. The plants may spread or grow for 4" to 12". The chickweed has very small egg shaped leaves. The leaves are smooth with lines of hairs on the Petioles (stem of leaf).

26. SOWTHISTLE

The sowthistle is a winter annual. The stem is smooth with green or purple branches. The leaves are complete with prickly edges that appear to be spiney. The sowthistle has small yellow flower beads on numerous branches. This plant is often found growing in fields where vegetables are grown.

27. WILD MUSTARD

The wild mustard is a winter annual that is often found growing in fields where vegetables are grown. The stems grow upright and branches out near the top. The lower leaves are much larger than the upper leaves. The flowers are located on the end of the branches in yellow clusters. The leaves are irregular and near the color of mustards found growing in the home garden.
28. CROWFOOTGRASS

Crowfootgrass is a summer annual. It is found in all cultivated fields. The stem produces many spreading branches. The seeds are borne on the short thick spikes that look like fingers. Crowfootgrass can survive long dry periods but can be easily controlled with good cultivation or with chemicals.

29. LARGE CRABGRASS

Large crabgrass is a summer annual. The stem grows both on the surface of the soil and upright. It has a smooth stout stem that produces roots at the nodes where the stem is in contact with the soil. The flowers and seeds are borne in clusters of 3 to 10 fingerlike structures on a single stem. The leaves of crabgrass are hairy with long leaf sheaths. Crabgrass is found everywhere.

30. BARNYARD GRASS

Barnyard grass is a summer annual. It has thick stems that grows 2 to 4-1/2 feet tall. It has smooth leaf sheaths and blades. The seeds are green to reddish purple, with conspicuous short stiff bristle. In this picture notice the seed at the top of the stem. Barnyard grass is found in all vegetable production areas of the state.

31. GOOSEGRASS

Goosegrass is a smooth stem summer annual that grows almost flat on the ground. However, it does not produce roots at each joint like crabgrass. The leaves are smooth and folded near the stem. The seeds are produced at the end of the stem forming a finger-like structure. Young goosegrass is often confused with crabgrass, but it is a darker green. Goosegrass is a problem in most vegetable production areas.
32. ANNUAL BLUEGRASS

Annual bluegrass is a winter annual. The stems are flattened and grow up to six inches tall. The leaves are very soft, light green and boat shaped at the top. Annual bluegrass grows extensively in fields where vegetables are grown in this area. The weeds just discussed are all annual weeds and will produce seed in one year or less. However, they can easily be controlled with good cultivation or with a recommended herbicide. Let's look now at the broadleaf perennial weeds. They look very much like broadleaf annual weeds but live for three or more years. A good example is the:

33. DANDELION

The dandelion is a perennial weed with thick fleshy roots, but no stem. The leaves are simple with many lobes and they are rosette from their crown. When the leaves are cut or broken, a milky juice will run out of the broken portion of the leaf. Dandelions produce yellow flowers that are borne on long bare hollow stalks. Dandelions may be found in all areas where vegetables are grown.

34. BIGROOT MORNING GLORY

The bigroot morning glory is a perennial weed. It has a greatly enlarged yellowish white root. The stems are purplish. The leaves are heart-shaped with smooth long petioles. The flowers are white and funnel-shaped with purple center. The plant looks similar to a sweet potato vine. Now that we have learned to identify the broadleaf perennials let's look now at the perennial grasses.

35. BERMUDAGRASS

Bermudagrass is a perennial weed. It is propagated by seed, surface creeping stems (stolons) and rootstocks (rhizomes). The flowers and seeds are produced upright on finger-like flower clusters. Bermudagrass is found in all areas of the state where vegetables are grown. It is a real pest to control on farms where chemicals are not used.
36. TORPEDOGRASS

Torpedograss is a perennial weed. It grows up from one to three feet tall. Notice how it grows upward from the joint creeping rhizomes. The leaves on torpedograss are flat or folded. The weed is found most abundant on sandy soil.

37. JOHNSONGRASS

Johnsongrass is a perennial grass. Its stem will grow up to six inches tall. The nodes on Johnsongrass will produce roots if they come in contact with the soil surface. Johnsongrass can reproduce itself from seed, pieces of stem roots or from rhizomes. The leaves of Johnsongrass are smooth and up to 15 to 20 inches long. The stem stands upright like sorghum. Johnsongrass is found growing in cultivated fields in all sections of the state.

38. BROOMSEDGE

Broomsedge is a perennial weed. Each plant has several stems growing from the base of the plant. The leaves are green to reddish-purple turning to various tints of straw color upon maturity. The seeds are borne with fine white silky hairs. Broomsedge is usually not a real difficult weed to control but it does cause problems on all fields when they are being put back into production.

39. YELLOW NUTSEDGE

The yellow nutsedge is a perennial weed that is reproduced by seed, rhizomes and tubers. It has a slender stem that has three angles and will grow one-half to three feet tall. The leaves are connected at the base of the plant except for the leaf-like brackets at the seed head. Yellow nutsedge is yellowish green in color and it is found growing in most vegetable crop areas of the state.
Purple nutsedge is a perennial weed similar to yellow nutsedge, except the plants are smaller, darker green with reddish-purple seed heads. Purple nutsedge is reproduced by rhizomes radiating, from the first plant, bulbs in series, forming tuber chain or seed.

Now we have learned to identify some of the most popular weed found growing in this area, let's pause and briefly review what we have learned.

REVIEW II

1. A. Pigweed 6. A. Broomedge
   B. Sowthistle   B. Goosegrass
2. A. Cocklebur 7. A. Bermudagrass
   B. Lambsquarter B. Nutsedge
3. A. Ragweed 8. A. Smutgrass
   B. Wild Mustard  B. Crabgrass
4. A. Cypressvine Morning Glory
   B. Tall Morning Glory
5. A. Nutsedge (Cocograss) 10. A. Annual Bluegrass
   B. Annual Bluegrass B. Bermuda Grass

KEY TO REVIEW II

1. A 6. A
2. A 7. A
3. A 8. B
4. B 9. A
5. A 10. A

If you failed to identify any of the weeds, you should review Section II. However, if you identified all of them correctly, you are ready to go to Section III.
1. **General Objective:**

   The objective of this module is for farmers to become knowledgeable of weed control.

2. **Specific Objectives:**

   1. Farmers will learn the importance of preventing the spread of weeds from field to field.
   2. Farmers will learn the value of controlling weeds by cultural methods.
   3. Farmers will learn the type of equipment used for mechanical weed control.
   4. Farmers will acquire knowledge of biological weed control.

3. **Behavior Objective:**

   When farmers have completed this module they will demonstrate their knowledge of the basic weed control methods by giving a correct response to the questions at the end of the module.
1. PULLING BY HAND

Weed control is as old as Agriculture. It is one of the most expensive steps in the crop production. However, with recent advances in weed technology, we quickly reduce losses caused by weeds.

2. WEED CONTROL METHODS

1. PREVENTING THE SPREAD OF WEEDS
2. CULTURAL CONTROL
3. MECHANICAL CONTROL
4. BIOLOGICAL CONTROL
5. CHEMICAL CONTROL

There are five methods of weed control:
1. Preventing the spread of weeds
2. Cultural control
3. Mechanical control
4. Biological control
5. Chemical control

3. PREVENTING THE SPREAD OF WEEDS

The best method of control is to prevent weeds from spreading into your field.

4. IMPURE SEEDS

There are three areas in which we should deal with in our attempt to reduce the spread of weeds. The first is (1) reducing or eliminating the use of impure seeds; impure seeds are those that contain a mixture of other weeds.

5. IRRIGATION CHANNEL

A second way to keep weed out of your field is to: (2) eliminate the spread of weed seeds through irrigation systems. This is very difficult because of the many ways weed seeds can enter the irrigation ditches. However, a great deal can be done to reduce the spread of weed in the irrigation water by keeping the banks and ditches of irrigation channels free of weeds.

6. CULTIVATION CONTAINING WEED SEED IN SOIL

And a third way to prevent the spread of weeds is to keep your farm machinery and other equipment clean so that they are not spreading weeds.
<table>
<thead>
<tr>
<th>7. CULTURAL CONTROL METHODS</th>
<th>Cultural weed control is the second method of weed control. There are three common used cultural weed control methods: 1. Plant competition 2. Mulching 3. Crop rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. COMPETITIVE CROP</td>
<td>Crop competition is one of the cheapest and most useful methods of weed control. It means using the crop production methods that favor crop growth rather than weed growth.</td>
</tr>
<tr>
<td>9. CROP GROWING BEFORE WEED</td>
<td>Such as planting early before certain weeds began to germinate or planting crops that will smother the weed.</td>
</tr>
<tr>
<td>10. VIGOROUS WEED</td>
<td>In crop production weeds are sometime more successful than the crops because under certain conditions, the weeds grow faster than the crop.</td>
</tr>
<tr>
<td>11. CABBAGE</td>
<td>Strong germinating seeds will give the crop a vigorous, close stand which will give the crop a head start on the weed, making it difficult for them to grow.</td>
</tr>
<tr>
<td>12. POOR STAND OF CORN</td>
<td>If you use poor seed, it will result in a spotty stand, and will leave open areas in which the weeds will take over, thus dominating the crop.</td>
</tr>
<tr>
<td>13. SWEET CORN</td>
<td>Crops such as sweet corn and southern peas are good competitors.</td>
</tr>
<tr>
<td>14. GARLIC</td>
<td>While bulb crops such as garlic are poor competitors.</td>
</tr>
<tr>
<td>15. CHINESE CABBAGE</td>
<td>Highly competitive crops are often planted for the primary purpose of reducing weed infestation.</td>
</tr>
</tbody>
</table>
Therefore, crop rotation for the purpose of growing highly competitive crops in weed infested areas is one of the simplest and most economical means of weed control.

A good rotation schedule would be to plant sweet corn during the first crop season. Then plant cabbage the second season.

Plant a vegetable such as okra the third crop season. And back to cabbage during the fourth cropping season.

Mulching. The use of mulch is one of the best methods of weed control. Although mulches are somewhat more expensive than other control methods, it is rapidly gaining popularity because it provides advantages other than weed control.

There are many types of materials used as a mulch. However, in recent years farmers have gone almost completely to black plastic.

There are several advantages of black plastic. It

1. Conserves moisture
2. Keeps soil from packing
3. Insures clean fruit
4. Hastens maturity
5. Increases yield
6. Reduces disease

When using plastic mulch, the entire bed is covered with the material.

The mulch is spreaded in the field with a mulch applicator which greatly reduces the amount of labor that would be required for hand application.
There are several advantages of a mechanical applicator:
1. Easy to use
2. Reduce labor requirement
3. Easy to construct, in fact many farmers make their own applicators

Before applying the mulch you should first (a) bed up your soil, then (b) firm and shape the bed so that the plastic mulch will fit firmly.

After firming the beds, plastic mulch can be mechanically applied.

At planting time vegetables are seeded or transplanted directly through the mulch.

Mechanical Weed Control
Mechanical Weed Control methods have been evolving since early man first realized that weeds were competing with the crops he was attempting to grow.

The first method of mechanical weed control was pulling by hand.

After the hand technique, which is still employed to some extent with most crops, comes the spear, and the

Introduction of early tillage method resulting finally in the hoe and
37. PLOW
Various forms of plows.

38. HOEING GARDEN
Hoeing is a popular method of weed control for small gardens and for most cultivated crops grown on limited areas. It is the most common and most widely used of all control methods.

39. HOEING
However, on most vegetable farms, hoeing is impractical on a large scale because of high labor cost. Yet some hoeing will be necessary in order to control weeds in areas of the field where other methods have failed.

40. IMPLEMENT TILLAGE
Tillage is physically breaking up the soil to destroy weeds and to prepare the seed bed.

41. TRACTOR PLOWING
The principal function of tillage is the destruction of weeds and the reduction of weed seeds in the soil.

42. ANNUAL WEED
Tillage is one of the most effective weed control methods available for annual weeds. Weeds such as common purslane and

43. CUTUP PIECES OF STOLONS
Wild mustards can be controlled by this method. However, tillage is not very effective on perennials. In most cases tillage tend to cutup pieces of weeds and spread them in the field.

44. PICTURE OF BERMUDAGRASS
Some shallow root perennials such as bermudagrass may be greatly reduced by plowing.

45. TYPES OF TILLAGE IMPLEMENTS
There are several types of tillage implements. A good example of some popular tillage implements are:
1. Disk
2. V-Shaped Harrow
3. Rotary Weeder
4. Bedding Disk
5. Cultivators
6. Spike-tooth Harrow.
46. DISK

**Disking.** The main purpose ofdisking is to destroy weeds and to loosen the soil. Disking should be either deep or shallow depending on the weed species and the season of the year. Disking is the first step in your weed control program. When your field is well disked you can greatly reduce your weed problem for the current year.

47. BEDDING DISK

The bedding disk can be used to bed up the soil when preparing to plant and to control weeds in the middles and side of the row when the crop is growing.

48. SPIKE TOOTH HARROW

The spike tooth harrow is used to smooth and level the soil just before planting. It will stir the soil to the depth of several inches, easily destroying young weeds as they germinate. Many annual weeds such as the cucklebur can be killed in very young stages by harrowing.

49. GARDEN PLOW

**Cultivators.** There are many types of cultivators ranging from the small garden tractor type to

50. CULTIVATORS

The 4 row tractor mounted mode. They may employ shovels, disk or sweeps depending on the situation.

51. V-SHAPED HARROW

One of the simplest and most widely used cultivator in vegetable production is the V-shaped harrow. This harrow is easily adopted to a variety of crops and does a good job of destroying young weeds. The V-shaped harrow is an important and necessary piece of equipment for each farm operation.

52. ROTARY WEEDEER

The rotary weeder is a useful piece of cultivating equipment for all vegetable farmers. It destroys germinating weeds around young crops and break up any crust formation that hinders crop growth.
53. BIOLOGICAL CONTROL

Biological Weed Control
The most effective method of controlling weeds is one in which their natural enemies are set to attack them. However, the problem with introduction and utilization of these enemies of weeds is that most noxious weeds have close related species that are important crop plants and the introduction of the enemies might mean the destruction of some important crops as well. Therefore, biological control is not an important weed control method.

REVIEW
We have discussed four methods of weed control; preventing the spread of weeds, cultural control, mechanical control and biological control. Let's pause now and briefly review what has been discussed.

FIRST
Listen to the questions then mark your answer true or false next to the appropriate number on the answer sheet given you at the beginning of the program.

REVIEW III

1. THE FOUR IMPORTANT METHODS OF WEED CONTROL ARE: (1) PREVENTING THE SPREAD OF WEEDS INTO YOUR FIELD, (2) MECHANICAL CONTROL SUCH AS HOEING AND CULTIVATION, (3) CULTURAL CONTROL SUCH AS CROP ROTATION AND MULCHING, AND (4) CHEMICAL WEED CONTROL WITH HERBICIDES.

_________ TRUE _________ FALSE

2. THREE IMPORTANT WAYS OF PREVENTING THE SPREAD OF WEEDS ARE: (1) ELIMINATING THE USE OF IMPURE SEED, (2) ELIMINATING THE SPREAD OF WEEDS THROUGH THE IRRIGATION SYSTEM, (3) REMOVING SOIL AND PLANT DEBRIS FROM EQUIPMENT USED IN FARMING SO THAT THEY ARE NOT SPREADING WEEDS WHEN GOING FROM FIELD TO FIELD.

_________ TRUE _________ FALSE
3. CROP COMPETITION IS ONE OF THE CHEAPEST AND MOST USEFUL METHODS OF WEED CONTROL. IT MEANS USING PRODUCTION METHODS THAT FAVOR CROP GROWTH RATHER THAN WEED GROWTH, SUCH AS GROWING CROPS THAT ARE MORE VIGOROUS THAN WEED, TRANSPLANTING THE CROP TO GIVE IT A HEADSTART AND SEEDING IMMEDIATELY AFTER THE LAST TILLAGE TO AVOID GIVING THE WEEDS A HEADSTART.

_______TRUE _______FALSE

4. CROP ROTATION AS A MEANS OF WEED CONTROL IS GROWING TWO OR MORE CROPS IN REGULAR SEQUENCE ON THE SAME FIELD SO THAT WEEDS ARE DIFFICULT TO CONTROL WITH ONE CROP CAN BE CONTROLLED WITH THE OTHER.

_______TRUE _______FALSE

5. THE MOST POPULAR MECHANICAL WEED CONTROL METHODS ARE PULLING BY HAND AND DESTROYING WEEDS WITH A HOE.

_______TRUE _______FALSE

6. THE MOST IMPORTANT OBJECTIVE OF CULTIVATION IS THE DESTRUCTION OF WEED AND THE REDUCTION OF WEED SEEDS.

_______TRUE _______FALSE

7. CULTIVATION IS ONE OF THE MOST EFFECTIVE WEED CONTROL METHODS FOR PERENNIAL WEEDS.

_______TRUE _______FALSE

8. DISKING IS ONE OF THE FIRST AND MOST IMPORTANT STEPS IN YOUR WEED CONTROL PROGRAM.

_______TRUE _______FALSE

9. THE ROTARY WEADEER IS A VERY IMPORTANT PIECE OF CULTIVATION EQUIPMENT FOR DESTROYING YOUNG WEEDS. IT IS ALSO USEFUL FOR INCORPORATING HERBICIDES AND LOOSENING THE SOIL BEFORE PLANTING.

_______TRUE _______FALSE

10. BIOLOGICAL WEED CONTROL IS A POPULAR METHOD OF WEED CONTROL BECAUSE THE NATURAL ENEMIES OF THE WEED WILL ATTACK AND COMPLETELY DESTROY IT.

_______TRUE _______FALSE

Now that you have responded to the questions let's check your answer to see how well you have done.
KEY TO REVIEW III

1. True 6. True
2. True 7. False
3. True 8. True
4. True 9. True
5. False 10. False

If you failed to answer all of the questions correctly you should go back and review Section III. However, if you have answered all questions correctly you are ready to go on to Section IV.
1. General Objective:

The objectives of this module is for farmers to become knowledgeable of, and develop an understanding of Chemical Weed Control.

2. Specific Objectives:

1. Farmers will learn the types of herbicides.
2. Farmers will learn the proper time to apply certain herbicides.
3. Farmers will learn the methods of applying herbicides.

3. Behavior Objective:

When farmers have completed this module they will demonstrate their knowledge of Chemical Weed Control by answering correctly ten questions at the end of the module.
The use of chemicals for weed control has developed rapidly in the past twenty-five years. In some areas, farmers depend almost completely on chemicals for their weed control program. Chemicals are now being used more and more because they are effective, economical and give good results when used properly.

Chemicals used to control weeds are called herbicides.

There are two types of Herbicides:

A. Contact
B. Systemic

Contact Herbicides are usually sprayed on the foliage of the weed you wish to control. It is highly toxic and will kill or damage almost all plants shortly after making contact.

Contact Herbicides may be selective or non-selective.

Selective Herbicide are more toxic to some plants than they are to others. It will kill or injure some plants on contact without injuring others growing close by.

A good example of a selective contact herbicide is basagram on lima beans. When applied as a postemergence it will control weeds such as the cocklebur up to 6 inches high.

A non-selective contact herbicide will kill or injury all plants that it comes in contact with.

A good example of a non-selective contact herbicide is paraquat. It will kill or damage any plant it comes in contact with.
10. SPRAYING TO SPECIFIC SITE

Some non-selective contact herbicides, can be made selective by directing the spray to a specific area avoiding contact with the crop.

11. PLANT KILLED BY HERBICIDES

Most contact Herbicides will kill only the above ground part of the plant and are effective only against annual weeds.

12. SYSTEMIC HERBICIDES

Systemic Herbicides are taken up by leaves, stems and/or roots of the plant. It is then moved throughout the plant killing the roots as well as the top of the plant, which make it very effective on perennial weeds.

13. SYSTEMIC SELECTIVE
    NON-SELECTIVE

Systemic Herbicides may be selective or non-selective.

14. EPTAM

Eptam is an example of a selective systemic herbicide. Eptam is applied to the soil and incorporated before planting.

15. ROUND-UP

Round-Up is a good example of a non-selective systemic herbicide. It is taken up by the plant and moves to all parts of the plant killing the roots as well as the top of the plant. However, Round-Up is only recommended for use on fields between cropping seasons and not while vegetables are actively growing.

16. TYPES OF HERBICIDES

Both contact and systemic herbicides will play an important roll in your weed control program. Contact herbicides are most effective on annual weeds while systemic herbicides are most effective on perennial weed.
<table>
<thead>
<tr>
<th>17. TIME OF APPLICATION</th>
<th>However, if any herbicide is to be effective, it must be applied at the proper time. Herbicides may be applied at three different phases of crop growth; they are</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Emergence</td>
<td>1. Pre-Emergence</td>
</tr>
<tr>
<td>Pre-Plant</td>
<td>2. Pre-Plant</td>
</tr>
<tr>
<td>Post-Emergence</td>
<td>3. Post-Emergence</td>
</tr>
<tr>
<td></td>
<td>18. PRE-EMERGENCE</td>
</tr>
<tr>
<td></td>
<td>Pre-Emergence is the application of a herbicide to the soil surface before the crop or weed comes up.</td>
</tr>
<tr>
<td></td>
<td>19. GERMINATING WEED</td>
</tr>
<tr>
<td></td>
<td>It may also be referred to the application after the weeds comes up, but before the crop comes up.</td>
</tr>
<tr>
<td></td>
<td>20. FIELD PLANTED CUCUMBERS</td>
</tr>
<tr>
<td></td>
<td>For example, Alanap is applied on cucumbers after they are planted but before they come up.</td>
</tr>
<tr>
<td></td>
<td>21. PRE-PLANT</td>
</tr>
<tr>
<td></td>
<td>Pre-plant is applying the herbicide to the soil before the crop is planted.</td>
</tr>
<tr>
<td></td>
<td>22. INCORPORATION</td>
</tr>
<tr>
<td></td>
<td>Usually herbicides that are applied before planting are incorporated or mixed well in the top 1 to 1-1/2 inches of soil.</td>
</tr>
<tr>
<td></td>
<td>23. TREFLAN</td>
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<tr>
<td></td>
<td>A good example of a pre-plant herbicide is Treflan. Treflan is applied to the soil after it is bedded up, but before planting. It is then incorporated or well mixed within the 1 to 1-1/2 inch of soil.</td>
</tr>
<tr>
<td></td>
<td>24. POST-EMERGENCE</td>
</tr>
<tr>
<td></td>
<td>Post-Emergence is the application of Herbicides after the crop has emerged. It may also refer to the application of the herbicide after the crop and the weed has emerged.</td>
</tr>
<tr>
<td></td>
<td>25. BASAGRAN</td>
</tr>
<tr>
<td></td>
<td>An example of a post-emergence application of herbicide is the use of Basagran on lima beans.</td>
</tr>
</tbody>
</table>
It is important that you know and understand the time each type of herbicide should be applied. Pre-plant is before planting. Pre-emergence is after planting but before the crop comes up and Post-emergence is after the crop comes up.

Many herbicides are applied at different times. Therefore, it is important that you read the label on each type of herbicide so that you can be sure that it is applied at the proper time.

There are several methods of applying herbicides:
- Broadcast Spray
- Directed Spray
- Spot Treatment
- Soil Incorporation

Broadcast Spray refers to the uniform application of herbicides over the entire field.

Band Spray is the application of a herbicide over a narrow strip down the center of each row or it may refer to the spraying of a narrow strip between rows.

Band Spray is commonly used between rows especially in fields where plastic mulch is used.

In this field band spray has been used to control weed between rows of tomatoes.

Directed Spray is spraying herbicide directly at the weeds to avoid contact with the crop. This method often uses non-selective herbicide in order to prevent crop damage.
34. SPOT TREATMENT

Spot Treatment
Spot Treatment with a herbicide involves spraying in certain spots in the field where weeds are a problem and other weed control methods have failed.

35. SOIL INCORPORATION

Soil Incorporation
This term refers to the mixing of herbicides into the soil after application. Herbicides are usually incorporated 1 to 2 inches deep.

36. METHOD OF INCORPORATION

Herbicides can be incorporated by mechanical means or by rain or irrigation.

MECHANICAL
RAIN AND IRRIGATION

37. TRACTOR INCORPORATION

The V-shaped Harrow and rolling cultivators are used for mechanical incorporation.

HERBICIDE

38. IRRIGATED FIELD

There are some herbicides that require mechanical incorporation while others can be incorporated with rain or irrigation.

39. VEGEDEX

A herbicide such as Vegedex requires mechanical incorporation in the soil, yet in order to be effective rain or overhead irrigation is required within 7 to 10 days after application.

40. ALANAP

Other herbicides such as Alanap only require overhead irrigation or rainfall but it is more effective when incorporated lightly.

41. TYPES OF HERBICIDES

We have discussed the types of herbicides, contact herbicide and systemic herbicide both of which can be applied as a selective or non-selective herbicide.

CONTACT HERBICIDE
SYSTEMIC HERBICIDE

42. TIME OF APPLICATION

We have also discussed the time and method of application. We understand that several methods can be used with the same herbicide depending on when it is applied.

PRE-PLANT
PRE-EMERGENCE
POST-EMERGENCE
Let's pause now and briefly review what we have discussed in Section IV.

First, listen to the question, then mark your answer true or false next to the appropriate number under Section IV on the answer sheet given to you at the beginning of the program.

**REVIEW IV**

1. **CHEMICAL WEED CONTROL IS KILLING WEEDS WITH CHEMICALS EITHER BEFORE OR AFTER THEY COME UP.**
   
   ______ TRUE    ______ FALSE

2. **CHEMICALS USED TO CONTROL WEEDS ARE MOST EFFECTIVE WHEN WEEDS ARE OLD.**
   
   ______ TRUE    ______ FALSE

3. **A SYSTEMIC HERBICIDE IS TAKEN UP BY THE LEAVES, STEM OR ROOTS OF THE PLANT AND WILL MOVE OVER THE ENTIRE PLANT KILLING THE ROOTS AS WELL AS THE STEM.**
   
   ______ TRUE    ______ FALSE

4. **HERBICIDES CAN BE APPLIED PRE-PLANT, PRE-EMERGENCE OR POST-EMERGENCE TO THE CROP.**
   
   ______ TRUE    ______ FALSE

5. **SOIL INCORPORATION OF A HERBICIDE IS A PROCESS BY WHICH THE HERBICIDE IS MIXED INTO THE TOP 1 TO 2 INCHES OF THE SOIL.**
   
   ______ TRUE    ______ FALSE

6. **TREFLAN IS AN EXAMPLE OF A PRE-PLANT INCORPORATED HERBICIDE.**
   
   ______ TRUE    ______ FALSE
7. BROADCAST APPLICATION OF A HERBICIDE MAY REFER TO SPRAYING THE HERBICIDE OVER A NARROW STRIP IN THE CENTER OF THE ROW OR IT MAY REFER TO SPRAYING HERBICIDE OVER A NARROW STRIP BETWEEN ROWS.

_________ TRUE  _________ FALSE

8. BAND APPLICATION OF A HERBICIDE IS THE UNIFORM APPLICATION OF THE HERBICIDE OVER THE ENTIRE FIELD.

_________ TRUE  _________ FALSE

9. DIRECTED SPRAY IS SPRAYING THE HERBICIDE DIRECTLY AT THE WEED YOU WISH TO CONTROL AND AVOIDING CONTACT WITH THE PLANT.

_________ TRUE  _________ FALSE

10. SPOT TREATMENT WITH A HERBICIDE IS SPRAYING IN CERTAIN AREAS IN THE FIELD WHERE WEEDS ARE A PROBLEM AND WHERE THE REGULAR WEED CONTROL METHODS HAVE FAILED.

_________ TRUE  _________ FALSE

Now that you have responded to the questions let's go back check your answers to see just how well you have done.

KEY TO REVIEW IV

1. TRUE  6. TRUE
2. FALSE  7. FALSE
3. TRUE  8. FALSE
4. TRUE  9. TRUE
5. TRUE  10. TRUE

If you have failed to answer any of the questions correctly, you should go back and review Section IV. However, if you have answered all questions correctly you are ready to go on to Section V.
MODULE V

WEED CONTROL SPRAYERS

1. General Objective:
   The objective of this module is that farmers acquire knowledge and understanding of the operations of Weed Control Sprayers.

2. Specific Objectives:
   1. Farmers will learn the types of weed control sprayers.
   2. Farmers will learn the parts of the herbicide sprayer.
   3. Farmers will learn the types of spray tanks.
   4. Farmers will learn the types of spray pumps.

3. Behavior Objective:
   When farmers have completed this module they will demonstrate their knowledge of weed control by giving the correct answer to the question asked at the end of the program.
1. COMMERCIAL SPRAYER

There are many types of herbicide sprayers commercially available, and it is important that you select the type that is most effective and economically for your own farm operation.

2. HOMEMADE SPRAYER

Many farmers choose to save a little money on sprayers by buying separate parts and making their own. Well constructed homemade sprayers are more effective than commercial sprayers.

3. LOW PRESSURE

The most common herbicide sprayers are low pressure sprayers that are powered by the PTO of the farm tractor.

4. PARTS OF THE SPRAYER

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Power Source</td>
<td></td>
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<tr>
<td>2. Spray Tank</td>
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<tr>
<td>3. Agitator</td>
<td></td>
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<tr>
<td>4. Intake Filter Screen</td>
<td></td>
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<tr>
<td>5. Pump</td>
<td></td>
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<tr>
<td>6. Cut-off Valve</td>
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<tr>
<td>7. Pressure Regulator</td>
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<tr>
<td>8. Pressure Gauge</td>
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<tr>
<td>9. Bypass Valve</td>
<td></td>
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</tbody>
</table>

5. GASOLINE ENGINE

Power Source - The power source for the herbicide sprayer may be a self contained gasoline engine.

6. PTO OF FARM TRACTOR

Or the PTO on the farm tractor. Most sprayers are powered by the PTO of the farm tractor.

7. 55 GALLON DRUM SPRAY TANK

Spray Tank

The spray tank is a carrier for the spray material. The size tank should be determined by the size of the field to be sprayed and amount of liquid to be applied per acre. Many farmers use a 55 gallon drum as a spray tank. These rapidly corrode and may cause the nozzle to clog.
8. ALUMINUM SPRAY TANK

Aluminum and Fiberglass tanks are much less susceptible to corrosion, but are more expensive. However, some farmer's use cheap tanks and replace them every year.

9. AGITATORS

Agitators
Agitators are devices used in the spray tank to keep the herbicide well mixed. Agitators are important for all herbicides but they are especially important when using wettable powders or unstable emulsions.

10. TYPES OF AGITATORS

BYPASS AGITATOR
MECHANICAL AGITATOR

There are several types of agitators. The two most commonly used types are:
1. Mechanical Agitator
2. Bypass Agitator

11. AGITATORS

The mechanical agitator consist of a series of fan shaped blades which rotate on a shaft in the lower portion of the tank. This shaft is turned by the same power source that turns the pump.

12. BYPASS AGITATOR

Bypass Agitation occurs when liquid is returned to the tank from the bypass line through the agitation line at high pressure, thus keeping the spray materials mixed in the tank.

13. INTAKE FILTER SCREEN

Intake filter screen is a strainer that will prevent debris in the tank from clogging up the pump and nozzles.

14. PUMP

There are basically two types of pumps used on herbicide sprayers.
1. Roller pumps
2. Piston pumps
In this slide we see the roller pump. It operates directly from the PTO of your farm tractor and it is the most commonly used pump for weed control.
15. PISTON PUMP

Piston Pump. The Piston Pump is a high pressure and high volume pump. It is not very popular on weed control sprayers.

16. LOW PRESSURE PUMP

General purpose sprayers capable of use at high pressure or low pressure usually have plunger or piston pumps. However, since most herbicides are applied at low pressure, the low pressure roller pump are most often used.

17. ADVANTAGES OF ROLLER PUMP

1. Low Cost
2. Easy to Operate
3. Low Maintenance Cost

The advantage of roller pumps are low initial cost, easy to operate and low maintenance cost.

18. CONTROL VALVE

Sprayer Control Valve

The sprayer control valve is used to control the release of spray solution to the nozzles. It should be located on the tractor in a convenient place for the driver.

19. PRESSURE REGULATOR

The pressure regulator is used to control the spray pressure to the boom.

20. PRESSURE GAUGE

The pressure gauge is a meter used to indicate the amount of spray pressure being discharged to the nozzles. The best spray pressure is 40-60 PSI.

21. BOOM

The Boom

The purpose of the boom is to distribute the spray to the spray surface. It may vary in length depending on the size of the fields to be sprayed. However, the most common width is 12 to 20 feet long.

22. BOOM ADJUSTMENT

The boom should be adjusted in height so that when a broadcast spray is used spray from adjacent nozzles will slightly overlap at the top of the weeds or soil surface.
Nozzles control the rate and pattern of spray distribution to the spray surface. Nozzles come in many different shapes and sizes. The types used for weed control in vegetable production will be discussed later.

To briefly review the parts of a sprayer, let's trace the pathway of spray materials through this diagram of a sprayer. At the top of the spray system is the spray tank. Inside the tank we see a bypass agitator which leads from the agitation line.

At the bottom of the tank we find the tank shut-off and main line which leads to the strainer and from the strainer to the pump. The pump connects to the PTO of the tractor.

From the pump the spray material is forced through the main line which leads through the control valve to the Agitation line. The agitation line leads back to the bypass agitator located inside the tank. The material is also forced through the pressure gauge.

From the pressure gauge the material is forced to the spray surface. Excess spray material is forced back through the relief valve through the bypass line and back into the tank.

The nozzles control the rate and pattern of spray distribution. There are many types of nozzles. The type used depends on the specific jobs.
REVIEW

First, listen to the question and then mark your answer.

TRUE OR FALSE

True or false next to the appropriate number under Section V on your answer sheet given you at the beginning of the program.

REVIEW V

1. THERE ARE MANY TYPES OF HERBICIDE SPRAYERS THAT ARE COMMERCIAL AVAILABLE. SOME FARMERS PURCHASE SEPARATE PARTS AND MAKE THEIR OWN SPRAYER, BUT HOMEMADE SPRAYERS ARE USUALLY NOT AS EFFECTIVE AS COMMERCIAL SPRAYERS.

__________TRUE  ________FALSE

2. HERBICIDE SPRAYERS ARE USUALLY LOW PRESSURE SPRAYERS WITH A PUMP THAT IS POWERED BY THE PTO OF THE FARM TRACTOR.

__________TRUE  ________FALSE

3. FIFTY-FIVE GALLON DRUMS ARE SOMETIME USED AS A SPRAY TANK. HOWEVER, THEY SHOULD NEVER BE USED BECAUSE DRUMS CORRODE RAPIDLY AND WILL CAUSE NOZZLES TO CLOG.

__________TRUE  ________FALSE

4. THE AGITATOR IN THE SPRAY TANK IS USED TO KEEP THE HERBICIDES MIXED WHILE SPRAYING. IT IS IMPORTANT FOR ALL HERBICIDES BUT IT IS ESPECIALLY IMPORTANT WHEN USING WETTABLE POWDERS AND UNSTABLE EMULSIONS.

__________TRUE  ________FALSE

5. THE PURPOSE OF THE NOZZLES ARE TO DISTRIBUTE SPRAY TO THE SPRAY SURFACE.

__________TRUE  ________FALSE

_________ TRUE _________ FALSE  

7. THERE ARE BASICALLY TWO TYPES OF PUMPS USED ON HERBICIDE SPRAYERS, ROLLER PUMP AND PISTON PUMP. THE PISTON PUMP IS MOST COMMONLY USED BECAUSE IT IS A HIGH PRESSURE HIGH VOLUME PUMP.  

_________ TRUE _________ FALSE  

8. THE PRESSURE GAUGE IS A METER USED TO INDICATE THE PRESSURE AT WHICH HERBICIDES ARE BEING DISCHARGED. THE BEST SPRAY PRESSURE IS ABOUT 120 TO 140 PSI.  

_________ TRUE _________ FALSE  

9. THE SPRAY BY-PASS LINE ON THE SPRAYER RELIEVES SOME OF THE PRESSURE FROM THE CONTROL VALVE. IT LEADS BACK TO THE SPRAY TANK UNDER PRESSURE WHERE IT SERVES AS AGITATOR FOR THE MATERIAL INSIDE THE TANK.  

_________ TRUE _________ FALSE  

10. THE CONTROL VALVE OF THE SPRAYER IS USED TO STOP OR START THE FLOW SPRAY SOLUTION TO THE NOZZLES. IT SHOULD BE LOCATED ON THE TRACTOR IN A CONVENIENT PLACE FOR THE DRIVER.  

_________ TRUE _________ FALSE  

Now that you have responded to the questions, let's check your answer to see how well you have done.  

KEY TO REVIEW V  

1. FALSE  6. TRUE  
2. TRUE  7. FALSE  
3. FALSE  8. FALSE  
4. TRUE  9. FALSE  
5. TRUE  10. TRUE  

If you failed to answer any of the questions correctly, you should go back and review Section V. However, if you have answered all questions correctly you are ready to go on to Section VI.
1. General Objective:

The objective of this module is for farmers to acquire the knowledge and skills of Sprayer Calibration.

2. Specific Objectives:

1. Farmers will learn the importance of proper sprayer calibration.
2. Farmers will learn the steps in sprayer calibration.
3. Farmers will learn the value of a Knapsack Sprayer.
4. Farmers will learn the steps used to calibrate a Knapsack Sprayer.

3. Behavior Objective:

When farmers have completed this module they will be able to

1. Answer questions at the end of the module correctly.
2. Demonstrate their knowledge of sprayer calibration by correctly calibrating a Boom and Knapsack Sprayer.
1. **SPRAYER CALIBRATION**
   One of the most important steps in good weed control is accurate calibration of the Sprayer. Calibration is the process of adjusting sprayer so it will put out the correct amount of herbicide.

2. **POW WEED CONTROL**
   Unless the proper amount is applied, poor weed control may be obtained or

3. **INJURED CROP**
   The crop may be injured if too much is applied.

4. **CORRECT CALIBRATION**
   Correct calibration depends on three factors
   - Discharge or flow rate of material
   - Ground speed
   - Width of application boom

5. **CALIBRATION METHODS**
   There are many ways to calibrate a sprayer. The method that we are about to discuss was selected for this program because it appeared to be the method most commonly used by small farmers.

6. **CALIBRATION**
   This method considers:
   - **SPEED**
     Speed - You must reach a constant speed when calibrating and maintain that speed.
   - **PRESSURE**
     Pressure - The pressure should only be adjusted enough to put out the desired amount of spray. Once the sprayer is calibrated you should maintain a constant pressure setting and nozzle size.
   - **NOZZLE**

7. **CHECK NOZZLES**
   Before calibrating make these quick checks:
   - See if the nozzle screen and other related parts are clean and positioned at the right height and spacing.

8. **COMPARE NOZZLE SIZE**
   Make sure all nozzles are the same size.
<table>
<thead>
<tr>
<th></th>
<th>CONTAINERS UNDER NOZZLES</th>
<th></th>
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<tbody>
<tr>
<td>9.</td>
<td>Check all nozzles for spray pattern uniformity. This is determined by placing an identical container under each nozzle. All containers should fill at the same time. Replace nozzles that do not fill at the same time.</td>
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<thead>
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<th>ACRE METHOD</th>
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<tbody>
<tr>
<td>10.</td>
<td>The most commonly used calibration method is the acre method. First select speed, pump pressure, and nozzle size.</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>FILL TANK</th>
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<tbody>
<tr>
<td>11.</td>
<td>Fill spray tank with water.</td>
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<thead>
<tr>
<th></th>
<th>MEASURE FIELD</th>
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<tbody>
<tr>
<td>12.</td>
<td>Measure off 1 acre in the field.</td>
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<thead>
<tr>
<th></th>
<th>TRACTOR SPRAYING</th>
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<tbody>
<tr>
<td>13.</td>
<td>Spray the measured area in the field with a selected tractor speed and pressure gauge setting.</td>
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<table>
<thead>
<tr>
<th></th>
<th>REFILLING TANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.</td>
<td>Measure the amount of water required to refill the tank. The number of gallons needed to refill the tank is your application rate per acre at the particular tractor speed, pressure and the nozzles used in the test. If 35 gallons were needed to refill the tank, then the application rate is 35 gallons per acre.</td>
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<tr>
<th></th>
<th>WAIT</th>
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<tbody>
<tr>
<td>15.</td>
<td>Wait just a minute. What if the herbicide label recommends more or less water than you applied.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th></th>
<th>WAY TO ADJUST WATER OUTPUT</th>
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<tbody>
<tr>
<td>16.</td>
<td>You can solve this problem in one of three ways. First, adjust the application rate by changing the pressure. By lowering the pressure you will spray less liquid and higher pressure delivers more spray.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th></th>
<th>PRESSURE CHANGE</th>
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</thead>
<tbody>
<tr>
<td>17.</td>
<td>However, if major adjustments are needed changing the pressure is a poor method of changing application rates because excessive pressure destroys the spray patterns. Under high pressure the spray material is more likely to drift.</td>
</tr>
</tbody>
</table>
18. CHANGE SPEED

A better method is to change the speed of your sprayer provided nothing else is changed. For example, a lower speed will deliver more spray a higher speed results in less spray delivered.

19. HALF AS FAST

If you drive half as fast the delivery rate doubles. Therefore, it is most important that you maintain the same speed while spraying. If you change tractor speed it will be necessary to re-calibrate the sprayer.

20. HERBICIDE SLIDE

CHANGE NOZZLE

Another method of adjusting application rate is to change nozzle tips according to the amount of herbicide you want delivered. By changing to tips with larger holes more herbicide will be sprayed. The opposite is true for tips with smaller holes.

21. REFILL TANK

After the necessary adjustments are made, refill the tank.

22. SPRAY THE AREA

Spray measured area in the field.

23. REFILL THE TANK

Determine the amount of water needed to spray the area.

24. HOW MUCH

Now that we have determined the amount of water needed to spray an acre based on the trial run, the next step is to find how much herbicide to add.

25. HOW MANY

To do this, you must know two things: How many gallons your spray tank holds, and second

26. WEED CONTROL MANUAL

The amount of herbicide to use per acre. This is based on the amount recommended on the label and in the weed control manual.
27. 45 GALLONS

If the spray tank will hold 55 gallons and 40 gallons of water it is required to spray one acre. It will be simpler to add only the amount of water needed for an acre then add the amount of herbicide recommended for an acre.

28. TRACTOR SPRAYING

You are now ready to spray the field.

29. SOLO

Solo or Knapsack Sprayers are good week control sprayers for small plots and spot application.

30. GARDEN

Some jobs may even require a hand or knapsack sprayer. They are extremely effective in home gardens, small plots of vegetables, and areas along fence rows.

31. MAN CARRYING SPRAYER

Knapsack sprayers are used to some degree by almost all successful vegetable farmers.

32. HAND SPRAYER

1. LOW COST
2. LIGHT WEIGHT
3. VERY PORTABLE
4. EASY TO OPERATE

The real advantage of hand sprayers for small jobs are their low cost and their light weight, making them very portable and easily operated.

33. PRESSURE GAUGE

The knapsack sprayer should consist of a pressure gauge to measure the pressure in the tank and a

34. NOZZLE

Flat fan nozzle series 8001E to 8008E will give best results.

35. SPRAYER

The following steps should be followed when calibrating the knapsack sprayer:

1. Fill sprayer with water. If the sprayer does not have a mark indicating the full level, make one.

36. MEASURE FIELD

2. Divide the field into plots with the same row length.

37. SPRAY ROW

Spray one row. If you are making a band application you can spray a 20" band by spraying once down the center of the row.
38. **36" ROW**

For Broadcast Spray Application on 36 inch rows spray two bands 20 inches wide one on each side of the row overlapping in the center of the row.

39. **48" ROW**

To get a broadcast application on a 48 inch row spray the row 3 times. Once on each side of the row and once in the center of the row. Spray only enough to cover the row.

40. **PINT JAR**

After spraying one row, measure the amount of water required to refill the spray tank.

41. **40 ROWS TIMES THE AMOUNT OF WATER NEEDED FOR ONE ROW**

Multiply the number of rows in the plot by the pints or quarts of water required to spray one row.

42. **40 X 1 = 40 PINTS OR 5 GALLONS**

For example, if 1 pint was required to spray 1 row then 40 pints will be required to spray 40 rows. The number of rows was 40. 40 X 1 = 40 pints or 5 gallons.

43. **PICTURE OF LARGE CONTAINER**

To spray an acre, mix the amount of herbicide recommended for an acre in a container that will hold enough water for an acre. Your herbicide sprayer can be refilled from this container. But be sure that the herbicide in the large container is well mixed before filling the sprayer.

44. **MAN WITH SPRAYER REVIEW**

You are now ready to spray the field.

**FIRST**

Now that we have learned a simple procedure for calibrating the boom and solo sprayer, let's pause and review what has been discussed.

First listen to the questions and then respond to the questions by answering true or false next to the appropriate number in Section VII.
REVIEW VII

1. SPRAYER CALIBRATION IS THE PROCESS OF ADJUSTING THE SPRAYER SO IT WILL PUT OUT THE CORRECT AMOUNT OF HERBICIDE.
   
   ________ TRUE ________ FALSE

2. THE MAJOR FACTORS TO CONSIDER IN SPRAYER CALIBRATION ARE TRACTOR SPEED, PRESSURE, AND NOZZLE SIZE.
   
   ________ TRUE ________ FALSE

3. BEFORE CALIBRATING THE SPRAYER CHECK AND SEE IF ALL NOZZLES ARE PUTTING OUT THE SAME AMOUNT BY PLACING IDENTICAL CONTAINERS UNDER EACH NOZZLE AND SEEING IF THEY ALL FILL AT THE SAME TIME.
   
   ________ TRUE ________ FALSE

4. THE MOST COMMONLY USED CALIBRATION METHOD IS THE ACRE METHOD. WHEN USING THIS METHOD TO CALIBRATE, THE OPERATOR FILLS HIS TANK THEN SPRAYS AN ACRE AT A PARTICULAR SPEED AND PRESSURE, THEN DETERMINES THE AMOUNT OF WATER NEEDED TO REFILL THE TANK. THE AMOUNT OF WATER NEEDED TO REFILL THE TANK IS THE AMOUNT OF SPRAY APPLIED PER ACRE.
   
   ________ TRUE ________ FALSE

5. THE AMOUNT OF WATER BEING APPLIED BY THE HERBICIDE SPRAYER CAN BE CHANGED BY INCREASING OR DECREASING THE PRESSURE. LESS WATER IS APPLIED WHEN YOU INCREASE THE PRESSURE, MORE WATER WILL BE APPLIED WHEN YOU DECREASE THE PRESSURE.
   
   ________ TRUE ________ FALSE

6. WHEN MAJOR ADJUSTMENTS ARE NEEDED IN THE AMOUNT OF WATER BEING APPLIED, CHANGING THE SPRAY PRESSURE IS A POOR METHOD OF CHANGING APPLICATION RATES BECAUSE EXCESSIVE PRESSURE DESTROYS THE NOZZLE SPRAY PATTERNS, CAUSING A POTENTIAL DRIFT PROBLEM, AND INCREASES WEAR ON THE EQUIPMENT.
   
   ________ TRUE ________ FALSE

7. CHANGING TRACTOR SPEED IS THE BEST WAY TO MAKE MAJOR CHANGES IN THE RATE OF APPLICATION BECAUSE A LOWER SPEED WILL DELIVER LESS SPRAY AND A HIGHER SPEED WILL APPLY MORE SPRAY.
   
   ________ TRUE ________ FALSE

8. ALL KNAPSACK OR SOLO SPRAYERS USED FOR APPLYING HERBICIDES SHOULD BE EQUIPPED WITH A EVEN FLOW FLAT FAN NOZZLE, STRAINER AND PRESSURE GAUGE.
   
   ________ TRUE ________ FALSE
9. KNAPSACK OR SOLO SPRAYERS ARE SOMETIMES MORE EFFECTIVE THAN THE BOOM SPRAYER WHEN USED IN SMALL PLOTS OR FOR SPOT TREATMENT.

_________ TRUE __________ FALSE

10. KNAPSACK OR SOLO SPRAYERS ARE JUST AS EFFECTIVE AS A BOOM SPRAYER WHEN THEY ARE PROPERLY USED.

_________ TRUE __________ FALSE

Now that you have responded to the questions let's check your answer to see how well you have done.

KEY TO REVIEW VI

1. TRUE  6. TRUE
2. TRUE  7. FALSE
3. TRUE  8. TRUE
4. TRUE  9. TRUE
5. FALSE 10. TRUE

If you fail to answer any of the questions correctly, you should go back and review section VI. However, if you have answered all questions then you are ready to go on to Section VII.
1. **General Objective:**

The objective of this module is for farmers to acquire knowledge and understanding of Herbicide Safety and Recommendation.

2. **Specific Objectives:**

1. Farmers will learn the many ways in which careless use of herbicides can damage your health.

2. Farmers will learn the importance of reading herbicide labels.

3. Farmers will learn to follow extension recommendation when using herbicides.

3. **Behavior Objective:**

When farmers have completed this module they will demonstrate their knowledge of Herbicide Safety and Recommendation by answering correctly all questions at the end of this module.
1. **CAUTION**
   Caution - Herbicides should be used with extreme care.

2. **FILLING TANK**
   Many accidents occur while the operator is filling the tank. There are three ways in which contact with herbicide can damage your health.

3. **SWALLOWING**
   The greatest health hazard is considered to be swallowing the chemicals. You can also swallow chemicals by licking your lips or eating without thoroughly washing.

4. **BREATHING**
   Chemical injuries can also occur as a result of breathing fumes from chemicals. Therefore, always wear goggles and a respirator when mixing herbicides.

5. **THROUGH THE SKIN**
   Injury may also occur by contact through the skin. In case a herbicide is spilled on your body remove the clothing immediately and wash thoroughly with soap and water.

6. **CALL A DOCTOR**
   In case of additional exposure to these chemicals, consult a physician immediately and if possible bring a label which will identify the chemical you were using.

7. **RUBBER GLOVES AND GOGGLES**
   Rubber gloves and goggles should be worn at all times when handling herbicides.

8. **WASHING CLOTHING**
   After using herbicides, change clothing and wash them separately from the others.

9. **READ THE LABELS**
   Before using any herbicide stop and read the label. Chemical companies are interested in providing information on labels which not only give directions for weed control, but also for safety factors. However, some of the information on labels is very complicated, while others can be easily understood.
Therefore, be sure to take the time to read and understand the label before using a herbicide.

There are FIVE times when you should read the herbicide labels:
1. Before you buy the herbicide.
2. Before you mix the herbicide.
3. Before you apply the herbicide.
4. Before you store the herbicide.
5. Before you dispose the herbicide containers.

Reading the label is the best way to assure safe and proper use of herbicides.

All herbicide labels are required to have certain basic features. Names are common to all herbicides. Most herbicides have three names. These are the Brand Name, Common Name, and Chemical name.

The most commonly known is the brand name; which is sometimes known as the trade name.

The manufacturer name will usually be listed above the brand name or at the bottom of the label and may be expressed in much smaller printing.

Probably the most important name to the herbicide user is the common name. This name is most often used in control recommendations. The common name for the herbicide identifies the active ingredients of a product.
21. RESTRICTED USES

The label list only those uses which have been registered. It is illegal to use the herbicide for any other purpose or in any other manner not described on the label.

22. DIRECTION RECOMMENDED CROPS

The direction on a label provide information on the use of the product. These are very important directions, including what crops it can safely be used on.

23. WHAT WEEDS

What weeds it will control.

24. WHERE TO APPLY

Where to apply on foliage or soil.

25. WHEN TO APPLY

And when to make application post-emergence, pre-emergence or pre-plant, etc.

26. HOW MUCH TO APPLY

How much herbicide to apply.

27. USE OF RECOMMENDED APPLICATION RATES

The selectivity of a herbicide for a given crop occurs only when the amount of chemical applied falls within a certain range.

28. POOR WEED CONTROL

Poor weed control will be obtained when less than the recommended rate is used and

29. CROP DAMAGE

Crop damage will likely occur if rates higher than those recommended are used.

30. RATE OF APPLICATION

Rate of application differs with soil type. A lower rate may be recommended for use on light or sandy soils and a higher rate on clay loams or organic matter soils; but with some chemicals, the reverse is also true.

31. HERBICIDE

We have learned that different herbicides are recommended for different weeds, and no single herbicide is effective on all weeds. A herbicide that will control a weed at one stage of growth may not necessarily control
that same weed at another stage of growth. With a basic understanding of the types of herbicides and the methods of applying them. We are now ready to study individual herbicide recommendations.

The following herbicide recommendations has proven effective throughout the states. Many factors -- soil type, rainfall, and temperature -- influences a herbicide's effectiveness.

Therefore, the recommendations established by the Agriculture Experiment Station, Cooperative Extension Service and local commercial companies must be considered as final authority.

There are many herbicides that are recommended for weed control in vegetable crops. But, remember that all weeds cannot be controlled by a single herbicide nor can any herbicide be safely used on all crops.

A successful weed control program will depend on the proper use of recommended herbicides and a combination of the other weed control methods.

To better understand herbicide recommendations let's look at the following terms related to herbicide usage:

1. Rate per acre of active ingredient.
2. Rate of formulated material per acre.
3. Time to apply.
5. Remarks.
| **37. RATES OF ACTIVE INGREDIENT PER ACRE** | Rate of Active Ingredient Per Acre  
Refers to the amount of actual herbicide you will use per acre.  
For example, when you buy a bag, jug or can of herbicide, a portion of the material in the container serves as a carrier for the chemicals; only a portion of this material is herbicide. The rate of active ingredient refers to the amount of actual weed killing chemical. |
| **38. TIME TO APPLY** | Time to Apply  
Refers to the time to apply your herbicide for best weed control and to avoid damaging your crops. |
| **39. REMARKS** | Remarks  
Any comment about the herbicide that is important to get good control and to avoid damage to other crops. |
| **40. RATE OF FORMULATED MATERIAL PER ACRE** | Rate of Formulated Material Per Acre.  
Refers to the total amount of a given herbicide recommended for an acre. This is the number of pounds, pints or quarts you need to take from the container to apply the proper amount per acre. This is the easiest recommendation to use because it is based on the total amount of material in the container. When herbicides are written at the rate of formulated material per acre you mix that amount in your spray tank. |
| **41. 2 1/1 POUND DACTHAL 75% WP PER ACRE** | If the recommendation says apply 2 1/2 lbs. of Dacthal 75% WP per acre you take 2 1/2 pounds from your bag and mix with the desired amount of water in your spray tank. |
| **42. WEEDS CONTROLLED** | Weeds Controlled  
Refers to the type of weeds a herbicide will control. |
Now that we have a basic understanding of terms related to Herbicide recommendations let's look at recommended herbicides for specific vegetable crops. There are many herbicides that are recommended for use on vegetable crops. Some can be used on a wide range of crops while others can only be used on a few specific crops. In this discussion we are going to look at those that can be considered the most widely used vegetable herbicides.

Dacthal is one of the most widely used herbicides in vegetable production. This is because of the large number of crops Dacthal is recommended for. It will control many small-seeded annual grasses and some broadleaf weeds. Dacthal should be applied to a weed-free soil either as a pre-emerge or post-emerge treatment.

Treflan is the second most important vegetable herbicide. Treflan can be used on more vegetable crops than any other herbicide except Dacthal. It will control many small seeded annual grasses, seedling Johnsongrass and many broadleaf weeds. Treflan is a pre-plant incorporated herbicide and it should be incorporated thoroughly in the top 2" of soil just before planting. It is recommended for use on more than 13 vegetable crops.

Diphenamid is an important vegetable herbicide. It can be used as a pre-plant or as a pre-transplant treatment. It is most effective when incorporated about two inches in the soil. Diphenamid is not a contact herbicide and must be
applied to a weed-free surface. It is recommended for use on more than five vegetables in this state.

49. EPTAM

Eptam is an important vegetable herbicide, especially in the sweet potato industry. It will control many small-seeded annual grasses, broadleaf weeds and seedling Johnsongrass. Eptan should be incorporated thoroughly in the top three inches of soil just before planting or transplanting. It is recommended for use on three or more vegetable crops.

50. ALANAP

Alanap is another important vegetable herbicide, especially for the cucurbits. It will control many small-seeded annual grasses and broadleaf weeds. Alanap should be applied to freshly cultivated soil. It is applied as a pre-emerge treatment at planting.

51. PREFAR BENSULIDE

Prefar is an important vegetable herbicide. It is especially important for cucurbits. It is used as a pre-plant incorporated treatment on most cucurbits. Bensulide will control certain annual grasses and broadleaf weeds.

REVIEW

We have just discussed a few factors associated with herbicide recommendations. We have also taken a brief look at herbicides in general and herbicides that are recommended for specific crops. While they are still somewhat fresh on your mind, let's stop and briefly review what has been discussed.

FIRST

First, listen to the questions and then mark your answer TRUE or FALSE next to the appropriate number under Section VIII on the answer sheet given to you at the beginning of the program.
REVIEW VIII

1. THERE IS NO ONE HERBICIDE FOR VEGETABLES THAT WILL CONTROL ALL WEEDS.

________ TRUE ________ FALSE

2. NO SINGLE WEED CONTROL IS EFFECTIVE WHEN USED ALONE. THE MOST EFFECTIVE WEED CONTROL PROGRAM INCLUDE A COMBINATION METHOD.

________ TRUE ________ FALSE

3. THE LABEL ON THE HERBICIDE TELLS YOU IF THE HERBICIDE SHOULD BE APPLIED PRE-PLANT, PRE-EMERGENCE OR POST-EMERGENCE.

________ TRUE ________ FALSE

4. SOME HERBICIDES REQUIRE OVERHEAD IRRIGATION WITHIN 7 TO 10 DAYS AFTER APPLICATION. HOWEVER, IF AN INCH OF RAIN FALL WITHIN 7 TO 10 DAYS, NO IRRIGATION IS REQUIRED.

________ TRUE ________ FALSE

5. HEAVY SOILS THAT ARE HIGH IN ORGANIC MATTER USUALLY REQUIRE HIGHER RATES OF MOST HERBICIDES THAN LIGHTER SOILS. HOWEVER, THE REVERSE IS SOMETIMES TRUE.

________ TRUE ________ FALSE

6. THERE ARE THREE WAYS IN WHICH CONTACT WITH HERBICIDES CAN DAMAGE YOUR HEALTH: (1) SWALLOWING, (2) BREATHING FUMES FROM THE HERBICIDE, AND (3) SKIN CONTACT.

________ TRUE ________ FALSE

7. IF YOU HAVE ACCIDENTALLY SWALLOWED SOME HERBICIDE YOU SHOULD DRINK PLENTY OF WATER AND GET PLENTY OF REST.

________ TRUE ________ FALSE

8. TO PREVENT HERBICIDE INJURY, RUBBER GLOVES, RUBBER BOOTS, GOGGLES, AND A RESPIRATOR SHOULD BE WORN AT ALL TIMES WHEN USING HERBICIDES.

________ TRUE ________ FALSE
9. THERE ARE FIVE TIMES WHEN YOU SHOULD READ THE LABEL ON HERBICIDES: (1) BEFORE BUYING, (2) BEFORE MIXING, (3) BEFORE APPLYING, (4) BEFORE STORING, AND (5) BEFORE DISPOSING.

__________ TRUE __________ FALSE

10. THE RATE OF FORMULATED MATERIAL AS INDICATED ON THE HERBICIDE LABEL REFERS TO THE TOTAL AMOUNT OF MATERIAL TO BE APPLIED PER ACRE.

__________ TRUE __________ FALSE

Now that you have responded to each of the questions, let's check your answers and see just how well you have done.

KEY TO REVIEW VII

1. TRUE 6. TRUE
2. TRUE 7. FALSE
3. TRUE 8. TRUE
4. TRUE 9. TRUE
5. TRUE 10. TRUE

If you fail to answer any of the questions correctly you should go back and review Section VII. However, if your answers were all correct in this section and in all other sections - Congratulations, for you have just completed the first series of lessons on weed control.
In the series of lessons just completed, you were given a review at the end of each section for you to test your understanding of what has been discussed. When you fail to answer a question correctly, it indicates that you may not clearly understand what has been discussed. Therefore, the entire program is being made available for you to come in and review the program at your convenience. You can stop the program whenever you desire, ask any questions you might have, and go over the program as often as you like. The most important thing is that you understand weed control and you must continue to review this program until you do. Remember, the best indication of your knowledge of weed control is the results you get in the field. This is the end of this series.
REFERENCES


DEPARTMENT OF HORTICULTURE
LOUISIANA STATE UNIVERSITY
BATON ROUGE, LOUISIANA

PROGRAM REVIEW

Thank you for participating in this important series of lessons on Weed Control. This program is divided into a series of 8 lessons on Weed Control. At the end of each lesson you will be asked a series of review questions. Below is an outline of the entire program with the appropriate numbers which correspond to the questions that will be asked at the end of each lesson. When questions are asked please respond by checking the appropriate answer on the answer sheet below.

This answer sheet is for your information alone. You will not need to turn it in at the end of the program. It is only being used as a key to indicate to you your understanding of the lessons being discussed.

All reviews will consist of true and false type questions. Therefore, you should check true if the statement is true, false if the statement is false.

Section I IMPORTANCE OF WEED CONTROL

1. True____ False____
2. True____ False____
3. True____ False____
4. True____ False____
5. True____ False____
6. True____ False____
7. True____ False____
8. True____ False____
9. True____ False____
10. True____ False____
Section II  
WEED IDENTIFICATION

1. A. PIGWEED  
   B. SOWTHISTLE

2. A. COCKLEBUR  
   B. LAMBSQUARTERS

3. A. RAGWEED  
   B. WILD MUSTARD

4. A. CYPRESSVINE MORNINGGLORY  
   B. TALL MORNINGGLORY

5. A. NUTSEDGE (COCOGRASS)  
   B. ANNUAL BLUEGRASS

6. A. BROOMSEDGE  
   B. GOOSEGRASS

7. A. BERMUDAGRASS  
   B. NUTSEDGE

8. A. SMUTGRASS  
   B. CRABGRASS

9. A. JOHNSON GRASS  
   B. BARNYARD GRASS

10. A. ANNUAL BLUEGRASS  
    B. BERMUDA GRASS

Section III  
WEED CONTROL METHODS

1. True  False

2. True  False

3. True  False

4. True  False

5. True  False

6. True  False

7. True  False

8. True  False

9. True  False

10. True  False

Section IV  
CHEMICAL WEED CONTROL

1. True  False

2. True  False

3. True  False

4. True  False

5. True  False

6. True  False

7. True  False

8. True  False

9. True  False

10. True  False
## Section V  HERBICIDE SPRAYERS

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## Section VI  SPRAYER CALIBRATION

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## Section VII  HERBICIDE SAFETY AND LABEL DIRECTION

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APPENDIX B

PRE-TEST AND POST-TEST

QUESTIONNAIRE
THE USE OF LEARNING MODULES TO TEACH WEED CONTROL PRACTICES TO SMALL COMMERCIAL VEGETABLE FARMERS

This study is being conducted to compare the use of Learning Modules to the Lecture-Discussion method of teaching weed control to small commercial vegetable farmers. It is hoped that the findings of this study will be helpful in developing an additional avenue for providing technical assistance to farmers producing vegetable crops.

The information obtained in this questionnaire will be kept anonymous and confidential. All information will be treated as group data and not individually.

The researcher wishes to thank you for your participation in this study. The validity of this study will depend upon your cooperation.

SECTION I

Introduction

1. State ____________________________

2. County or Parish ____________________________

3. Questionnaire Number ____________________________

4. How many acres of farm land do you own? ____________________________

5. Do you lease or rent any land?

   a. Yes
   b. No

6. How many acres of both owned and rented land can be used for vegetable production? ____________________________
7. Do you own a tractor?
   ___ a. Yes
   ___ b. No

8. If your answer to question 7 was No, how do you plow your field?
   ___ a. Borrow a neighbor's tractor
   ___ b. Mule or horse
   ___ c. Employ a friend with a tractor
   ___ d. Other arrangements, explain

9. How many acres of vegetables do you produce each year?

10. Where do you sell your vegetables?
    ___ a. To local stores
    ___ b. At a farmer's market
    ___ c. Curb market
    ___ d. To a broker
    ___ e. Peddle
    ___ f. Processor
    ___ g. Others

11. How many years have you been growing vegetables? ___________

12. What kind of vegetables do you produce for market? (Check all that apply to you.)
    ___ a. Tomatoes ___ acres or ___ row feet
    ___ b. Bell Pepper ___ acres or ___ row feet
    ___ c. Peas ___ acres or ___ row feet
    ___ d. Lima Beans ___ acres or ___ row feet
    ___ e. Snap Beans ___ acres or ___ row feet
    ___ f. Mustards ___ acres or ___ row feet
    ___ g. Collards ___ acres or ___ row feet
    ___ h. Squash ___ acres or ___ row feet
    ___ i. Onions ___ acres or ___ row feet
13. How much labor do you have available?
   a. Number of adults _______
   b. Number of children _______

14. Do you use hired labor? Yes ____ No ____
   If yes, how much? __________________________

15. What type of weed control program did you follow during the past 12 months? (Check all that apply.)
   a. Cultural control such as mulching, crop rotation or crop competition.
   b. Mechanical control such as cultivation or hoeing.
   c. Chemical control with herbicides.

16. Have you ever used chemicals to control weeds in your vegetables?
   a. Yes
   b. No

17. How often have you used chemicals to control weeds in your vegetables?
   a. Very often
   b. Often
   c. Not very often

18. What crops were the chemicals used on?
   Please list __________________________________
19. What type of herbicide did you use?
   _____a. Treflan
   _____b. Dacthal
   _____c. Diphenamid
   _____d. Lasso
   _____e. Alanap
   _____f. Atrazine
   _____g. Amiben
   _____h. Prefar
   _____i. Others, please list

20. What type of control did you get?
   _____a. Good
   _____b. Fair
   _____c. Poor

21. What type of sprayer did you use?
   _____a. Tractor mounted boom sprayer
   _____b. Knapsack or hand sprayer
   _____c. List type used if other than the above

22. Do you own a boom type sprayer?
   _____a. Yes
   _____b. No

23. Age (list actual age) _________

24. Sex
   _____a. Male
   _____b. Female

25. What was the highest grade you completed in school? _________

26. Number of family members, including yourself
   1, 2, 3, 4, 5, 6, 7, 8, 9, 10
   If more than 10, indicate number _________
SECTION II

Prior Learning Experience

1. Have you contacted a Cooperative Extension Agent in the past 12 months?
   Yes ( ) No ( ) If yes, how many times? 1, 2, 3, 4, 5, 6, ____

2. Have you attended county or parish meetings, workshops, or clinics sponsored by Cooperative Extension Services during the past 12 months? Yes ( ) No ( ) If yes, how many times? 1, 2, 3, 4, 5, 6, ____

3. Have you attended a community or neighborhood meeting sponsored by Cooperative Extension Service in the past 12 months?
   Yes ( ) No ( ) If yes, how many times? 1, 2, 3, 4, 5, 6, ____

4. Have you attended an experiment station field day in the past 12 months?
   Yes ( ) No ( ) If yes, how many times? 1, 2, 3, 4, 5, 6, ____

5. Have you received any mail from the County Extension Office in the past 12 months?
   Yes ( ) No ( )

6. Have you read extension or research bulletins on weed control in the past 12 months?
   ______a. Yes
   ______b. No

7. Do you read daily or weekly newspaper articles written by your county agent?
   ______a. Yes
   ______b. No

8. How often do you listen to agricultural programs on the radio?
   ______a. Daily
   ______b. Twice weekly
   ______c. Once a week
   ______d. Seldom if ever
9. How often do you watch agricultural programs on TV?

___ a. Daily
___ b. Twice weekly
___ c. Once per week
___ d. Seldom if ever

SECTION III

Sources of Information

When you have problems with your vegetable production program, to what extent do you rely on the advice of the following sources?

<table>
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<th>Often</th>
<th>Not Very Often</th>
<th>Never Often</th>
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<tr>
<td>1. Friends or neighbors</td>
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<td>2. County extension agents</td>
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<td>3. Co-op representative</td>
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<td>9. Farmer Home Administration</td>
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<td>10. Other</td>
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SECTION IV

Knowledge of Weed Control

A. Weed Classification

In this section I am going to read you some questions on weed classification. Several answers will be given for each question. Please tell me the answer you think is best by placing an "X" in the blank space next to the answer you have selected.
1. A weed is any plant
   ___a. except grasses that grow in the field.
   ___b. that has economic value.
   ___c. growing where it is not wanted.

2. The most expensive pest control problem in crop production is
   ___a. insect control.
   ___b. disease control.
   ___c. weed control.

3. The time required for a seed to come up, produce foliage, flowers, seeds and die is called:
   ___a. the plant's life cycle.
   ___b. the plant's growing season.
   ___c. plant rotation.
   ___d. plant evolution.

4. An annual plant is one that completes its life cycle in:
   ___a. 1 year.
   ___b. 2 years.
   ___c. 3 years.

5. Biennial plants such as the wild carrot complete their life cycle in:
   ___a. 1 year.
   ___b. 2 years.
   ___c. 3 years.

6. A perennial weed such as bermudagrass completes its life cycle in:
   ___a. 1 year.
   ___b. 2 years.
   ___c. 3 years or more.

7. Plants that live for three or more years and spread by seeds and by pieces of the plant are called:
   ___a. annual plants.
   ___b. biennial plants.
   ___c. perennial plants.

8. A plant that comes up in the fall or winter, produces seeds in the early spring, and dies when the weather gets hot is called a:
   ___a. perennial plant.
   ___b. summer annual.
   ___c. winter annual.
B. Weed Identification

In this section I would like for you to identify some weeds. I will show you pictures of some weeds. Look at them carefully and see if you can identify them. Then check the correct answer on the answer sheet below.

1. ___a. Pigweed
   ___b. Chickweed
   ___c. Ragweed

2. ___a. Cocklebur
   ___b. Sowthistle
   ___c. Common lambsquarter

3. ___a. Hairy galinsoga
   ___b. Tall morningglory
   ___c. Sunflower morningglory

4. ___a. Cocograss
   ___b. Goosegrass

5. ___a. Crowfootgrass
   ___b. Bermudagrass

6. ___a. Large crabgrass
   ___b. Annual bluegrass
   ___c. Torpedograss

7. ___a. Wooly croton
   ___b. Hemp sesbania
   ___c. Common purslane

8. ___a. Florida purslane
   ___b. Chickweed
   ___c. Hairy galinsoga

9. ___a. Torpedograss
   ___b. Johnsongrass
   ___c. Barnyardgrass

10. ___a. Wild mustard
    ___b. Ragweed
    ___c. Pigweed
C. Cultural and Mechanical Weed Control Methods

In this section I will read you some questions on various weed control methods. Several answers will be listed for each question. Please tell me the answer you think is best by placing an X in the blank space next to the answer you have selected.

1. Jack Jones is a very successful vegetable farmer. He stated that good weed control is the key to his success. Mr. Jones also said that he has to use all weed control methods but the method most often used is:
   ___a. cultivation.
   ___b. chemical.
   ___c. crop rotation.
   ___d. crop competition.

2. You have been cultivating corn for your neighbor for two hours. You return home that same afternoon to cultivate your sweet potatoes. What should you do to your tractor and cultivators before leaving your neighbor’s farm or before going into your field with the same equipment?
   ___a. Readjust your cultivators.
   ___b. Clean all soil debris from your tractor and cultivator.
   ___c. Lubricate tractor and cultivator so that they operate properly.

3. Crop competition is the practice of:
   ___a. growing two or more crops on the same row.
   ___b. growing crops more vigorous than the weed.
   ___c. growing a plant that is the natural enemy of the weed.

4. If you found that bermudagrass was a real problem in one of your best fields, which of the following crops could you plant to reduce the weed problem?
   ___a. Garlic
   ___b. Onions
   ___c. Peas
   ___d. Radishes

5. Mechanical weed control is destroying weeds with a hoe, disk, plow, or horrow. This type of weed control is:
   ___a. no longer an important weed control method.
   ___b. one of the most important methods of weed control.
   ___c. a poor method of weed control.
6. John Jones has learned that good weed control is important for successful vegetable production. But at what stage of growth are weeds best controlled?

___ a. After flowering.
___ b. Just before flowering.
___ c. Shortly after coming up.

7. Covering the row or seedbed before planting or after transplanting with straw, hay, paper, plastic and other organic material to control weeds is called:

___ a. mulching.
___ b. biological control.
___ c. mechanical control.

8. The main reason why you disc your field is:

___ a. to destroy weeds and to loosen the soil.
___ b. to loosen the soil so it can absorb water.
___ c. to break up clods.

9. Cultivation is said to be too deep anytime it:

___ a. cuts the roots of the crop.
___ b. results in heavy clay being brought to the surface.
___ c. goes below the original planting depth.

10. Jack Jones has cultivated his field four times this year to control cocograss, but he has more cocograss now than he had before cultivation began. Why?

___ a. Because cultivation increase growth rate.
___ b. Because cocograss reproduces from cut up pieces and cultivation cuts up the weed and spreads it in the field.
___ c. Because cultivation reduces competition from other weeds allowing cocograss to spread.

D. Chemical Weed Control

In this section, I am going to read you some questions on chemical weed control. Several answers will be given for each question. Please tell me the answer you think is best by placing an X in the blank space next to the answer you have selected.
1. Chemicals used to control weeds are called:
   _____a. insecticides.
   _____b. fungicides.
   _____c. herbicides.

2. A selective herbicide is:
   _____a. a herbicide that will kill some plants and not injure others.
   _____b. a herbicide that will kill only broad leaf plants.
   _____c. a herbicide that will kill all plants.

3. Contact herbicides will kill:
   _____a. all plant parts as they germinate.
   _____b. all plants it comes in contact with.
   _____c. all plants for which is is toxic to when it comes in contact with them.

4. A non-selective herbicide is:
   _____a. not as good as a selective herbicide.
   _____b. toxic to all plants.
   _____c. toxic only to certain plants.

5. Herbicides that are most effective on perennial weeds are called:
   _____a. herbicides that kill the top of the weed only.
   _____b. selective herbicides.
   _____c. herbicides that move from the top of the weed to the roots killing the roots as well as the top.

6. Paraquat is a non-selective herbicide, however, it can be made selective by:
   _____a. reducing the rate.
   _____b. directing the spray toward the weeds and avoiding any contact with the crop.
   _____c. using to control weeds only after flowering.

7. When herbicides are applied to the soil surface after planting but before the crop or weed comes up, it is called a:
   _____a. pre-emergence herbicide.
   _____b. post-emergence herbicide.
   _____c. post-transplant herbicide.
8. The application of a herbicide to the soil before planting the crop is called:
   ___a. pre-emergence application.
   ___b. contact application.
   ___c. preplant application.

9. The application of herbicide after the crop has come up or application after the crop and the weed have both come up is called:
   ___a. post-emergence.
   ___b. pre-plant herbicide.
   ___c. contact herbicide.

10. The uniform application of herbicides over an entire field is:
    ___a. broadcast application.
    ___b. band application.
    ___c. soil application.

11. Spraying a herbicide over a narrow strip down the center of each row or spraying a narrow strip between each row is called:
    ___a. broadcast application.
    ___b. directed spray.
    ___c. band application.

12. Spraying herbicides directly at the weeds to avoid contact with the crop is called:
    ___a. directed spraying.
    ___b. spot treatment.
    ___c. band spraying.

13. The mixing of herbicides into the top one to two inches of the soil is called:
    ___a. pre-plant herbicide.
    ___b. post-emergent
    ___c. soil incorporation.

14. Herbicides can be best incorporated into the soil with:
    ___a. a bedding disk.
    ___b. a rolling cultivator.
    ___c. a flat disk.
15. The application of herbicides in certain spots in the field where weeds are a particular problem and other methods of control have failed is called:

   ___ a. spot treatment.
   ___ b. band application.
   ___ c. broadcast application.

E. Herbicide Sprayers

In this section I will read you some questions on herbicide sprayers. Several answers will be listed for each question. Please indicate the answer you think is best by placing an X in the blank space next to the answer you have selected.

1. The most common herbicide sprayers used in vegetable production are:

   ___ a. high pressure sprayers.
   ___ b. low pressure sprayers.
   ___ c. high volume, high pressure sprayers.

2. There are several types of pumps that can be used on a herbicide sprayer, but the most commonly used pump is the:

   ___ a. piston pump.
   ___ b. roller pump.
   ___ c. centrifugal pump.

3. The aluminum and fiber glass tanks are highly recommended for herbicide sprayers. This is because they are:

   ___ a. lighter.
   ___ b. less susceptible to corrosion.
   ___ c. will carry more water.
   ___ d. easier to clean.

4. An agitator is a device used in the spray tank to keep the herbicide well mixed. Agitators are especially important when using:

   ___ a. liquid herbicides.
   ___ b. wettable powders.
   ___ c. granular herbicides.
5. The pressure regulator on the sprayer is used to:
   ______a. start and stop the flow of spray material.
   ______b. increase agitation.
   ______c. adjust the spray pressure.

6. The pressure gauge is a meter used to indicate the amount of spray pressure being discharged to the nozzles. The best spray pressure is:
   ______a. 40 to 60 PSI.
   ______b. 140 to 160 PSI.
   ______c. 10 to 20 PSI.

7. There are two different types of spray nozzles used for weed control in vegetable crops. However, the regular flat fan nozzle 8001 to 8008 is used for:
   ______a. broadcast spraying.
   ______b. band spraying.
   ______c. directed spraying.

8. The second type of nozzle is the even flow flat fan nozzle. It is used for:
   ______a. broadcast spraying.
   ______b. band spraying.
   ______c. directed spraying.

9. The most commonly used nozzles are:
   ______a. inexpensive plastic nozzles.
   ______b. brass nozzles.
   ______c. stainless steel nozzles.

10. When making a broadcast spray application, the nozzles should be spaced on the boom so that:
    ______a. they are 10 to 15 inches from the soil surface.
    ______b. you get one-third overlap.
    ______c. they are 36 inches from spray surface.
F. Sprayer Calibration

In this section, we are going through the process of sprayer calibration. There are 12 steps involved in this process. I am going to read you several statements that are related to each statement. Please tell me which step is correct by placing an X in the blank space next to the statement you have selected.

1. The 1st step in sprayer calibration is:
   □ a. clean all nozzles, screens and adjust spacing.
   □ b. see if all nozzles are putting out the same amount.
   □ c. fill spray tank.

2. The 2nd step is to:
   □ a. see if all nozzles are putting out the same amount of spray.
   □ b. make sure all nozzles are the same size.
   □ c. adjust spray pressure.

3. The 3rd step is to:
   □ a. check to see if all nozzles are putting out the same amount.
   □ b. measure off the field.
   □ c. check your speed.

4. The 4th step is to:
   □ a. start your tractor and select the speed and pressure setting (40-60 PSI).
   □ b. fill spray tank with water.
   □ c. clean nozzles and screen.

5. The 5th step is to:
   □ a. measure off one acre in the field.
   □ b. spray the measured acre.
   □ c. check your nozzles.
6. The 6th step in calibration is to:
   a. start your tractor, adjust pressure and speed.
   b. measure off one acre in field.
   c. fill spray tank.

7. In the 7th step, you should:
   a. spray the measured area in the field.
   b. check your nozzle.
   c. add herbicide recommended for an acre.

8. In the 8th step, you should:
   a. add the recommended herbicide for one acre.
   b. measure the amount of water needed to refill the spray tank.
   c. spray the field.

9. In the 9th step:
   a. add the same amount of water used to spray one acre to the tank.
   b. adjust tractor speed.
   c. you are ready to spray the field.

10. In the 10th step, you
    a. begin spraying the field
    b. add the recommended amount of herbicide for one acre.
    c. fill spray tank.

The sprayer should now be correctly calibrated.
G. Herbicide Safety and Recommendation

In this section, I am going to read a few statements to you. Please listen to each statement and indicate if you think it is true or false. Some of them you may not know for sure, but try to answer all of them as best you can. If the statement is true, check "True"; if the statement is false, check "False." If you are not sure of the answer, check "Do Not Know."

1. There is no one herbicide recommended for vegetables that will control all weeds.
   a. True
   b. False
   c. Do not know

2. No single weed control method is effective in controlling all weeds. The most effective weed control program includes a combination of methods.
   a. True
   b. False
   c. Do not know

3. The label on the herbicide tells you if the herbicide should be applied before planting, after planting but before the crop comes up, or after it comes up.
   a. True
   b. False
   c. Do not know

4. Some herbicides require overhead irrigation within 7 to 10 days after application. However, if an inch of rain falls within 7 to 10 days after application, no irrigation is required.
   a. True
   b. False
   c. Do not know

5. Heavy soils that are high in organic matter usually require less herbicides.
   a. True
   b. False
   c. Do not know
6. When applying herbicide you should use slightly more than the recommended rate to get control.
   ___a. True
   ___b. False
   ___c. Do not know

7. There are three ways in which contact with herbicides can damage your health: (1) swallowing, (2) breathing fumes from the herbicide, and (3) skin contact.
   ___a. True
   ___b. False
   ___c. Do not know

8. If you have accidentally swallowed some herbicide, you should drink plenty of water and get plenty of rest.
   ___a. True
   ___b. False
   ___c. Do not know

9. To prevent herbicide injury, rubber gloves, rubber boots, goggles, and a respirator should be worn at all times when using herbicides.
   ___a. True
   ___b. False
   ___c. Do not know

10. All herbicides can damage your health, therefore, you should always read the label before buying, before mixing, before applying, before storing, and before disposing of the herbicide container.
    ___a. True
    ___b. False
    ___c. Do not know
DEPARTMENT OF HORTICULTURE
Louisiana State University
Baton Rouge, LA 70803

Post Questionnaire

THE USE OF LEARNING MODULES TO TEACH WEED CONTROL
PRACTICES TO SMALL COMMERCIAL VEGETABLE
FARMERS

When this questionnaire is complete, you will have completed the
first phase of this important study on weed control. The results will
be made available to you within the next two or three months.

The information obtained in this questionnaire will be kept anonymous
and confidential. All information will be treated as group data and not
individually.

The researcher wish to thank you for your participation in this study.
You have been both cooperative and very challenging.

SECTION I

1. State ____________________
2. County or Parish ____________
3. Questionary Number ____________

SECTION II

Knowledge of Weed Control

A. Weed Classification

In this section I am going to read you some questions on weed classi-
fication. Several answers will be given for each question. Please tell
me the answer you think is best by placing an "X" in the blank space next
to the answer you have selected.
1. A weed is any plant
   ____ a. except grasses that grow in the field.
   ____ b. that has economic value.
   ____ c. growing where it is not wanted.

2. The most expensive pest control problem in crop production is
   ____ a. insect control.
   ____ b. disease control.
   ____ c. weed control.

3. The time required for a seed to come up, produce foliage, flowers, seeds and die is called:
   ____ a. the plant's life cycle.
   ____ b. the plant's growing season.
   ____ c. plant rotation.
   ____ d. plant evolution.

4. An annual plant is one that completes its life cycle in:
   ____ a. 1 year.
   ____ b. 2 years.
   ____ c. 3 years.

5. Biennial plants such as the wild carrot complete their life cycle in:
   ____ a. 1 year.
   ____ b. 2 years.
   ____ c. 3 years.

6. A perennial weed such as bermudagrass completes its life cycle in:
   ____ a. 1 year.
   ____ b. 2 years.
   ____ c. 3 years or more.

7. Plants that live for three or more years and spread by seeds and by pieces of the plant are called:
   ____ a. annual plants.
   ____ b. biennial plants.
   ____ c. perennial plants.

8. A plant that comes up in the fall or winter, produces seeds in the early spring, and dies when the weather gets hot is called a:
   ____ a. perennial plant.
   ____ b. summer annual.
   ____ c. winter annual.
B. Weed Identification

In this section I would like for you to identify some weeds. I will show you pictures of some weeds. Look at them carefully and see if you can identify them. Then check the correct answer on the answer sheet below.

1. ___a. Pigweed
   ___b. Chickweed
   ___c. Ragweed

2. ___a. Cocklebur
   ___b. Sowthistle
   ___c. Common lambsquarter

3. ___a. Hairy galinsoga
   ___b. Tall morningglory
   ___c. Sunflower morningglory

4. ___a. Cocogloss
   ___b. Goosegrass

5. ___a. Crowfootgrass
   ___b. Bermudagrass

6. ___a. Large crabgrass
   ___b. Annual bluegrass
   ___c. Torpedograss

7. ___a. Wooly croton
   ___b. Hemp sesbania
   ___c. Common purslane

8. ___a. Florida purslane
   ___b. Chickweed
   ___c. Hairy galinsoga

9. ___a. Torpedograss
   ___b. Johnsongrass
   ___c. Barnyardgrass

10. ___a. Wild mustard
    ___b. Ragweed
    ___c. Pigweed
C. Cultural and Mechanical Weed Control Methods

In this section I will read you some questions on various weed control methods. Several answers will be listed for each question. Please tell me the answer you think is best by placing an X in the blank space next to the answer you have selected.

1. Jack Jones is a very successful vegetable farmer. He stated that good weed control is the key to his success. Mr. Jones also said that he has to use all weed control methods but the method most often used is:
   _____ a. cultivation.
   _____ b. chemical.
   _____ c. crop rotation.
   _____ d. crop competition.

2. You have been cultivating corn for your neighbor for two hours. You return home that same afternoon to cultivate your sweet potatoes. What should you do to your tractor and cultivators before leaving your neighbor's farm or before going into your field with the same equipment?
   _____ a. Readjust your cultivators.
   _____ b. Clean all soil debris from your tractor and cultivator.
   _____ c. Lubricate tractor and cultivator so that they operate properly.

3. Crop competition is the practice of:
   _____ a. growing two or more crops on the same row.
   _____ b. growing crops more vigorous than the weed.
   _____ c. growing a plant that is the natural enemy of the weed.

4. If you found that bermudagrass was a real problem in one of your best fields, which of the following crops could you plant to reduce the weed problem?
   _____ a. Garlic
   _____ b. Onions
   _____ c. Peas
   _____ d. Radishes

5. Mechanical weed control is destroying weeds with a hoe, disk, plow, or horrow. This type of weed control is:
   _____ a. no longer an important weed control method.
   _____ b. one of the most important methods of weed control.
   _____ c. a poor method of weed control.
6. John Jones has learned that good weed control is important for successful vegetable production. But at what stage of growth are weeds best controlled?
   _____a. After flowering.
   _____b. Just before flowering.
   _____c. Shortly after coming up.

7. Covering the row or seedbed before planting or after transplanting with straw, hay, paper, plastic and other organic material to control weeds is called:
   _____a. mulching.
   _____b. biological control.
   _____c. mechanical control.

8. The main reason why you disc your field is:
   _____a. to destroy weeds and to loosen the soil.
   _____b. to loosen the soil so it can absorb water.
   _____c. to break up clods.

9. Cultivation is said to be too deep anytime it:
   _____a. cuts the roots of the crop.
   _____b. results in heavy clay being brought to the surface.
   _____c. goes below the original planting depth.

10. Jack Jones has cultivated his field four times this year to control cocograss, but he has more cocograss now than he had before cultivation began. Why?
    _____a. Because cultivation increase growth rate.
    _____b. Because cocograss reproduces from cut up pieces and cultivation cuts up the weed and spreads it in the field.
    _____c. Because cultivation reduces competition from other weeds allowing cocograss to spread.

D. Chemical Weed Control

In this section, I am going to read you some questions on chemical weed control. Several answers will be given for each question. Please tell me the answer you think is best by placing an X in the blank space next to the answer you have selected.
1. Chemicals used to control weeds are called:
   ___a. insecticides.
   ___b. fungicides.
   ___c. herbicides.

2. A selective herbicide is:
   ___a. a herbicide that will kill some plants and not injure others.
   ___b. a herbicide that will kill only broad leaf plants.
   ___c. a herbicide that will kill all plants.

3. Contact herbicides will kill:
   ___a. all plant parts as they germinate.
   ___b. all plants it comes in contact with.
   ___c. all plants for which is it toxic to when it comes in contact with them.

4. A non-selective herbicide is:
   ___a. not as good as a selective herbicide.
   ___b. toxic to all plants.
   ___c. toxic only to certain plants.

5. Herbicides that are most effective on perennial weeds are called:
   ___a. herbicides that kill the top of the weed only.
   ___b. selective herbicides.
   ___c. herbicides that move from the top of the weed to the roots killing the roots as well as the top.

6. Paraquat is a non-selective herbicide, however, it can be made selective by:
   ___a. reducing the rate.
   ___b. directing the spray toward the weeds and avoiding any contact with the crop.
   ___c. using to control weeds only after flowering.

7. When herbicides are applied to the soil surface after planting but before the crop or weed comes up, it is called a:
   ___a. pre-emergence herbicide.
   ___b. post-emergence herbicide.
   ___c. post-transplant herbicide.
8. The application of a herbicide to the soil before planting the crop is called:
   ___a. pre-emergence application.
   ___b. contact application.
   ___c. preplant application.

9. The application of herbicide after the crop has come up or application after the crop and the weed have both come up is called:
   ___a. post-emergence.
   ___b. pre-plant herbicide.
   ___c. contact herbicide.

10. The uniform application of herbicides over an entire field is:
    ___a. broadcast application.
    ___b. band application.
    ___c. soil application.

11. Spraying a herbicide over a narrow strip down the center of each row or spraying a narrow strip between each row is called:
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    ___b. directed spray.
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12. Spraying herbicides directly at the weeds to avoid contact with the crop is called:
    ___a. directed spraying.
    ___b. spot treatment.
    ___c. band spraying.

13. The mixing of herbicides into the top one to two inches of the soil is called:
    ___a. pre-plant herbicide.
    ___b. post-emergent
    ___c. soil incorporation.

14. Herbicides can be best incorporated into the soil with:
    ___a. a bedding disk.
    ___b. a rolling cultivator.
    ___c. a flat disk.
15. The application of herbicides in certain spots in the field where weeds are a particular problem and other methods of control have failed is called:

   a. spot treatment.
   b. band application.
   c. broadcast application.

E. Herbicide Sprayers

In this section I will read you some questions on herbicide sprayers. Several answers will be listed for each question. Please indicate the answer you think is best by placing an X in the blank space next to the answer you have selected.

1. The most common herbicide sprayers used in vegetable production are:

   a. high pressure sprayers.
   b. low pressure sprayers.
   c. high volume, high pressure sprayers.

2. There are several types of pumps that can be used on a herbicide sprayer, but the most commonly used pump is the:

   a. piston pump.
   b. roller pump.
   c. centrifugal pump.

3. The aluminum and fiber glass tanks are highly recommended for herbicide sprayers. This is because they are:

   a. lighter.
   b. less susceptible to corrosion.
   c. will carry more water.
   d. easier to clean.

4. An agitator is a device used in the spray tank to keep the herbicide well mixed. Agitators are especially important when using:

   a. liquid herbicides.
   b. wettable powders.
   c. granular herbicides.
5. The pressure regulator on the sprayer is used to:
   a. start and stop the flow of spray material.
   b. increase agitation.
   c. adjust the spray pressure.

6. The pressure gauge is a meter used to indicate the amount of
   spray pressure being discharged to the nozzles. The best spray
   pressure is:
   a. 40 to 60 PSI.
   b. 140 to 160 PSI.
   c. 10 to 20 PSI.

7. There are two different types of spray nozzles used for weed
   control in vegetable crops. However, the regular flat fan
   nozzle 8001 to 8008 is used for:
   a. broadcast spraying.
   b. band spraying.
   c. directed spraying.

8. The second type of nozzle is the even flow flat fan nozzle. It
   is used for:
   a. broadcast spraying.
   b. band spraying.
   c. directed spraying.

9. The most commonly used nozzles are:
   a. inexpensive plastic nozzles.
   b. brass nozzles.
   c. stainless steel nozzles.

10. When making a broadcast spray application, the nozzles should be
    spaced on the boom so that:
    a. they are 10 to 15 inches from the soil surface.
    b. you get one-third overlap.
    c. they are 36 inches from spray surface.
F. Sprayer Calibration

In this section, we are going through the process of sprayer calibration. There are 12 steps involved in this process. I am going to read you several statements that are related to each statement. Please tell me which step is correct by placing an X in the blank space next to the statement you have selected.

1. The 1st step in sprayer calibration is:
   ___ a. clean all nozzles, screens and adjust spacing.
   ___ b. see if all nozzles are putting out the same amount.
   ___ c. fill spray tank.

2. The 2nd step is to:
   ___ a. see if all nozzles are putting out the same amount of spray.
   ___ b. make sure all nozzles are the same size.
   ___ c. adjust spray pressure.

3. The 3rd step is to:
   ___ a. check to see if all nozzles are putting out the same amount.
   ___ b. measure off the field.
   ___ c. check your speed.

4. The 4th step is to:
   ___ a. start your tractor and select the speed and pressure setting (40-60 PSI).
   ___ b. fill spray tank with water.
   ___ c. clean nozzles and screen.

5. The 5th step is to:
   ___ a. measure off one acre in the field.
   ___ b. spray the measured acre.
   ___ c. check your nozzles.
6. The 6th step in calibration is to:
   a. start your tractor, adjust pressure and speed.
   b. measure off one acre in field.
   c. fill spray tank.

7. In the 7th step, you should:
   a. spray the measured area in the field.
   b. check your nozzle.
   c. add herbicide recommended for an acre.

8. In the 8th step, you should:
   a. add the recommended herbicide for one acre.
   b. measure the amount of water needed to refill the spray tank.
   c. spray the field.

9. In the 9th step:
   a. add the same amount of water used to spray one acre to the tank.
   b. adjust tractor speed.
   c. you are ready to spray the field.

10. In the 10th step, you
    a. begin spraying the field.
    b. add the recommended amount of herbicide for one acre.
    c. fill spray tank.

The sprayer should now be correctly calibrated.
G. Herbicide Safety and Recommendation

In this section, I am going to read a few statements to you. Please listen to each statement and indicate if you think it is true or false. Some of them you may not know for sure, but try to answer all of them as best you can. If the statement is true, check "True"; if the statement is false, check "False." If you are not sure of the answer, check "Do Not Know."

1. There is no one herbicide recommended for vegetables that will control all weeds.
   - a. True
   - b. False
   - c. Do not know

2. No single weed control method is effective in controlling all weeds. The most effective weed control program includes a combination of methods.
   - a. True
   - b. False
   - c. Do not know

3. The label on the herbicide tells you if the herbicide should be applied before planting, after planting but before the crop comes up, or after it comes up.
   - a. True
   - b. False
   - c. Do not know

4. Some herbicides require overhead irrigation within 7 to 10 days after application. However, if an inch of rain falls within 7 to 10 days after application, no irrigation is required.
   - a. True
   - b. False
   - c. Do not know

5. Heavy soils that are high in organic matter usually require less herbicides.
   - a. True
   - b. False
   - c. Do not know
6. When applying herbicide you should use slightly more than the recommended rate to get control.
   ___a. True
   ___b. False
   ___c. Do not know

7. There are three ways in which contact with herbicides can damage your health: (1) swallowing, (2) breathing fumes from the herbicide, and (3) skin contact.
   ___a. True
   ___b. False
   ___c. Do not know

8. If you have accidently swallowed some herbicide, you should drink plenty of water and get plenty of rest.
   ___a. True
   ___b. False
   ___c. Do not know

9. To prevent herbicide injury, rubber gloves, rubber boots, goggles, and a respirator should be worn at all times when using herbicides.
   ___a. True
   ___b. False
   ___c. Do not know

10. All herbicides can damage your health, therefore, you should always read the label before buying, before mixing, before applying, before storing, and before disposing of the herbicide container.
    ___a. True
    ___b. False
    ___c. Do not know
APPENDIX C

QUESTIONNAIRE USED IN PRELIMINARY REVIEW OF VEGETABLE PRODUCTION IN THE PROPOSED STUDY AREA
PRELIMINARY REVIEW OF VEGETABLE PRODUCTION
IN THE
PROPOSED STUDY AREA

Informal Interview

1. How many acres of vegetables do you produce? 76 acres

2. What type of vegetables do you produce?

   18 Greens
   10 Beans
   5 Okra
   — Cantaloupe
   — Cucumbers
   — Watermelons
   4 Irish Potatoes
   12 Sweet Potatoes
   18 Peas
   — Corn, Sweet
   — Okra

3. What is your most important cash crop?

   — Greens
   — Beans
   — Okra
   — Cantaloupe
   — Cucumbers
   — Watermelons
   — Irish Potatoes
   — Sweet Potatoes
   — Peas
   — Corn, Sweet
   — Okra

4. What is your most important production problem? (list your first and second choices).

   12 second,
   7 first
   20 first,
   5 second
   10 second
   2 second,
   2 first

1. Insect control (4 farmers + 3 agents)
2. Weed control (12 farmers + 8 agents)
3. Disease control
4. Nematode control
5. Labor
6. Water
7. Available Seed
8. Available fertilizer

9. Other

5. Have you attended county or community meetings sponsored by the Cooperative Extension Service within the past twelve (12) months?

   11 Yes       7 No

6. If you did not attend a meeting was any of the following responsible for you not attending? (Please check)

   2 1. meeting time
   2 2. meeting place
   4 3. working hours
   1 4. traveling distance

   5. Others (Explain)
Jesse Harness was born August 14, 1944 in Magnolia, Mississippi. He attended elementary and secondary school at The South Pike Consolidated School District, graduating from high school from the Eva Garden Attendance Center.

In September, 1963, he entered Alcorn State University at Lorman, Mississippi and graduated in May, 1967 with a BS Degree in Agriculture Education.

He worked as Assistant County Agent for Mississippi Cooperative Extension Service in Collins, Mississippi from June, 1967 to June, 1971.

In June, 1971 he returned to school at the University of Florida where he completed a M.A. Degree in Vegetable Crops.

In July of 1972 he began work with the Alcorn State University, Branch of Mississippi Cooperative Extension Service, as an Area Horticultural Specialist. In 1976, he joined Louisiana State University to study for a Ph.D.

The author is married to Mary E. Isaac Harness and they have three children.
EXAMINATION AND THESIS REPORT

Candidate: Jesse Harness

Major Field: Horticulture

Title of Thesis: A Study of Learning Modules and the Traditional Lecture Discussion Method for Teaching Weed Control Practices to Small Vegetable Farmers

Approved:

[Signatures of Major Professor and Chairman, Dean of the Graduate School]

EXAMINING COMMITTEE:

[Signatures of Committee Members]

Date of Examination:

November 26, 1979