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Experimental evaluation of video-tape on instruction in vocational agriculture

by

Herbert Eugene Hansen

A Dissertation Submitted to the Graduate Faculty in Partial Fulfillment of The Requirements for the Degree of DOCTOR OF PHILOSOPHY

Major Subject: Agricultural Education

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

Head of Major Department

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Dean Graduate College

Iowa State University
Of Science and Technology
Ames, Iowa

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The purpose of this study was to investigate the effectiveness of video-taped instruction in selected vocational agriculture departments in Iowa. Twelve schools were randomly selected from all those that met certain criteria with six being assigned to the treatment and six to the control groups. Four subject matter units were selected which were typical of the four grade levels of vocational agriculture, namely, animal health, commercial fertilizers, small gas engines, and farm credit. Subject matter outlines and reference material were furnished to all schools to be used during the three-week experiment. Four video-taped segments designed to reinforce specific learning objectives were provided to the treatment schools in each subject matter area.

Data were collected on each student concerning aptitudes, interests, experiences, home farm and family factors. Information was also gathered relative to teacher knowledge, attitudes, experience and class size. The method of evaluation was achievement as measured by pre- and posttests.

Since schools were the sampled units, school means were computed and used as the basis for analysis. The statistical methods used on the data included analysis of variance, step-wise regression, analysis of covariance and two-factor experiment with repeated measures.
The findings of the study may be summarized as follows: (1) no differences in pretest scores were measured between the experimental groups, (2) no differences in posttest scores were measured between the groups due to video-tape when other factors were made equal through the analysis of covariance technique, (3) no differences in gain scores due to video-tape were measured between the groups when other factors were made equal through the analysis of covariance technique, and (4) both groups gained a significant amount of knowledge during the experiment. The factors used as covariates which were identified by the step-wise regression technique included 16 personal factors, 5 home farm and family factors and 5 teacher and school factors.

It was concluded that video-tape, when used as a supplement to instruction in vocational agriculture, is an effective technique of teaching. Even though its use did not appear to increase student achievement, the media is expected to be more widely used by vocational agriculture teachers. Further studies should include design factors to overcome the effect of the teacher variable and also should include methods of evaluation in addition to student achievement.
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INTRODUCTION

Large amounts of funds have been spent by educational institutions for instructional aids. Instructional materials, or media centers, are being developed by many schools and the use of instructional aids has become routine in many classrooms.

New developments in technology are permitting the design of new audio-visual equipment adaptable to classroom use. One of the newer innovations, now available in the local schools, is instructional television. Even though use of television as an entertainment media has been common for years, its use in the classroom has recently been made possible by the development of small, compact equipment for recording and playback. Along with the development of this smaller equipment, the costs of such equipment has been greatly reduced.

Vocational agriculture teachers have been leaders in the use of audio-visual aids in their classrooms. Overhead projectors, slide and filmstrip projectors, 16mm sound film and opaque projectors are standard equipment in many vocational agriculture classrooms. A few instructors are beginning to experiment with video-tape equipment which is available in their schools.

As video-tape equipment becomes more widely available in secondary schools, information is needed about the use of the media by the classroom teacher. It is estimated about 50 percent of Iowa schools in 1970 owned video-tape equipment. This study was conducted to determine how video-tape might best be used by vocational agriculture teachers in their instructional programs.

Television as an instructional media presents some unique problems
which must be confronted when planning an experiment of its use. Among these is the fact that students see and hear a large amount of television outside of school. Wittich and Schuller (13), commenting on this problem in their book, "Audiovisual Materials," state (pp. 2-3),

The classroom pupil today is the product of a modern communications world. Over the weekend or during the preceding evening, he may have given his entire attention to television, radio, newspaper, entertainment film, comics, and slick-paper picture magazine. When this pupil enters the classroom the next morning, he brings with him vivid understandings gained through the many demands for his attention made by various communications media.

These authors listed barriers to communications which exist in the school classroom. They are:

1. Verbalism
2. Referent confusion
3. Daydreaming
4. Imperception
5. Disinterest
6. Physical discomfort

Fortunately, good audio-visual aids help to overcome these barriers since they have a tendency to command the attention of the student, at least for short periods of time.

These same authors, in discussing the topic of how students learn, call perception the foundation of learning and state (pp. 30-31):

Our perceptor sensory mechanisms are our continuing contacts with our world of things and events. The eye, the ear, the nerve endings which respond to pressure, to heat and cold, and to odors and tastes are the means of perception.

The normal learner, insofar as the functions of his perceptor mechanisms are concerned, gains understanding in terms of multiple impressions recorded through eye, ear, touch, etc.
These functions do not occur in isolation but rather through a blended pattern from any or all of the perceptor mechanisms that are stimulated by external occurrences.

Effective perception is thus a blending of sensations which then gives rise to thoughtful shuffling, arranging, and selection of a pattern. This pattern may be thought of as an understanding of an event or object.

In their book, "Teaching Vocations," Hammonds and Lamar (4) list three principles of learning which also must be considered when planning the use of visual aids. The first, the principle of self-activity or practice, was defined (p. 178) as: "We learn from what we do; continued doing or use or practice is usually necessary for retention of learning." The authors' second principle was the principle of effect defined (pp. 186-187) as:

Satisfaction of the experience or its results promotes learning insofar as it makes for intensity of the experience or encourages more of it; annoyance of the experience or its results may promote learning insofar as it makes for intensity of experience or causes better responses to be made, but hinders learning insofar as it discourages further experience.

The third principle was the principle of association and was defined (p. 193) as follows: "Experiences that occur together tend to recur together."

These concepts indicate a deeper involvement by the student rather than the passive one which might be necessitated when the student is observing a visual-aids presentation. The use of video-tape in this setting seems to present some problems since during the presentation of video-tapes the student becomes a passive observer.

It was the purpose of this study to investigate the effectiveness of video-taped instruction in selected vocational agriculture departments in Iowa. For this study the researcher assumed that the role of video-tape should be a supplement to instruction rather than the main medium of communication or experience. Therefore, the video-tapes for this experiment
ranged from 12 to 15 minutes in length and were designed to reinforce the specific learning objectives on the day shown. It was also assumed that student achievement should be the basis for evaluation of the effectiveness of the technique.

Specifically, the objectives of this study were:

1. To determine the effectiveness of video-tape in vocational agriculture as measured by student achievement.

2. To determine those factors which are related to achievement in vocational agriculture when video-tape is used.

3. To determine the implications of the use of video-tape in vocational agriculture.

This study was a part of a larger overall study entitled "An Experimental Evaluation of the Effectiveness of Selected Techniques and Resources on Instruction in Vocational Agriculture." It incorporated eight teaching techniques including: (1) audio-tutorial, (2) single concept films, (3) prepared lesson plans, (4) field trips, (5) demonstrations, (6) transparencies, (7) video-tape and (8) control. The project was under the direction of Department of Agricultural Education at Iowa State University with funds provided by the Iowa Department of Public Instruction, Research Coordinating Unit and the Iowa Agriculture and Home Economics Experiment Station.
REVIEW OF LITERATURE

There has been a great deal of research on the use of instructional television. Most of this study, however, was instructional television compared with face to face instruction. There have been some studies using video-tape as a supplement to instruction, however, no studies were found by the researcher examining the use of video-tape in teaching vocational agriculture.

In the literature, two terms may be used in reference to the subject of television. They are "educational television" (ETV) and "instructional television" (ITV). Some authors did not discriminate between these two terms. Generally, educational television is defined as broadcast television usually intended for large audiences with learning objectives not well defined. Instructional television is defined as television prepared for a specific unit or class problem, and entailing a high degree of coordination in preparation and showing in order that specific learning objectives may be met. Instructional television segments may be played back by the individual classroom instructor or may be beamed through a closed circuit system to several classrooms on a scheduled basis.

Schramm (9) of Stanford University, in summarizing 393 research reports of instructional television, found that 65 percent of the studies showed no significant difference between classes taught with television as compared to those without. He found that 21 percent revealed significant differences in favor of instructional television at the five percent level and beyond, whereas, 14 percent of the reports indicated televised lessons to be significantly less effective than face to face instruction. These
studies involved students from the third grade through college and included the following subject matter areas: mathematics, sciences, social studies, humanities, history, literature, arts, language skills, health and safety.

The data revealed that for grades 3 through 9, 33 percent learned more from ITV, 11 percent learned less, and 56 percent resulted in no significant differences. For high school students, 13 percent of the studies showed ITV to be more effective, 24 percent less effective, and 63 percent indicated no differences. For college students, 3 percent of the reports reviewed indicated ITV to be more effective, 13 percent revealed it less effective, and 84 percent resulted in no significant differences.

Schramm concluded that there were differences in performance of students due to subject matter with mathematics and science students tending to perform better with ITV, and history, humanities and literature students taught with use of ITV to learn less effectively than with face to face instruction. He also found interaction between grade level and subject matter with students studying language skills by use of ITV to attain less effectively at lower grade levels, and mathematics students to attain more effectively in lower grades than in high school.

In evaluating student attitudes toward ITV, Schramm (9) cited a study in Indiana which revealed that 66 percent of the students studying government and socio-economics liked the TV class, whereas only 37.1 percent of the geometry students liked it better than face to face instruction.

A Nebraska study of 267 high school students indicated that the students thought they learned more from ITV in English, art and physics, but liked ITV only with the art course better than classroom instruction. They also liked classroom instruction better than TV instruction in algebra,
geometry and Spanish.

Teacher attitudes were also measured in several studies. In general, most teachers indicated they thought students learned more from ITV. Most resistance to the use of ITV was found at the college level. However, in a study in Oregon, from 42 to 68 percent of the faculty thought ITV was a "pretty good approach; should have some use."

In summary, Schramm (9, pp. 66-67) stated:

On the basis of this information, what can we say about the process of learning from instructional television?

We can say confidently that students learn from it and that they learn fast and efficiently. But of that we have been fairly certain for some time. The further step we have now taken has put us in position to say something about the conditions under which a student learns more from television and something about what he learns from television.

What are the great weaknesses of television? It doesn't stop to answer questions. It doesn't readily permit class discussion. It can't very efficiently conduct drill. It doesn't adjust very well to individual differences. It tends to encourage a passive form of learning rather than an active seeking.

It also has great strengths. It is very good at bringing demonstrations to the classroom: it lets everyone look through a microscope at the same time, gives all the medical students a good view of surgery, handles films and other changes from straight classroom presentation with a minimum of transitional difficulty. It lets a school or a college share its best teachers, rather than rationing them. It provides a change of pace, often a lift, for the classroom. It brings a sense of timeliness to classes where that helps. It concentrates attention.

After summarizing the differences between student achievement with use of ITV in grade schools as compared to colleges, Schramm (9, pp. 68-69) continued,

There is a difference that is still more important between the meaning of television to the lower grades and to the higher ones and college.
In grade school, television is typically thought of as only a part of the learning experience, and efforts are taken to integrate it, just as the textbook, the film, the blackboard, the class drill, are integrated. The teacher is with the child five hours a day, and only half an hour or so of that is given over to television teaching. Therefore, the lesson is carefully built around the television experience. Care is taken to motivate the children to want to learn from television, and to ask the teacher the questions they cannot ask television directly. The program is thus prepared for, and followed up, and is accompanied by other learning experiences (such as drill and discussion) which television cannot so readily accomplish.

In other words, it is usually the classroom teacher, rather than the television teacher, who is in command of the situation. The TV teacher is a valued ally and helper. But a teaching team is in operation, the different roles are meshed, and the student still has a teacher of his own to give him personal attention and help him progress in his own best way.

Schramm did not find any important differences in achievement when comparing students of different abilities when taught with television.

A study was conducted by Law (6) to compare the various uses of TV as a medium of instruction. This researcher applied the treatment in two manners. One group of college education students had the teacher replaced with TV lessons while the other group received 25 minutes of TV instruction and 25 minutes of lecture and discussion per period. No significant differences were found between the groups.

Entorf (2) conducted an experimental study to determine the effectiveness of video-taped, closed circuit television in teaching selected woodworking units in a beginning college industrial education course for architectural students. Video-taped lessons were compared with the conventional method of teaching information, which was described as lecture presentation supplemented with visual aids. The methods were used to teach four units of related technical information of a beginning woodworking course.

The method of evaluation was student understanding and retention as
measured by a teacher constructed achievement test, and a student questionnaire.

Selected units of related technical information were selected to be taught to treatment and control groups. Teaching programs were developed for each unit and validated by a jury of specialists in the field. The same instruction and homework were provided to each group.

A crossover design was used so that each student received both treatment and control methods. Sections were randomly assigned to the experiment and control groups for the first half of the experiment and then were reversed with the treatment group becoming control, etc.

The four units selected were: (1) forests and trees, (2) harvesting and manufacturing lumber, (3) methods of fastening and (4) wood lamination. Video-tapes were prepared and taped with the advice of a television production staff. Visual aids used on the video-tapes were: slides, sound motion picture film, samples of materials, charts and key cards. A written script was closely followed during the taping sessions and key words or phrases were superimposed on the screen as each topic was discussed. The teachers of the control sections received a copy of the unit outline and supplemented their teaching with 99 slides and a 32 minute sound motion picture film.

The evaluation instruments contained four-answer multiple choice questions. The tests were given as a pretest, then immediately after the lesson was given, again at the end of the four-week period, and after 14 weeks had passed. The tests were primarily power tests but after trials, time was limited to 35 seconds per question. Test reliability ranged from .56 to .77.
A scholastic aptitude test was given all students in order to check for homogeneity between sections. It was concluded that the sections were equal. The student questionnaire was administered at the end of the four-week experiment. The chi-square technique was used to analyze the responses to the questionnaire.

The analysis of variance technique was used to test the differences between the treatment and control group means on the pretest with no significant differences found.

The posttest was also analyzed with the analysis of variance technique and significant differences were found between units, methods and interaction between units and methods beyond the .01 level, when the posttest was administered immediately after the lesson.

Similar results were found when the posttests were given at the end of the four-week experiment, however, when the posttest was given after 14 weeks, the interaction between units and methods was not significant.

Differences between treatment and control groups were measured with the pooled t test for each of the four units and at each of the three test administrations. Significant differences were found between treatment and control when the posttest was administered immediately after the lesson for units 1, 2 and 4. When the posttest was administered at the end of the four-week unit, significant differences were found for unit 4 and after 14 weeks differences were found between treatment and control for units 1 and 4.

The analysis of the questionnaire data, using the chi-square technique, revealed the students preferred the lecture method over the videotape method beyond the .01 level. They also felt the lecture method cov-
ered the material better. The students' objection to video-tape was attributed to the fact that they were unable to take comprehensive notes or ask questions during the presentation of the taped lessons.

Entorf (2) concluded that video-tape could be used to make more efficient use of the teacher's time and that it is an effective means of imparting related technical information in a woodworking course. His recommendations for further study included repeating the experiment in other areas of industrial education and using junior high and high school students. He also recommended including manipulative demonstrations in the tapes.

The use of video-tape as a supplement to instruction in a beginning welding and metals course in college was investigated by Pothoven (8). The video-tapes were used as supplements to lectures and also included demonstrations of four laboratory projects in metals. Lecture topics associated with the use of video-tapes were: (1) steel production, (2) specifications and shapes, (3) heat treating of metals, (4) metal properties and (5) identification of metals. Laboratory demonstrations included were: (1) making a tool gage, (2) forging a cold chisel, (3) forging and threading an eyebolt and (4) sharpening a drill bit. The video-tapes ranged in length from 25 to 35 minutes.

The method of evaluation was achievement as measured by identical pre- and posttests. The experiment was replicated twice with 51 students used the first half of the quarter and 23 the second half. Students in six laboratory sections were randomly assigned to two instructors. Each laboratory instructor had both treatment and control sections. A third instructor taught all lecture sections. Laboratory project scores were assigned
by an instructor not otherwise connected with the experiment.

The student's t test was used to compare differences between treatment and control groups with the video-tape group showing significantly better laboratory scores on the cold chisel, eyebolt and total laboratory score.

The analysis of covariance technique was used to determine the effect of four selected covariates on the pretest, posttest and laboratory scores. The F-value obtained verified the t-values obtained and indicated the video-tape group to have significantly better laboratory scores at the .01 level.

Pothoven (8) concluded that the data indicated video-tape could be used as a supplement in lecture to improve laboratory skills.

Beane (1) investigated the relationship between instructor's knowledge and the level of his student's academic achievement in agriculture using various techniques of instruction.

Instructors were administered a 45 item pretest before teaching three-week units in animal health, commercial fertilizers, small gas engines and farm credit. The instructors were grouped into high, medium and low, equal sized groups.

An F-value significant at the .05 level was obtained between groups as measured by the posttest. A student's t test was used on the data with a significant t-value at the .05 level obtained between high and low, medium and low, but not between the high and medium groups. When each subject matter was analyzed separately, farm credit was found to reveal significant differences between groups. The student's t test was again used indicating a significant t-value between the medium and low groups at the .05 level.

Another analysis concerned the instructors' gain in knowledge during
the teaching of the three-week units. Pre- and posttest scores indicated instructors gained a significant amount of knowledge in all subject matter areas. When students were grouped according to their instructors' gain in knowledge, significant differences were found between students' posttest scores in small gas engines.

Beane's findings included (1, p. 54):

1. In general, student's achievement was found to be related to their instructor's knowledge of the subject matter. This was not the case in the specific subject matter units of animal health, commercial fertilizers and small gasoline engines.

2. Instructor's knowledge of the subject matter unit increased as they taught the unit.

3. In general, student achievement was not related to their instructor's change in knowledge of the subject matter. This was not the case in the small gasoline engines unit.

4. There was no significant interaction between instructors' knowledge and instructional media used.

5. There was no significant interaction between instructors' change in knowledge and instructional media used.

6. In general, student's whose instructors were in the medium group had the highest level of achievement and students whose instructors were in the low group had the lowest achievement.

A study to determine the relationships of class size and department enrollment to effectiveness of selected instructional media in vocational agriculture was conducted by Tindall (12). Class size ranged from 7 to 27 with department size ranging from 36 to 79 students.

The criterion for evaluation was student achievement as measured by the gain between pretest and posttest. Tindall concluded that students in larger departments achieved more effectively when audio-tutorial, single concept films and video-tape techniques were used.
In a study conducted under the same overall project as the one undertaken by the author, Klit (5) investigated the effectiveness of single concept films in high school vocational agriculture. During the experiment, 21 short single concept films were shown to the treatment group on selected days covering specific objectives to be taught.

Using the analysis of variance technique he found no significant differences in pretest and posttest scores between the treatment and control groups. He did, however, find significant differences in favor of the control group for the animal health unit when gain scores were used. Using a two-factor experiment with repeated measures technique, Klit found both groups gained a significant amount of knowledge during the three-week period in all subject matter areas.

In a similar study, McVey (7) tested the use of an audio-tutorial system for teaching animal health, commercial fertilizers, small gas engines and farm credit to vocational agriculture students. A synchronatated slide and tape system was used with four slide-tape programs prepared for each of the four subject matter units. The programs ranged from 12 to 19 minutes in duration.

In the analysis of the data, McVey found no significant differences between the treatment and control groups when pretest and posttest scores were used. When the analysis of covariance technique was used he found significant differences between the groups in favor of the treatment in the farm credit posttest scores.

Stickell (11) reviewed 250 studies comparing televised instruction and direct instruction. According to his strict requirements for adequate experiment designs, he classified 217 of the studies as "uninterpretable,"
23 were classified as "partially interpretable," whereas only 10 were classified as "interpretable." All of these 10 studies revealed no significant difference at the five percent level.

In writing in the introduction to Reid and MacLennan's "Research in Instructional Television and Film," Leslie P. Greenhill (3) commented on the high frequency of nonsignificant differences in research of video-tape. He (3, p. 4) stated:

Many administrators and researchers have expressed disappointment at the frequency with which nonsignificant differences in learning have resulted from comparisons of direct and televised instruction and they seem to regard this finding as a negative result.

In the section on possible lines for future research given below, some of the reasons why nonsignificant differences seem to typify the results of this kind of research will be discussed. Although a finding of no significant difference does not prove that no differences exist, there is a practical value in such results in that consistent findings of nonsignificant differences in learning from different instructional methods give educational administrators some confidence that several alternative methods of instruction are available for use, and allow them to choose which one should be used in a specific situation on the basis of considerations other than relatative instructional merits.

For example, television has excellent distributive powers. It can extend instruction (good or bad) to many places simultaneously. It is, therefore, an excellent means of extending experienced teachers and above-average teaching resources to larger numbers of students than would be possible under direct instruction. In this way television can offset a shortage of experienced teachers. To the extent that the television teacher is more experienced than the available classroom teachers and has better instructional resources than might be available to the average classroom teacher, it is possible that televised instruction can be superior to direct teaching. Some of the findings favoring televised instruction can possibly be accounted for by differences in the abilities of the teachers in the comparison situations rather than by the influence of television per se.

Another reason for using television might be to offer courses that would otherwise be unavailable. In some cases there might also be economic advantages in using televised instruction.
It is for these reasons that the use of instructional television has expanded so rapidly during the past 10 years.

Greenhill (3) further pointed out other uses of instructional television which included: (1) observation of demonstration teaching, (2) inservice training and professional training, and (3) teaching performance skills.
METHOD OF PROCEDURE

Subject Matter Units

Typical subject matter units were selected in order that the teaching techniques might be used at the four grade levels of vocational agriculture. These units and the classes taught were: animal health--Vo-Ag I, commercial fertilizers--Vo-Ag II, small gas engines--Vo-Ag III and farm credit--Vo-Ag IV. Lesson plans for a three-week period were developed for each of the four units. These lesson plans included daily objectives, problems, assignments and references (Appendix A).

The specific areas covered in each of the subject matter units were:

1. Animal health - The identification, causes, prevention, and control of the major swine, sheep and cattle parasites and diseases.

2. Commercial fertilizers - The study of the essential plant food elements, crop hunger signs, soil sampling, liming, fertilizer application rates and selection of fertilizers.

3. Small gas engines - The principles of operation of the two- and four-stroke cycle engines, functions of the engine parts, measuring devices and preventive maintenance in small gas engines.

4. Farm credit - Budgeting principles, types of loans, sources of credit, interest rates, collateral, credit instruments and the use of farm credit.

Selection of Schools

Twelve schools were randomly selected from Iowa vocational agriculture departments with six assigned to each the treatment and control groups. Restrictions applied to the sample were: (1) the teacher must have at
least one year of teaching experience, (2) separate classes must be held for each grade level, (3) a minimum of seven students must be enrolled in each class, (4) no more than 22 students may be enrolled in each class and (5) at least 35 students must be enrolled in each department. The number of students enrolled in each class of each school were detailed in Table 1. The geographical location of the participating schools was charted in Figure 1.

Each school was visited to obtain agreement to participate in the study. Upon favorable consideration by the teacher and administration, participation agreements were signed by the school administrators and the chairman of the Agricultural Education Department at Iowa State University.

Preparation of Video-Tapes

Four video-taped segments were prepared for each subject matter unit. These segments covered the specific objectives to be taught on the day shown. The video-tapes were prepared at WOI-TV at Iowa State University with some portions filmed outside the studio and transferred to video-tape during the taping sessions. Slides, charts, props, models and chalkboard were also used with the presentations during taping. Experts in each subject matter field were used as resource persons on the video-tapes.

The equipment selected for the experiment included Ampex model 5000 and 5100, one inch, slant track video-tape recorders. This equipment was selected primarily because it was compatible with the recording equipment at WOI-TV. Each school was also furnished with a 23" Setchell-Carlson television receiver. The video-tape recorder was used as a playback unit only.
Table 1. Number of students by group, school and subject matter area

<table>
<thead>
<tr>
<th>School</th>
<th>Animal health</th>
<th>Commercial fertilizers</th>
<th>Small gas engines</th>
<th>Farm credit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Video-tape</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarion</td>
<td>12</td>
<td>17</td>
<td>18</td>
<td>17</td>
<td>64</td>
</tr>
<tr>
<td>Eldridge</td>
<td>14</td>
<td>18</td>
<td>9</td>
<td>14</td>
<td>55</td>
</tr>
<tr>
<td>Mediapolis</td>
<td>27*</td>
<td>17</td>
<td>15</td>
<td>20</td>
<td>79</td>
</tr>
<tr>
<td>Waukon</td>
<td>13</td>
<td>13</td>
<td>17</td>
<td>14</td>
<td>57</td>
</tr>
<tr>
<td>West Branch</td>
<td>13</td>
<td>8</td>
<td>15</td>
<td>8</td>
<td>44</td>
</tr>
<tr>
<td>Winterset</td>
<td>14</td>
<td>12</td>
<td>15</td>
<td>8</td>
<td>49</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>93</td>
<td>85</td>
<td>89</td>
<td>81</td>
<td>348</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alta</td>
<td>12</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>Everly</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>11</td>
<td>36</td>
</tr>
<tr>
<td>Hartley</td>
<td>13</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>39</td>
</tr>
<tr>
<td>Rock Valley</td>
<td>10</td>
<td>9</td>
<td>3</td>
<td>10</td>
<td>37</td>
</tr>
<tr>
<td>Sac City</td>
<td>10</td>
<td>9</td>
<td>13</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>West Liberty</td>
<td>16</td>
<td>10</td>
<td>10</td>
<td>9</td>
<td>45</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>67</td>
<td>52</td>
<td>58</td>
<td>55</td>
<td>232</td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td>160</td>
<td>137</td>
<td>147</td>
<td>136</td>
<td>580</td>
</tr>
</tbody>
</table>

*Taught in two sections.
Figure 1. Geographical location of participating schools

C - Control school
T - Treatment school
Collection of Data

In preparation for the experiment, several tests were given to all students participating in the project. These included the Otis IQ Test (Short form), Differential Aptitude Test (Mechanical, Abstract reasoning and Verbal), Nebraska Agricultural Achievement Test and Kuder General Interest Survey (Form E including outdoor interest, computational interest, scientific interest, persuasive interest, artistic interest, literary interest, social service interest and clerical interest). All tests were administered by the high school guidance personnel. Scores of these tests were converted to percentile ranks according to national norms.

Students were also asked to indicate those activities or skills in which they had participated in each of the subject matter areas. These student skill sheets were scored and the scores converted to percentages according to the proportion completed out of the list.

Home farm and family information was gathered on each student including crop acres on the home farm, noncrop acres on the home farm, total acres on the home farm and number of animal units on the home farm. Family background information included the number of older brothers, number of younger brothers, number of older sisters, number of younger sisters and total number of brothers and sisters.

Educational background information gathered on each student included semesters of science, semesters of mathematics, semesters of business, semesters of vocational agriculture and semesters of industrial arts. Vocational agriculture class size and department size were also recorded and used as independent variables.

Teacher factors recorded were teacher knowledge of the subject matter,
teacher attitude, teacher tenure and teacher experience. Teacher knowledge of the subject matter was determined by a test given all teachers before the project began and teacher attitude scores were obtained by the Minnesota Teacher Attitude Inventory.

Training of Teachers

Teachers were brought together twice for orientation and training for the experiment. The first meeting was held to familiarize the teachers with the project and to explain the controls to be exercised. The teacher knowledge pretest was given at this time. The second meeting was held at the Iowa State University campus at which time the teachers were given their final instructions and familiarized with the video-tape equipment. This meeting was held the weekend before the experiment started.

Conduct of the Experiment

At the start of the experiment, students were given a pretest over the subject matter to be studied. Scores were converted to percentages and instructors were not allowed to see the pretest. The pretest was developed to measure the objectives which were developed for the unit. These tests, which were also the posttests, were item analyzed to determine their reliability. The reliability estimates obtained were:

1. Animal health - .85
2. Commercial fertilizers - .85
3. Small gas engines - .85
4. Farm credit - .87

Specific questions which were related to the objectives to be taught on the days the treatment was applied were identified and analyzed separately and
identified as objectives scores whereas the total scores were identified as overall scores.

During the experiment, the video-taped segments were shown on the appropriate day as listed in Table 2. Only one malfunction of equipment was reported during the experiment. This was repaired within 24 hours of reporting and did not interrupt the proper sequence or timeliness of presentation of the tapes in the school.

At the conclusion of the three-week unit, students were administered a posttest which was identical to the pretest. These scores were converted to percentages in preparation for computing school means. Two methods of evaluating the outcomes of the experiment were used, posttest and gain. The pretests and posttests were evaluated in terms of the overall scores achieved. Attainment was also evaluated in terms of the specific questions which pertained to the objectives taught on the day that the video-tapes were used. In the analysis, these are identified as overall scores and treatment day objectives scores.

The data were coded onto 80 column data cards and computations were made by the Computation Center at Iowa State University. Since schools were the sampling units, school means were the bases for all comparisons. Statistics were in accordance with Snedecor and Cochran (10).

**Statistical Models**

The model used for the single class analysis of variance was:

\[ Y_{ij} = \mu + a_i + \varepsilon_{ij} \]

Where:

\[ Y_{ij} = \text{the pretest, posttest or gain measurement of the } j\text{th school} \]
Table 2. Video-tape segments by subject matter area, title and day used

<table>
<thead>
<tr>
<th>Area</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal health</td>
<td></td>
</tr>
<tr>
<td>1. Introduction</td>
<td>2</td>
</tr>
<tr>
<td>2. Cattle parasites</td>
<td>5</td>
</tr>
<tr>
<td>3. Swine diseases</td>
<td>9</td>
</tr>
<tr>
<td>4. Planning the health program</td>
<td>12</td>
</tr>
<tr>
<td>Commercial fertilizers</td>
<td></td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Taking a soil sample</td>
<td>5</td>
</tr>
<tr>
<td>3. The soil test report</td>
<td>9</td>
</tr>
<tr>
<td>4. Determining application rates</td>
<td>11</td>
</tr>
<tr>
<td>Small gas engines</td>
<td></td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Measuring devices</td>
<td>6</td>
</tr>
<tr>
<td>3. Carburetion</td>
<td>7</td>
</tr>
<tr>
<td>4. Ignition</td>
<td>11</td>
</tr>
<tr>
<td>Farm credit</td>
<td></td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Types of loans</td>
<td>6</td>
</tr>
<tr>
<td>3. Loan sources</td>
<td>7</td>
</tr>
<tr>
<td>4. Evaluating loan applications</td>
<td>10</td>
</tr>
</tbody>
</table>
within the $i$th technique,
$\mu$ = the pretest, posttest or gain overall grand mean,
$\alpha_i$ = effect of the $i$th technique,
$\epsilon_{ij}$ = effect due to error,

And:

$i = 1, 2,$
$j = 1, 2, \ldots, 6.$

The model used for the analysis of covariance was:

$$y_{ij} = \mu + \alpha_i + \beta_1(x_{ij} - \bar{x}_i) + \beta_2(x_{ij} - \bar{x}_j) + \cdots + \beta_k(x_{ij} - \bar{x}_k) + \epsilon_{ij}$$

Where:

$y_{ij}$ = the pretest, posttest or gain measurement of the $j$th school within the $i$th technique,
$\mu$ = the pretest, posttest or gain overall grand mean,
$\alpha_i$ = effect of the $i$th technique,
$\beta_1, \beta_2, \ldots, \beta_k$ = regression coefficients,
$x_{ij}$ = covariate measurement of the $j$th school within the $i$th treatment,
$\bar{x}_i$ = covariate grand mean,
$\epsilon_{ij}$ = effect due to error,

And:

$i = 1, 2,$
$j = 1, 2, \ldots, 6,$
$k = 1, 2, 3.$

The model for the step-wise regression was:

$$y_{ij} = \beta_0 + \beta_1x_1 + \beta_2x_2 + \cdots + \beta_kx_k + \epsilon_{ij}$$
Where:

\[ Y_{ij} = \text{the posttest or gain measurement of the } j\text{th school within the } i\text{th technique}, \]

\[ \beta_0 = \text{Y intercept or the height of the regression line at the origin}, \]

\[ \beta_1, \beta_2, \ldots, \beta_k = \text{regression coefficients}, \]

\[ x_1, x_2, \ldots, x_k = \text{independent variables used to predict posttest or gain scores}, \]

\[ \varepsilon_{ij} = \text{effect due to error}, \]

And:

\[ i = 1, 2, \]

\[ j = 1, 2, \ldots, 6, \]

\[ k = 1, 2, 3. \]

The model used for the analysis of variance with four subject matters combined was:

\[ Y_{ijk} = \mu + \alpha_i + \epsilon_{ij} + \beta_k + (\alpha\beta)_{ik} + \delta_{ijk} \]

Where:

\[ Y_{ijk} = \text{the posttest or gain measurement of the } k\text{th class of the } j\text{th school within the } i\text{th technique}, \]

\[ \mu = \text{the posttest or gain overall grand mean}, \]

\[ \alpha_i = \text{effect of the } i\text{th technique}, \]

\[ \epsilon_{ij} = \text{effect due to error associated with the } j\text{th school within the } i\text{th technique}, \]

\[ \beta_k = \text{effect of the } k\text{th subject matter}, \]

\[ (\alpha\beta)_{ik} = \text{effect of the technique by subject matter interaction}, \]
\[ \delta_{ijk} = \text{effect due to error}, \]

And:

\[ \begin{align*}
  i &= 1, 2, \\
  j &= 1, 2, \ldots, 6, \\
  k &= 1, 2, \ldots, 4.
\end{align*} \]

The model used for the two factor experiment with repeated measures was as follows:

\[ Y_{ijk} = \mu + \alpha_i + \varepsilon_{ij} + \beta_k + (\alpha\beta)_{ij} + \delta_{ijk} \]

Where:

\[ Y_{ijk} = \text{the pretest and posttest measurement of the kth repeated measure of the jth school of the ith technique}, \]
\[ \mu = \text{the pretest and posttest overall grand means}, \]
\[ \alpha_i = \text{effect of the ith technique}, \]
\[ \varepsilon_{ij} = \text{effect due to error associated with the jth school within the ith technique}, \]
\[ \beta_k = \text{effect of the repeated measure (pretest and posttest)}, \]
\[ (\alpha\beta)_{ik} = \text{effect of the technique by repeated measure interaction}, \]
\[ \delta_{ijk} = \text{effect due to error}, \]

And:

\[ \begin{align*}
  i &= 1, 2, \\
  j &= 1, 2, \ldots, 6, \\
  k &= 1, 2.
\end{align*} \]

According to Snedecor and Cochran (10, pp. 560-562), the F-values necessary for significance for 1 and 10 degrees of freedom are 4.96 at the 5 percent level and 10.04 at the 1 percent level. For 1 and 7 degrees of freedom, the values necessary are 5.59 at the 5 percent level and 12.25 at
the 1 percent level. For 3 and 30 degrees of freedom, these authors list F-values of 2.92 and 4.51 as necessary for significance at the 5 and 1 percent levels, respectively.

In the findings, the step-wise regression technique was referred to as the step-wise technique.

When the null hypotheses were stated in the findings, it was assumed that the differences measured would have to be due to video-tape before the hypotheses could be rejected.
FINDINGS

Analysis of Pretest Scores

The analysis of the data of this study was based on the testing of several null hypotheses. The first hypothesis stated was:

$H_0^1$: There is no difference between treatment and control groups as measured by the animal health pretest.

Pretest mean scores and standard deviations by group and subject matter area are listed in Table 3. The treatment group had an animal health

Table 3. Pretest means and standard deviations by group and subject matter area

<table>
<thead>
<tr>
<th>Area</th>
<th>Treatment</th>
<th></th>
<th>Control</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. dev.</td>
<td>Mean</td>
<td>Std. dev.</td>
</tr>
<tr>
<td><strong>By overall percentage scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal health</td>
<td>37.11</td>
<td>2.88</td>
<td>34.04</td>
<td>5.87</td>
</tr>
<tr>
<td>Commercial fert.</td>
<td>27.46</td>
<td>3.17</td>
<td>33.62</td>
<td>5.67</td>
</tr>
<tr>
<td>Small gas engines</td>
<td>41.33</td>
<td>5.24</td>
<td>38.42</td>
<td>8.21</td>
</tr>
<tr>
<td>Farm credit</td>
<td>47.13</td>
<td>8.95</td>
<td>48.39</td>
<td>6.27</td>
</tr>
<tr>
<td><strong>By objectives percentage scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal health</td>
<td>39.06</td>
<td>3.00</td>
<td>34.71</td>
<td>7.35</td>
</tr>
<tr>
<td>Commercial fert.</td>
<td>30.46</td>
<td>5.66</td>
<td>36.38</td>
<td>7.13</td>
</tr>
<tr>
<td>Small gas engines</td>
<td>38.92</td>
<td>6.70</td>
<td>36.15</td>
<td>9.34</td>
</tr>
<tr>
<td>Farm credit</td>
<td>52.72</td>
<td>10.17</td>
<td>51.61</td>
<td>8.80</td>
</tr>
</tbody>
</table>
pretest mean score of 37.11 percent with a standard deviation of 2.88, whereas the control group had a mean score of 34.04 percent with a standard deviation of 5.87. An analysis of variance of the difference between these means yielded an F-value of 1.103 which was not significant. When the treatment day objectives scores were tabulated, treatment had a mean of 39.01 percent with a standard deviation of 3.01 and control had a mean of 34.71 percent with a standard deviation of 7.36. The analysis of variance of these scores produced an F-value of 1.502 which also was not significant. These data, presented in Table 4, failed to reject $H_0$, which was:

There is no difference between treatment and control groups as measured by the animal health pretest.

Table 4. Analysis of variance of animal health pretest scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>28.301</td>
<td>1</td>
<td>28.301</td>
<td>1.103</td>
</tr>
<tr>
<td>Within groups</td>
<td>256.539</td>
<td>10</td>
<td>25.654</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>284.840</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>56.902</td>
<td>1</td>
<td>56.902</td>
<td>1.502</td>
</tr>
<tr>
<td>Within groups</td>
<td>378.918</td>
<td>10</td>
<td>37.892</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>435.820</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The second hypothesis dealt with the commercial fertilizers unit. It stated:

\[ H_{o2} \]: There is no difference between treatment and control groups as measured by the commercial fertilizers pretest.

The scores for this test revealed the treatment to have a mean of 27.46 percent with a standard deviation of 3.17 and the control to have a mean of 33.61 percent and a standard deviation of 5.67. The analysis of variance between these two means revealed an F-value of 4.498 which was not significant. The analysis of the treatment day objectives scores revealed treatment to have a mean pretest score of 30.46 percent with a standard deviation of 5.66 and the control to have a mean of 36.38 percent with a standard deviation of 7.13. The analysis of variance between these means revealed an F-value of 2.086 which was not significant. These analyses may be seen in Table 5 and failed to reject \[ H_{o2} \] which was: There is no difference between treatment and control groups as measured by the commercial fertilizers pretest.

The third hypothesis stated was:

\[ H_{o3} \]: There is no difference between treatment and control groups as measured by the small gas engines pretest.

The data collected resulted in a mean pretest score for the treatment group of 41.33 percent (standard deviation - 5.24) and a mean for control of 38.42 percent (standard deviation - 8.21). The analysis of variance of these data determined an F-value of 0.446 which was not significant. The treatment day objectives scores revealed treatment to have a mean of 38.92 percent (standard deviation - 6.70) and the control to have a mean of 36.15 percent (standard deviation - 9.34). The analysis of variance of these
Table 5. Analysis of variance of commercial fertilizers pretest scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>113.723</td>
<td>1</td>
<td>113.723</td>
<td>4.498</td>
</tr>
<tr>
<td>Within groups</td>
<td>252.804</td>
<td>10</td>
<td>25.280</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>366.527</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>105.324</td>
<td>1</td>
<td>105.325</td>
<td>2.086</td>
</tr>
<tr>
<td>Within groups</td>
<td>505.020</td>
<td>10</td>
<td>50.502</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>610.344</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Means resulted in an F-value of 0.291 which also was not significant. These data are tabulated in Table 6 and failed to reject \(H_0^3\) which was:

There is no difference between treatment and control groups as measured by the small gas engines pretest.

The farm credit pretest scores were analyzed in the same manner with the hypothesis stated as:

\(H_0^4:\) There is no difference between treatment and control groups as measured by the farm credit pretest.

Means for these pretest scores indicated treatment with 47.13 percent with a standard deviation of 8.95 and control with 48.39 percent with a standard deviation of 6.27. The comparison of these means yielded an F-value of 0.066, which was not significant. When examining the treatment
Table 6. Analysis of variance of small gas engines pretest scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>25.379</td>
<td>1</td>
<td>25.379</td>
<td>0.446</td>
</tr>
<tr>
<td>Within groups</td>
<td>569.250</td>
<td>10</td>
<td>56.925</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>594.629</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>23.074</td>
<td>1</td>
<td>23.074</td>
<td>0.291</td>
</tr>
<tr>
<td>Within groups</td>
<td>792.527</td>
<td>10</td>
<td>79.253</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>815.601</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

day objectives scores, the treatment group had a mean of 52.72 percent whereas control had a mean of 51.61 percent with standard deviations of 10.17 and 8.80, respectively. The analysis of variance between these means produced an F-value of 0.034 which also was not significant. These analyses, which are presented in Table 7, failed to reject \( H_0 \), which was: There is no difference between treatment and control groups as measured by the farm credit pretest.

Analysis of Posttest Scores

The next hypothesis, dealing with the outcome of this experiment, was:

\( H_0^5 \): There is no difference between treatment and control groups as measured by the animal health posttest.
Table 7. Analysis of variance of farm credit pretest scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>4.726</td>
<td>1</td>
<td>4.726</td>
<td>0.066</td>
</tr>
<tr>
<td>Within groups</td>
<td>716.473</td>
<td>10</td>
<td>71.647</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>721.199</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>3.656</td>
<td>1</td>
<td>3.656</td>
<td>0.034</td>
</tr>
<tr>
<td>Within groups</td>
<td>1084.371</td>
<td>10</td>
<td>108.437</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1088.027</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The posttest means and standard deviations are listed in Table 8. For animal health, the treatment group had a mean posttest score of 54.63 percent with a standard deviation of 4.38, whereas the control group had a mean of 57.57 percent and a standard deviation of 9.18. The analysis of variance between these two means produced an F-value of 0.418 which was not significant. The treatment day objectives scores revealed the treatment to have a mean of 55.89 percent with a standard deviation of 3.46 and the control to have a mean of 57.37 percent with a standard deviation of 8.84. The analysis of variance in this case yielded an F-value of 0.120 which also was not significant. These analyses are listed in Table 9.

In order to determine if other factors had an effect on posttest scores, the independent variables listed in Table 10 were used in a step-
Table 8. Posttest means and standard deviations by group and subject matter area

<table>
<thead>
<tr>
<th>Area</th>
<th>Treatment Mean</th>
<th>Treatment Std. dev.</th>
<th>Control Mean</th>
<th>Control Std. dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal health</td>
<td>54.63</td>
<td>4.38</td>
<td>57.57</td>
<td>9.18</td>
</tr>
<tr>
<td>Commercial fert.</td>
<td>44.02</td>
<td>8.04</td>
<td>48.26</td>
<td>9.89</td>
</tr>
<tr>
<td>Small gas engines</td>
<td>58.83</td>
<td>6.73</td>
<td>68.44</td>
<td>5.76</td>
</tr>
<tr>
<td>Farm credit</td>
<td>63.22</td>
<td>6.32</td>
<td>64.44</td>
<td>6.40</td>
</tr>
</tbody>
</table>

By overall percentage scores

By objectives percentage scores

<table>
<thead>
<tr>
<th>Area</th>
<th>Treatment Mean</th>
<th>Treatment Std. dev.</th>
<th>Control Mean</th>
<th>Control Std. dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal health</td>
<td>55.89</td>
<td>3.46</td>
<td>57.37</td>
<td>8.84</td>
</tr>
<tr>
<td>Commercial fert.</td>
<td>50.25</td>
<td>10.21</td>
<td>55.31</td>
<td>11.33</td>
</tr>
<tr>
<td>Small gas engines</td>
<td>60.70</td>
<td>6.53</td>
<td>69.02</td>
<td>4.91</td>
</tr>
<tr>
<td>Farm credit</td>
<td>69.35</td>
<td>7.55</td>
<td>69.52</td>
<td>6.44</td>
</tr>
</tbody>
</table>

wise technique to identify those variables which might be used as co-variates. The covariates identified for the animal health posttest overall scores, as listed in Table 11, were agricultural achievement, pre-test score and teacher experience. When these variables were used as co-variates, the F-value became 1.807 which was not significant. This analysis may be seen in Table 12.

When the treatment day objectives scores were used as the dependent variable, the step-wise technique identified pretest, department size and artistic interest to account for the largest amount of the variance. In
Table 9. Analysis of variance of animal health posttest scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>25.984</td>
<td>1</td>
<td>25.984</td>
<td>0.418</td>
</tr>
<tr>
<td>Within groups</td>
<td>621.426</td>
<td>10</td>
<td>62.143</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>647.410</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **By objectives scores**|       |      |       |         |
| Between groups         | 6.504 | 1    | 6.504 | 0.120   |
| Within groups          | 540.566| 10  | 54.057|         |
| Total                  | 547.070| 11  |       |         |

Table 13, the analysis of covariance using these covariates revealed an F-value of 2.707 which was also not significant.

The analyses of the animal health posttest scores failed to reject $H_0$ which was: There is no difference between treatment and control groups as measured by the animal health posttest.

For the commercial fertilizers unit, the hypothesis stated was:

$H_{06}$: There is no difference between treatment and control groups as measured by the commercial fertilizers posttest.

The treatment group had a mean of 44.02 percent with a standard deviation of 8.04, whereas the control had a mean of 48.26 percent with a standard deviation of 9.89. A comparison of these two means with the analysis of variance technique produced an F-value of 0.553 which was not signifi-
Table 10. Means of independent variables for animal health unit by group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence quotient</td>
<td>100.93</td>
<td>101.96</td>
</tr>
<tr>
<td>Mechanical aptitude</td>
<td>64.36</td>
<td>58.64</td>
</tr>
<tr>
<td>Abstract reasoning aptitude</td>
<td>57.18</td>
<td>59.73</td>
</tr>
<tr>
<td>Verbal aptitude</td>
<td>58.63</td>
<td>56.38</td>
</tr>
<tr>
<td>Agricultural achievement</td>
<td>60.56</td>
<td>57.41</td>
</tr>
<tr>
<td>Outdoor interest</td>
<td>67.71</td>
<td>70.53</td>
</tr>
<tr>
<td>Mechanical interest</td>
<td>53.01</td>
<td>52.09</td>
</tr>
<tr>
<td>Computational interest</td>
<td>42.74</td>
<td>52.03</td>
</tr>
<tr>
<td>Scientific interest</td>
<td>31.99</td>
<td>34.98</td>
</tr>
<tr>
<td>Persuasive interest</td>
<td>48.60</td>
<td>57.45</td>
</tr>
<tr>
<td>Artistic interest</td>
<td>39.67</td>
<td>40.13</td>
</tr>
<tr>
<td>Literary interest</td>
<td>44.00</td>
<td>46.55</td>
</tr>
<tr>
<td>Social service interest</td>
<td>36.73</td>
<td>38.64</td>
</tr>
<tr>
<td>Clerical interest</td>
<td>53.62</td>
<td>47.91</td>
</tr>
<tr>
<td>Student skill sheet</td>
<td>43.40</td>
<td>45.67</td>
</tr>
<tr>
<td>Crop acres</td>
<td>171.54</td>
<td>228.22</td>
</tr>
<tr>
<td>Noncrop acres</td>
<td>65.36</td>
<td>32.33</td>
</tr>
<tr>
<td>Total farm acres</td>
<td>223.54</td>
<td>260.55</td>
</tr>
<tr>
<td>Animal units</td>
<td>80.31</td>
<td>123.99</td>
</tr>
<tr>
<td>Number of older brothers</td>
<td>.97</td>
<td>.71</td>
</tr>
<tr>
<td>Number of younger brothers</td>
<td>.81</td>
<td>1.02</td>
</tr>
<tr>
<td>Number of older sisters</td>
<td>1.06</td>
<td>.71</td>
</tr>
<tr>
<td>Number of younger brothers</td>
<td>.84</td>
<td>.79</td>
</tr>
<tr>
<td>Total number of brothers and sisters</td>
<td>3.43</td>
<td>3.22</td>
</tr>
<tr>
<td>Semesters of science</td>
<td>1.69</td>
<td>1.88</td>
</tr>
<tr>
<td>Semesters of mathematics</td>
<td>2.19</td>
<td>1.98</td>
</tr>
<tr>
<td>Semesters of business</td>
<td>.11</td>
<td>.17</td>
</tr>
<tr>
<td>Semesters of vocational agriculture</td>
<td>2.35</td>
<td>1.98</td>
</tr>
<tr>
<td>Semesters of industrial arts</td>
<td>.83</td>
<td>.14</td>
</tr>
<tr>
<td>Teacher knowledge</td>
<td>32.33</td>
<td>33.67</td>
</tr>
<tr>
<td>Teacher attitude</td>
<td>64.50</td>
<td>52.67</td>
</tr>
<tr>
<td>Class size</td>
<td>15.50</td>
<td>11.50</td>
</tr>
<tr>
<td>Department size</td>
<td>58.50</td>
<td>39.17</td>
</tr>
<tr>
<td>Teacher tenure</td>
<td>10.67</td>
<td>4.83</td>
</tr>
<tr>
<td>Teacher experience</td>
<td>12.67</td>
<td>6.83</td>
</tr>
</tbody>
</table>
Table 11. Covariates identified by step-wise technique for animal health posttest scores

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agricultural achievement</td>
<td>0.6718</td>
</tr>
<tr>
<td>2</td>
<td>Department size</td>
<td>0.8104</td>
</tr>
<tr>
<td>3</td>
<td>Pretest</td>
<td>0.8922</td>
</tr>
<tr>
<td>4</td>
<td>Teacher experience</td>
<td>0.9289</td>
</tr>
<tr>
<td>5</td>
<td>Department size (removed)</td>
<td>0.9276</td>
</tr>
</tbody>
</table>

By objectives

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pretest</td>
<td>0.6903</td>
</tr>
<tr>
<td>2</td>
<td>Department size</td>
<td>0.8577</td>
</tr>
<tr>
<td>3</td>
<td>Artistic interest</td>
<td>0.9298</td>
</tr>
</tbody>
</table>

Table 12. Analysis of covariance of animal health posttest scores between groups using agricultural achievement, pretest and teacher experience as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>25.911</td>
<td>1</td>
<td>25.911</td>
<td>1.807</td>
</tr>
<tr>
<td>Within groups</td>
<td>100.356</td>
<td>7</td>
<td>14.338</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>126.267</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 13. Analysis of covariance of animal health posttest scores by objectives between groups using pretest, department size and artistic interest as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>31.504</td>
<td>1</td>
<td>31.504</td>
<td>2.707</td>
</tr>
<tr>
<td>Within groups</td>
<td>81.452</td>
<td>7</td>
<td>11.637</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>112.966</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

cant. The treatment day objectives scores produced a mean of 50.25 percent for the treatment (standard deviation - 10.21) and a mean of 55.31 percent for control (standard deviation - 11.33). The analysis of variance between these means yielded an F-value of 0.551 which also was not significant (Table 14).

The independent variables for the commercial fertilizers unit are listed in Table 15. When these variables were used in the step-wise technique, pretest, department size and scientific interest accounted for the most effect on the variance (Table 16). When these variables were used in the covariance analysis, as shown in Table 17, the F-value was 0.989, which was not significant.

In analyzing the treatment day objectives posttest scores of the commercial fertilizers unit, the variables identified by the step-wise technique were abstract reasoning aptitude, scientific interest and mechanical interest. The analysis of covariance between these means then resulted in an F-value of 1.236 which was also not significant (Table 18).

These data failed to reject $H_0$ which was: There is no difference
Table 14. Analysis of variance of commercial fertilizers posttest scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>53.926</td>
<td>1</td>
<td>53.926</td>
<td>0.553</td>
</tr>
<tr>
<td>Within groups</td>
<td>974.496</td>
<td>10</td>
<td>97.450</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1028.422</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>76.902</td>
<td>1</td>
<td>76.902</td>
<td>0.551</td>
</tr>
<tr>
<td>Within groups</td>
<td>1395.996</td>
<td>10</td>
<td>139.599</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1472.898</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

between the treatment and control groups as measured by the commercial fertilizers posttest.

The hypothesis related to the small gas engines posttest scores was:

\[ H_0: \text{There is no difference between the treatment and control groups as measured by the small gas engines posttest scores.} \]

The data revealed a treatment mean score of 58.83 percent with a standard deviation of 6.73, whereas the control had a mean score of 68.44 percent with a standard deviation of 6.40. The analysis of variance test of these two means produced an F-value of 5.885 which was significant at the five percent level. The treatment day objectives scores yielded means of 60.70 percent for the treatment group with a standard deviation of 6.53, and a 69.02 percent score for the control with a standard deviation of
Table 15. Means of independent variables for commercial fertilizers unit by group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence quotient</td>
<td>96.99</td>
<td>104.20</td>
</tr>
<tr>
<td>Mechanical aptitude</td>
<td>55.68</td>
<td>65.84</td>
</tr>
<tr>
<td>Abstract reasoning aptitude</td>
<td>53.67</td>
<td>73.44</td>
</tr>
<tr>
<td>Verbal aptitude</td>
<td>52.78</td>
<td>59.15</td>
</tr>
<tr>
<td>Agricultural achievement</td>
<td>61.36</td>
<td>62.14</td>
</tr>
<tr>
<td>Outdoor interest</td>
<td>72.25</td>
<td>74.00</td>
</tr>
<tr>
<td>Mechanical interest</td>
<td>50.82</td>
<td>57.12</td>
</tr>
<tr>
<td>Computational interest</td>
<td>39.96</td>
<td>47.67</td>
</tr>
<tr>
<td>Scientific interest</td>
<td>34.47</td>
<td>37.50</td>
</tr>
<tr>
<td>Persuasive interest</td>
<td>50.20</td>
<td>53.67</td>
</tr>
<tr>
<td>Artistic interest</td>
<td>46.45</td>
<td>48.99</td>
</tr>
<tr>
<td>Literary interest</td>
<td>52.54</td>
<td>48.38</td>
</tr>
<tr>
<td>Social service interest</td>
<td>50.99</td>
<td>40.98</td>
</tr>
<tr>
<td>Clerical interest</td>
<td>54.67</td>
<td>56.01</td>
</tr>
<tr>
<td>Student skill sheet</td>
<td>13.15</td>
<td>13.72</td>
</tr>
<tr>
<td>Crop acres</td>
<td>188.87</td>
<td>236.98</td>
</tr>
<tr>
<td>Noncrop acres</td>
<td>57.10</td>
<td>51.30</td>
</tr>
<tr>
<td>Total farm acres</td>
<td>243.94</td>
<td>289.79</td>
</tr>
<tr>
<td>Animal units</td>
<td>93.48</td>
<td>189.58</td>
</tr>
<tr>
<td>Number of older brothers</td>
<td>1.03</td>
<td>1.13</td>
</tr>
<tr>
<td>Number of younger brothers</td>
<td>.92</td>
<td>.67</td>
</tr>
<tr>
<td>Number of older sisters</td>
<td>.91</td>
<td>.97</td>
</tr>
<tr>
<td>Number of younger sisters</td>
<td>.95</td>
<td>.86</td>
</tr>
<tr>
<td>Total number of brothers and sisters</td>
<td>4.00</td>
<td>3.62</td>
</tr>
<tr>
<td>Semesters of science</td>
<td>2.62</td>
<td>2.75</td>
</tr>
<tr>
<td>Semesters of mathematics</td>
<td>3.22</td>
<td>2.98</td>
</tr>
<tr>
<td>Semesters of business</td>
<td>.34</td>
<td>.21</td>
</tr>
<tr>
<td>Semesters of vocational agriculture</td>
<td>3.78</td>
<td>3.62</td>
</tr>
<tr>
<td>Semesters of industrial arts</td>
<td>1.36</td>
<td>0.00*</td>
</tr>
<tr>
<td>Teacher knowledge</td>
<td>30.83</td>
<td>33.50</td>
</tr>
<tr>
<td>Teacher attitude</td>
<td>64.50</td>
<td>52.67</td>
</tr>
<tr>
<td>Class size</td>
<td>14.33</td>
<td>8.83</td>
</tr>
<tr>
<td>Department size</td>
<td>58.50</td>
<td>39.17</td>
</tr>
<tr>
<td>Teacher tenure</td>
<td>10.67</td>
<td>4.83</td>
</tr>
<tr>
<td>Teacher experience</td>
<td>12.67</td>
<td>6.83</td>
</tr>
</tbody>
</table>

*Complete data not available.
Table 16. Covariates identified by step-wise technique for commercial fertilizers posttest scores

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>By overall scores</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Pretest</td>
<td>0.7136</td>
</tr>
<tr>
<td>2</td>
<td>Department size</td>
<td>0.8616</td>
</tr>
<tr>
<td>3</td>
<td>Scientific interest</td>
<td>0.9276</td>
</tr>
<tr>
<td></td>
<td><strong>By objectives scores</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Pretest</td>
<td>0.7277</td>
</tr>
<tr>
<td>2</td>
<td>Abstract reasoning aptitude</td>
<td>0.8163</td>
</tr>
<tr>
<td>3</td>
<td>Scientific interest</td>
<td>0.8672</td>
</tr>
<tr>
<td>4</td>
<td>Mechanical interest</td>
<td>0.9134</td>
</tr>
<tr>
<td>5</td>
<td>Pretest (removed)</td>
<td>0.8913</td>
</tr>
</tbody>
</table>

Table 17. Analysis of covariance of commercial fertilizers posttest scores between groups using pretest, department size and scientific interest as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>23.696</td>
<td>1</td>
<td>23.696</td>
<td>0.989</td>
</tr>
<tr>
<td>Within groups</td>
<td>167.697</td>
<td>7</td>
<td>23.954</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>191.393</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 18. Analysis of covariance of commercial fertilizers posttest scores by objectives between groups using abstract reasoning aptitude, scientific interest and mechanical interest as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>71.677</td>
<td>1</td>
<td>71.677</td>
<td>1.236</td>
</tr>
<tr>
<td>Within groups</td>
<td>405.886</td>
<td>7</td>
<td>57.984</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>477.563</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.91. The analysis of variance between these two means gave an F-value of 5.190 which was also significant at the five percent level. These analyses are included in Table 19.

The means of the independent variables for both experimental groups for the small gas engines unit are listed in Table 20. The step-wise technique identified the three variables which accounted for the most variance. They are presented in order of selection in Table 21. By overall scores, mechanical aptitude, animal units and intelligence quotient were the variables selected.

The analysis of covariance using these three covariates yielded an F-value of 1.972 as indicated in Table 22. This value was not significant.

Using the step-wise technique, with the treatment day objectives scores as the dependent variable, mechanical aptitude, animal units and intelligence quotient were selected. The covariance analysis using these three variables gave an F-value of 2.064 which was not significant (Table 23).

These data failed to reject $H_0$, which was: There is no difference
Table 19. Analysis of variance of small gas engines posttest scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>227.242</td>
<td>1</td>
<td>227.242</td>
<td>5.885*</td>
</tr>
<tr>
<td>Within groups</td>
<td>471.113</td>
<td>10</td>
<td>47.111</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>748.355</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>208.000</td>
<td>1</td>
<td>208.000</td>
<td>5.190*</td>
</tr>
<tr>
<td>Within groups</td>
<td>400.777</td>
<td>10</td>
<td>40.078</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>608.777</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant beyond the five percent level.

between treatment and control groups as measured by the small gas engines posttest.

The last hypothesis concerning posttest scores was:

$H_{0g}$: There is no difference between treatment and control groups as measured by the farm credit posttest.

The treatment group mean score on the farm credit posttest was 63.22 percent with a standard deviation of 6.32, whereas the mean score for the control group was 64.44 percent (standard deviation = 6.40). The F-value between these means was 0.092 which was not significant (Table 24). When the treatment day objectives scores were tabulated, they indicated a mean for the treatment group of 69.35 percent (standard deviation = 7.55) and a mean
Table 20. Means of independent variables for small gas engines unit by group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence quotient</td>
<td>100.36</td>
<td>104.73</td>
</tr>
<tr>
<td>Mechanical aptitude</td>
<td>54.50</td>
<td>51.14</td>
</tr>
<tr>
<td>Abstract reasoning aptitude</td>
<td>45.09</td>
<td>60.85</td>
</tr>
<tr>
<td>Verbal aptitude</td>
<td>38.62</td>
<td>52.61</td>
</tr>
<tr>
<td>Agricultural achievement</td>
<td>52.86</td>
<td>61.25</td>
</tr>
<tr>
<td>Outdoor interest</td>
<td>68.50</td>
<td>74.29</td>
</tr>
<tr>
<td>Mechanical interest</td>
<td>50.76</td>
<td>51.58</td>
</tr>
<tr>
<td>Computational interest</td>
<td>44.96</td>
<td>51.64</td>
</tr>
<tr>
<td>Scientific interest</td>
<td>30.33</td>
<td>31.42</td>
</tr>
<tr>
<td>Persuasive interest</td>
<td>44.56</td>
<td>58.75</td>
</tr>
<tr>
<td>Artistic interest</td>
<td>42.80</td>
<td>44.10</td>
</tr>
<tr>
<td>Literary interest</td>
<td>45.10</td>
<td>47.86</td>
</tr>
<tr>
<td>Social service interest</td>
<td>41.93</td>
<td>50.51</td>
</tr>
<tr>
<td>Clerical interest</td>
<td>53.93</td>
<td>56.90</td>
</tr>
<tr>
<td>Student skill sheet</td>
<td>43.55</td>
<td>21.87</td>
</tr>
<tr>
<td>Crop acres</td>
<td>191.35</td>
<td>267.93</td>
</tr>
<tr>
<td>Noncrop acres</td>
<td>63.68</td>
<td>58.63</td>
</tr>
<tr>
<td>Total farm acres</td>
<td>237.16</td>
<td>297.07</td>
</tr>
<tr>
<td>Animal units</td>
<td>92.83</td>
<td>249.93</td>
</tr>
<tr>
<td>Number of older brothers</td>
<td>.80</td>
<td>.79</td>
</tr>
<tr>
<td>Number of younger brothers</td>
<td>.79</td>
<td>.58</td>
</tr>
<tr>
<td>Number of older sisters</td>
<td>.97</td>
<td>.86</td>
</tr>
<tr>
<td>Number of younger sisters</td>
<td>.70</td>
<td>.76</td>
</tr>
<tr>
<td>Total number of brothers and sisters</td>
<td>3.29</td>
<td>2.95</td>
</tr>
<tr>
<td>Semesters of science</td>
<td>3.03</td>
<td>3.57</td>
</tr>
<tr>
<td>Semesters of mathematics</td>
<td>3.21</td>
<td>3.84</td>
</tr>
<tr>
<td>Semesters of business</td>
<td>.79</td>
<td>.73</td>
</tr>
<tr>
<td>Semesters of vocational agriculture</td>
<td>4.60</td>
<td>5.63</td>
</tr>
<tr>
<td>Semesters of industrial arts</td>
<td>1.82</td>
<td>.41</td>
</tr>
<tr>
<td>Teacher knowledge</td>
<td>30.17</td>
<td>31.50</td>
</tr>
<tr>
<td>Teacher attitude</td>
<td>64.50</td>
<td>52.67</td>
</tr>
<tr>
<td>Class size</td>
<td>14.83</td>
<td>9.67</td>
</tr>
<tr>
<td>Department size</td>
<td>58.50</td>
<td>39.17</td>
</tr>
<tr>
<td>Teacher tenure</td>
<td>10.67</td>
<td>4.83</td>
</tr>
<tr>
<td>Teacher experience</td>
<td>12.67</td>
<td>6.83</td>
</tr>
</tbody>
</table>
Table 21. Covariates identified by step-wise technique for small gas engines posttest scores

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mechanical aptitude</td>
<td>0.3674</td>
</tr>
<tr>
<td>2</td>
<td>Animal units</td>
<td>0.5646</td>
</tr>
<tr>
<td>3</td>
<td>Intelligence quotient</td>
<td>0.8127</td>
</tr>
</tbody>
</table>

*By overall scores*

*By objectives scores*

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mechanical aptitude</td>
<td>0.4030</td>
</tr>
<tr>
<td>2</td>
<td>Animal units</td>
<td>0.5997</td>
</tr>
<tr>
<td>3</td>
<td>Intelligence quotient</td>
<td>0.8845</td>
</tr>
</tbody>
</table>

Table 22. Analysis of covariance of small gas engines posttest scores between groups using mechanical aptitude, animal units and intelligence quotient as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>91.155</td>
<td>1</td>
<td>91.155</td>
<td>1.972</td>
</tr>
<tr>
<td>Within groups</td>
<td>323.616</td>
<td>7</td>
<td>46.231</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>414.771</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 23. Analysis of covariance of small gas engines posttest scores by objectives between groups using mechanical aptitude, animal units and intelligence quotient as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>89.002</td>
<td>1</td>
<td>89.002</td>
<td>2.064</td>
</tr>
<tr>
<td>Within groups</td>
<td>301.830</td>
<td>7</td>
<td>43.119</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>390.832</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 24. Analysis of variance of farm credit posttest scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>4.445</td>
<td>1</td>
<td>4.445</td>
<td>0.092</td>
</tr>
<tr>
<td>Within groups</td>
<td>485.817</td>
<td>10</td>
<td>48.482</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>490.262</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>0.078</td>
<td>1</td>
<td>0.078</td>
<td>0.001</td>
</tr>
<tr>
<td>Within groups</td>
<td>591.402</td>
<td>10</td>
<td>59.140</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>491.480</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
of 69.52 percent (standard deviation - 6.44) for the control. The F-ratio of the analysis of variance test between these means was 0.001, which also was not significant.

The means for the independent variables for the farm credit unit are listed in Table 25. The three most important variables related to the farm credit posttest were identified by the step-wise technique. As revealed in Table 26, they were intelligence quotient, student skill sheet and number of younger brothers, in that order. Using these in the analysis of covariance, an F-value of 0.045 was obtained, which was not significant (Table 27). When the treatment day objectives scores were examined by the step-wise technique, intelligence quotient, number of younger brothers and student skill sheet were identified. Using these in the analysis of covariance produced an F-value of 0.038 which was not significant. These data are listed in Table 28.

The analysis of the posttest scores of the farm credit unit failed to reject H0g which was: There is no difference between treatment and control groups as measured by the farm credit posttest.

Analysis of Gain Scores

The next set of hypotheses dealt with the analysis of the gain scores (difference between pretest and posttest scores). The means and standard deviations by group and by subject matter are detailed in Table 29.

The first hypothesis for this set of analyses was stated as:

H0g: There is no difference between treatment and control groups as measured by the animal health gain scores.

The treatment group had a mean gain in animal health of 17.52 per-
Table 25. Means of independent variables for farm credit unit by group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence quotient</td>
<td>105.65</td>
<td>104.77</td>
</tr>
<tr>
<td>Mechanical aptitude</td>
<td>50.10</td>
<td>52.37</td>
</tr>
<tr>
<td>Abstract reasoning aptitude</td>
<td>57.48</td>
<td>62.26</td>
</tr>
<tr>
<td>Verbal aptitude</td>
<td>43.58</td>
<td>45.47</td>
</tr>
<tr>
<td>Agricultural achievement</td>
<td>71.67</td>
<td>69.36</td>
</tr>
<tr>
<td>Outdoor interest</td>
<td>70.61</td>
<td>75.21</td>
</tr>
<tr>
<td>Mechanical interest</td>
<td>50.87</td>
<td>65.08</td>
</tr>
<tr>
<td>Computational interest</td>
<td>49.27</td>
<td>53.31</td>
</tr>
<tr>
<td>Scientific interest</td>
<td>35.15</td>
<td>41.57</td>
</tr>
<tr>
<td>Persuasive interest</td>
<td>44.61</td>
<td>50.09</td>
</tr>
<tr>
<td>Artistic interest</td>
<td>38.79</td>
<td>42.11</td>
</tr>
<tr>
<td>Literary interest</td>
<td>37.16</td>
<td>34.70</td>
</tr>
<tr>
<td>Social service interest</td>
<td>47.26</td>
<td>48.05</td>
</tr>
<tr>
<td>Clerical interest</td>
<td>49.17</td>
<td>59.87</td>
</tr>
<tr>
<td>Student skill sheet</td>
<td>28.24</td>
<td>30.73</td>
</tr>
<tr>
<td>Crop acres</td>
<td>200.31</td>
<td>259.49</td>
</tr>
<tr>
<td>Noncrop acres</td>
<td>69.55</td>
<td>49.72</td>
</tr>
<tr>
<td>Total farm acres</td>
<td>264.42</td>
<td>309.21</td>
</tr>
<tr>
<td>Animal units</td>
<td>94.32</td>
<td>158.24</td>
</tr>
<tr>
<td>Number of older brothers</td>
<td>.62</td>
<td>.72</td>
</tr>
<tr>
<td>Number of younger brothers</td>
<td>.63</td>
<td>.55</td>
</tr>
<tr>
<td>Number of older sisters</td>
<td>.94</td>
<td>1.13</td>
</tr>
<tr>
<td>Number of younger sisters</td>
<td>1.08</td>
<td>.85</td>
</tr>
<tr>
<td>Total number of brothers and sisters</td>
<td>3.39</td>
<td>3.18</td>
</tr>
<tr>
<td>Semesters of science</td>
<td>4.10</td>
<td>3.64</td>
</tr>
<tr>
<td>Semesters of mathematics</td>
<td>4.69</td>
<td>4.55</td>
</tr>
<tr>
<td>Semesters of business</td>
<td>1.36</td>
<td>1.64</td>
</tr>
<tr>
<td>Semesters of vocational agriculture</td>
<td>6.62</td>
<td>7.19</td>
</tr>
<tr>
<td>Semesters of industrial arts</td>
<td>1.71</td>
<td>.75</td>
</tr>
<tr>
<td>Teacher knowledge</td>
<td>29.50</td>
<td>29.33</td>
</tr>
<tr>
<td>Teacher attitude</td>
<td>64.50</td>
<td>52.67</td>
</tr>
<tr>
<td>Class size</td>
<td>13.83</td>
<td>9.17</td>
</tr>
<tr>
<td>Department size</td>
<td>58.50</td>
<td>39.17</td>
</tr>
<tr>
<td>Teacher tenure</td>
<td>10.67</td>
<td>4.83</td>
</tr>
<tr>
<td>Teacher experience</td>
<td>12.67</td>
<td>6.83</td>
</tr>
</tbody>
</table>
Table 26. Covariates identified by step-wise technique for farm credit posttest scores

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>By overall scores</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Intelligence quotient</td>
<td>0.4945</td>
</tr>
<tr>
<td>2</td>
<td>Student skill sheet</td>
<td>0.6436</td>
</tr>
<tr>
<td>3</td>
<td>Number of younger brothers</td>
<td>0.8212</td>
</tr>
<tr>
<td></td>
<td><strong>By objectives scores</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Intelligence scores</td>
<td>0.4141</td>
</tr>
<tr>
<td>2</td>
<td>Number of younger brothers</td>
<td>0.6667</td>
</tr>
<tr>
<td>3</td>
<td>Student skill sheet</td>
<td>0.8600</td>
</tr>
</tbody>
</table>

Table 27. Analysis of covariance of farm credit posttest scores between groups using intelligence quotient, student skill sheet and number of younger brothers as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>.992</td>
<td>1</td>
<td>.992</td>
<td>0.045</td>
</tr>
<tr>
<td>Within groups</td>
<td>153.001</td>
<td>7</td>
<td>21.859</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>153.993</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 28. Analysis of covariance of farm credit posttest scores by objectives between groups using intelligence quotient, number of younger brothers and student skill sheet as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>.799</td>
<td>1</td>
<td>.799</td>
<td>0.038</td>
</tr>
<tr>
<td>Within groups</td>
<td>147.492</td>
<td>7</td>
<td>21.070</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>148.291</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 29. Means and standard deviations of gain scores by group

<table>
<thead>
<tr>
<th>Area</th>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. dev.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>By overall percentage scores</td>
<td></td>
</tr>
<tr>
<td>Animal health</td>
<td>17.52</td>
<td>2.99</td>
</tr>
<tr>
<td>Commercial fert.</td>
<td>16.56</td>
<td>5.13</td>
</tr>
<tr>
<td>Small gas engines</td>
<td>17.49</td>
<td>5.75</td>
</tr>
<tr>
<td>Farm credit</td>
<td>16.09</td>
<td>5.73</td>
</tr>
<tr>
<td></td>
<td>By objectives percentage scores</td>
<td></td>
</tr>
<tr>
<td>Animal health</td>
<td>16.83</td>
<td>1.21</td>
</tr>
<tr>
<td>Commercial fert.</td>
<td>19.79</td>
<td>5.34</td>
</tr>
<tr>
<td>Small gas engines</td>
<td>21.78</td>
<td>6.78</td>
</tr>
<tr>
<td>Farm credit</td>
<td>16.63</td>
<td>7.30</td>
</tr>
</tbody>
</table>
cent with a standard deviation of 2.99, whereas the control had a mean gain of 23.53 percent with a standard deviation of 4.61. The analysis of variance between these means yielded an F-value of 5.993 which was significant at the five percent level. The mean gain scores on treatment day objectives items were 16.83 percent for the treatment group, with a standard deviation of 1.21, and 22.66 for the control, with a standard deviation of 3.18. The analysis of these two means produced an F-value of 14.64 which was significant beyond the one percent level. These data are found in Table 30.

Table 30. Analysis of variance of animal health gain scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>By overall scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>108.544</td>
<td>1</td>
<td>108.544</td>
<td>5.993*</td>
</tr>
<tr>
<td>Within groups</td>
<td>181.132</td>
<td>10</td>
<td>18.113</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>289.676</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>By objectives scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>101.909</td>
<td>1</td>
<td>101.909</td>
<td>14.641**</td>
</tr>
<tr>
<td>Within groups</td>
<td>69.603</td>
<td>10</td>
<td>6.960</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>171.512</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant beyond the five percent level.

**Significant beyond the one percent level.
Covariates which may have affected the gain scores were identified by the step-wise technique as revealed in Table 31. For the overall gain scores, crop acres, animal units and social service interest were identified in that order. An analysis of covariance then produced an F-value of 0.248 which was not significant.

Table 31. Covariates identified by step-wise technique for animal health gain scores

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crop acres</td>
<td>0.4706</td>
</tr>
<tr>
<td>2</td>
<td>Animal units</td>
<td>0.6974</td>
</tr>
<tr>
<td>3</td>
<td>Social service interest</td>
<td>0.8966</td>
</tr>
</tbody>
</table>

Covariates which may have affected the gain scores for the treatment day objectives items were identified by the step-wise technique and are also included in Table 31. The analysis of covariance using crop acres, animal units and social service interest as covariates yielded an F-value of 0.248 as indicated in Table 32. This value was not significant.

The most important variables for these gain scores were department
Table 32. Analysis of covariance of animal health gain scores between groups using crop acres, animal units and social service interest as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1.027</td>
<td>1</td>
<td>1.027</td>
<td>0.248</td>
</tr>
<tr>
<td>Within groups</td>
<td>28.934</td>
<td>7</td>
<td>4.133</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>29.961</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

size, social service interest and teacher tenure. When these variables were used in the analysis of covariance, an F-value of 0.218 was obtained which was not significant (Table 33).

The data failed to reject $H_{0g}$ which was: There is no difference between treatment and control groups as measured by the animal health gain scores.

Table 33. Analysis of covariance of animal health gain scores by objectives between groups using department size, social service interest and teacher tenure as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>0.444</td>
<td>1</td>
<td>0.444</td>
<td>0.218</td>
</tr>
<tr>
<td>Within groups</td>
<td>14.237</td>
<td>7</td>
<td>2.023</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>14.681</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The hypothesis stated for the commercial fertilizers gain scores was:

$$H_0: \text{There is no difference between treatment and control groups as measured by the commercial fertilizers gain scores.}$$

The treatment group mean for commercial fertilizers gain was 16.56 percent with a standard deviation of 5.13, whereas the control group had a mean of 14.65 percent with a standard deviation of 5.61. The analysis of variance between these means yielded an F-value of 0.318 which was not significant. When the treatment day objectives scores were compared, the treatment group had a mean of 19.79 percent with a standard deviation of 5.34, whereas the control's mean was 18.92 percent with a standard deviation of 6.98. The F-value produced by the analysis of variance between these scores was 0.048 which also was not significant (Table 34).

Table 34. Analysis of variance of commercial fertilizers gain scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>By overall scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>11.020</td>
<td>1</td>
<td>11.020</td>
<td>0.318</td>
</tr>
<tr>
<td>Within groups</td>
<td>346.605</td>
<td>10</td>
<td>34.661</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>357.625</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>By objectives scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>2.230</td>
<td>1</td>
<td>2.230</td>
<td>0.048</td>
</tr>
<tr>
<td>Within groups</td>
<td>462.217</td>
<td>10</td>
<td>46.332</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>465.547</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The step-wise technique was used to identify the most important co-
variates related to the commercial fertilizers gain scores with the results
presented in Table 35. For the overall gain scores, social service inter-
est, teacher experience and clerical interest were the three most important
variables. The analysis of covariance between the gain scores using these
covariates is presented in Table 36 and produced an F-value of 0.976 which
was not significant.

The step-wise technique, when used on the treatment day objectives
gain scores for the commercial fertilizers unit, identified semesters of
mathematics, noncrop acres and outdoor interest as the three most important
variables. The analysis of covariance, as listed in Table 37, yielded an
F-value of 0.205 which was also not significant.

Table 35. Covariates identified by step-wise technique for commercial fer-
tilizers gain scores

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Social service interest</td>
<td>0.4630</td>
</tr>
<tr>
<td>2</td>
<td>Teacher experience</td>
<td>0.6552</td>
</tr>
<tr>
<td>3</td>
<td>Clerical interest</td>
<td>0.8348</td>
</tr>
<tr>
<td></td>
<td><strong>By overall scores</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Semesters of mathematics</td>
<td>0.3923</td>
</tr>
<tr>
<td>2</td>
<td>Noncrop acres</td>
<td>0.6809</td>
</tr>
<tr>
<td>3</td>
<td>Outdoor interest</td>
<td>0.8436</td>
</tr>
</tbody>
</table>
Table 36. Analysis of covariance of commercial fertilizers gain scores between groups using social service interest, teacher experience and clerical interest as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>7.237</td>
<td>1</td>
<td>7.237</td>
<td>0.976</td>
</tr>
<tr>
<td>Within groups</td>
<td>51.853</td>
<td>7</td>
<td>7.408</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59.090</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 37. Analysis of covariance of commercial fertilizers gain scores by objectives between groups using semesters of mathematics, non-crop acres and outdoor interest as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>8.969</td>
<td>1</td>
<td>8.969</td>
<td>0.205</td>
</tr>
<tr>
<td>Within groups</td>
<td>306.471</td>
<td>7</td>
<td>43.782</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>315.440</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These data failed to reject $H_{10}$ which was: There is no difference between treatment and control groups as measured by the commercial fertilizers gain scores.

Hypothesis $H_{11}$ was stated:

$H_{11}$: There is no difference between treatment and control groups as measured by the small gas engines gain scores.

The mean scores for this variable indicated the treatment group to have a score of 17.49 percent (standard deviation - 5.75) and control group
to have a score of 30.02 percent (standard deviation - 6.47). In Table 38 are the analysis of variance data for these scores. The F-value of 10.460 was significant beyond the one percent level.

When the treatment day objectives scores were used, the treatment group had a mean gain of 21.78 percent (standard deviation - 6.78) with control's gain tabulated at 32.88 percent (standard deviation - 7.11). The analysis of variance between these gain scores produced an F-value of 6.389 which was also significant but at the five percent level.

The step-wise technique was again used to identify the variables which

Table 38. Analysis of variance of small gas engines gain scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>470.383</td>
<td>1</td>
<td>470.383</td>
<td>10.460**</td>
</tr>
<tr>
<td>Within groups</td>
<td>449.680</td>
<td>10</td>
<td>44.968</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>920.063</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>369.633</td>
<td>1</td>
<td>369.633</td>
<td>6.389*</td>
</tr>
<tr>
<td>Within groups</td>
<td>578.160</td>
<td>10</td>
<td>57.853</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>948.160</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant beyond the five percent level.

**Significant beyond the one percent level.
might have affected the small gas engines gain scores (Table 39). For the overall gain scores, student skill sheet, noncrop acres and teacher knowledge were selected. The F-value produced by the analysis of covariance using these three variables was 0.155 which was not significant. These data are outlined in Table 40.

Table 39. Covariates identified by step-wise technique for small gas engines gain scores

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>By overall scores</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Student skill sheet</td>
<td>0.5286</td>
</tr>
<tr>
<td>2</td>
<td>Noncrop acres</td>
<td>0.7225</td>
</tr>
<tr>
<td>3</td>
<td>Teacher knowledge</td>
<td>0.8595</td>
</tr>
<tr>
<td></td>
<td><strong>By objectives scores</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Teacher tenure</td>
<td>0.5386</td>
</tr>
<tr>
<td>2</td>
<td>Teacher attitude</td>
<td>0.7136</td>
</tr>
<tr>
<td>3</td>
<td>Noncrop acres</td>
<td>0.8793</td>
</tr>
</tbody>
</table>

The three most important variables affecting the treatment day objectives gain scores are displayed in Table 39. They were teacher tenure, teacher attitude and noncrop acres. Using these three variables as covariates produced an F-value of 0.436 which was not significant. These data may be seen in Table 41.

The data failed to reject $H_0_{11}$ which was: There is no difference be-
Table 40. Analysis of covariance of small gas engines gain scores between groups using student skill sheet, noncrop acres and teacher knowledge as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>2.809</td>
<td>1</td>
<td>2.809</td>
<td>0.155</td>
</tr>
<tr>
<td>Within groups</td>
<td>126.483</td>
<td>7</td>
<td>18.069</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>129.292</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 41. Analysis of covariance of small gas engines gain scores by objectives between groups using teacher tenure, teacher attitude and noncrop acres as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>6.713</td>
<td>1</td>
<td>6.713</td>
<td>0.436</td>
</tr>
<tr>
<td>Within groups</td>
<td>107.757</td>
<td>7</td>
<td>15.394</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>114.470</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

tween treatment and control groups as measured by the small gas engines gain scores.

The mean gain scores for the farm credit unit were tested in relation to the hypothesis:

$H_{012}$: There is no difference between treatment and control groups as measured by the farm credit gain scores.

The gain scores for this unit were 16.09 percent for the treatment group (standard deviation = 5.73), and 16.05 percent for the control
(standard deviation - 6.42). The analysis of variance of these scores yielded an F-value of 0.000 which was not significant. The gain scores for the farm credit unit by treatment day objectives were 16.63 percent for the treatment group (standard deviation - 7.30) and 17.91 percent for the control (standard deviation - 8.50). The F-value of the difference between these means was 0.065 which was also not significant as revealed in Table 42.

Table 42. Analysis of variance of farm credit gain scores between groups

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>.004</td>
<td>1</td>
<td>.004</td>
<td>0.000</td>
</tr>
<tr>
<td>Within groups</td>
<td>444.674</td>
<td>10</td>
<td>44.467</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>444.678</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>4.876</td>
<td>1</td>
<td>4.876</td>
<td>0.065</td>
</tr>
<tr>
<td>Within groups</td>
<td>753.617</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>758.493</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In order to use the analysis of covariance on these data the step-wise technique was again used to identify covariates. For overall scores those identified were semesters of science, computational interest and semesters of industrial arts. These data are displayed in Table 43.

When these variables were used in the analysis of covariance, the F-
Table 43. Covariates identified by step-wise technique for farm credit gain scores

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>By overall scores</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Semesters of science</td>
<td>0.4633</td>
</tr>
<tr>
<td>2</td>
<td>Computational interest</td>
<td>0.6118</td>
</tr>
<tr>
<td>3</td>
<td>Semesters of industrial arts</td>
<td>0.7662</td>
</tr>
<tr>
<td></td>
<td><strong>By objectives scores</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Semesters of science</td>
<td>0.4974</td>
</tr>
<tr>
<td>2</td>
<td>Number of older sisters</td>
<td>0.7743</td>
</tr>
<tr>
<td>3</td>
<td>Outdoor interest</td>
<td>0.9072</td>
</tr>
</tbody>
</table>

value obtained was 0.151 which was not significant (Table 44).

For the treatment day objectives scores, the variables identified were semesters of science, number of older sisters and outdoor interest. The analysis of covariance using these covariates resulted in an $F$-value of 0.170 which was also not significant (Table 45).

These data failed to reject $H_0$, which was: There is no difference between treatment and control groups as measured by the farm credit gain scores.

Analysis of Posttest and Gain Scores
Over All Subject Matter Units

In order to identify the overall effect of the treatment over all subject matter units, the following hypothesis was stated:
Table 44. Analysis of covariance of farm credit gain scores between groups using semesters of science, computational interest and semesters of industrial arts as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>2.191</td>
<td>1</td>
<td>2.191</td>
<td>0.151</td>
</tr>
<tr>
<td>Within groups</td>
<td>101.784</td>
<td>7</td>
<td>14.541</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>103.975</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 45. Analysis of covariance of farm credit gain scores by objectives between groups using semesters of science, number of older sisters and outdoor interest as covariates

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1.672</td>
<td>1</td>
<td>1.672</td>
<td>0.170</td>
</tr>
<tr>
<td>Within groups</td>
<td>68.747</td>
<td>7</td>
<td>9.821</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>70.419</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( H_{13}^{0} \): There is no difference between treatment and control groups as measured by the posttests.

By combining the four subject matter means, the treatment group had an overall posttest mean of 55.18 percent whereas the control had a mean of 59.68 percent. The analysis of variance between these means, as displayed in Table 46, yielded an F-value of 1.373 which was not significant. The subject matter factor, however, was significant with an F-value of 32.090 which was significant beyond the one percent level. The design of the
### Table 46. Analysis of variance of posttest scores between groups with four subject matter units combined

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>243.409</td>
<td>1</td>
<td>243.409</td>
<td>1.373</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>1772.579</td>
<td>10</td>
<td>177.258</td>
<td></td>
</tr>
<tr>
<td>Subject matter</td>
<td>2503.315</td>
<td>3</td>
<td>834.438</td>
<td>32.090**</td>
</tr>
<tr>
<td>Group X subject matter</td>
<td>118.219</td>
<td>3</td>
<td>39.406</td>
<td>1.515</td>
</tr>
<tr>
<td>Group X school X subject matter</td>
<td>780.082</td>
<td>30</td>
<td>26.003</td>
<td></td>
</tr>
<tr>
<td>(Error B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5417.605</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>169.505</td>
<td>1</td>
<td>169.505</td>
<td>1.026</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>1652.034</td>
<td>10</td>
<td>165.203</td>
<td></td>
</tr>
<tr>
<td>Subject matter</td>
<td>2072.279</td>
<td>3</td>
<td>690.760</td>
<td>16.235**</td>
</tr>
<tr>
<td>Group X subject matter</td>
<td>122.010</td>
<td>3</td>
<td>40.670</td>
<td>0.956</td>
</tr>
<tr>
<td>Group X school X subject matter</td>
<td>1276.435</td>
<td>30</td>
<td>42.548</td>
<td></td>
</tr>
<tr>
<td>(Error B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5417.605</td>
<td>47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.
study did not permit the determination of the sources of this difference. The interaction of groups and subject matter was not significant.

Similar results were obtained with treatment day objectives posttest scores were analyzed. The F-value between groups was 1.026 which was not significant. In this analysis, subject matter was again significant beyond the one percent level with an F-value of 16.235.

These data failed to reject $H_0$ which was: There is no difference between treatment and control groups as measured by the posttests.

Hypothesis 14 was stated as:

$H_{14}$: There is no difference between treatment and control groups as measured by the gain scores.

The overall mean gain score for the treatment group was 16.92 percent whereas the control group's was 15.50 percent. The analysis of variance between these means produced an F-value of 0.192 which was not significant. In this analysis, as shown in Table 47, subject matter was significant beyond the one percent level with an F-value of 8.044. Group and subject matter interaction was also significant beyond the one percent level with an F-value of 8.067.

Similar results were obtained when the treatment day objectives gain scores were used in the analysis of variance. As detailed in Table 47, the F-value between groups was 0.061 which was not significant. The means tested were 18.76 percent for the treatment group and 18.00 percent for the control group. Here again, subject matter, and group and subject matter interaction, were significant beyond the one percent level with F-values of 14.733 and 7.699, respectively.

The data failed to reject $H_{14}$ which was: There is no difference be-
Table 47. Analysis of variance of gain scores between groups with four subject matter units combined

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>24.239</td>
<td>1</td>
<td>24.239</td>
<td>0.192</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>1263.533</td>
<td>10</td>
<td>126.353</td>
<td></td>
</tr>
<tr>
<td>Subject matter</td>
<td>1245.946</td>
<td>3</td>
<td>415.315</td>
<td>8.044**</td>
</tr>
<tr>
<td>Group X subject matter</td>
<td>1249.511</td>
<td>3</td>
<td>416.504</td>
<td>8.067**</td>
</tr>
<tr>
<td>Group X school X subject matter (Error B)</td>
<td>1548.913</td>
<td>30</td>
<td>51.630</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5332.145</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>6.810</td>
<td>1</td>
<td>6.810</td>
<td>0.061</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>1228.826</td>
<td>10</td>
<td>122.883</td>
<td></td>
</tr>
<tr>
<td>Subject matter</td>
<td>1919.282</td>
<td>3</td>
<td>639.760</td>
<td>14.733**</td>
</tr>
<tr>
<td>Group X subject matter</td>
<td>1002.995</td>
<td>3</td>
<td>334.332</td>
<td>7.699**</td>
</tr>
<tr>
<td>Group X school X subject matter (Error B)</td>
<td>1302.684</td>
<td>30</td>
<td>43.423</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5460.602</td>
<td>47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.**
between treatment and control groups as measured by the gain scores.

Analysis of Pretest and Posttest Scores to Determine Significance of Gain

The next hypothesis tested was to determine if the gain in knowledge during the experiment by both groups was significant. It was stated as follows:

\[ H_{0,15} : \text{There is no difference between pretest and posttest scores for the animal health unit.} \]

An analysis of variance using a two-factor experiment with repeated measures was used producing the results listed in Table 48. The gain was significant beyond the one percent level with an F-value of 279.084. The group by gain interaction verifies the previous F-value obtained. Similar results were obtained with the treatment day objectives scores. The F-value for gain with these scores was 671.903 which was significant beyond the one percent level. The group by gain interaction F-value of 14.637 also verifies previous results. These data indicated that \( H_{0,15} \) should be rejected. \( H_{0,15} \) was stated as: There is no difference between pretest and posttest scores for the animal health unit.

\[ H_{0,16} \] was stated:

\[ H_{0,16} : \text{There is no difference between pretest and posttest scores for the commercial fertilizers unit.} \]

The analysis of variance of a two-factor experiment with repeated measures of commercial fertilizers pretest and posttest scores (Table 49) produced an F-value of 84.307 which was significant beyond the one percent level. When the treatment day objectives scores were used, the F-value was 97.065 which was also significant beyond the one percent level. These data
Table 48. Analysis of variance of a two-factor experiment with repeated measures of animal health pretest and posttest scores

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>By overall scores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>0.025</td>
<td>1</td>
<td>0.025</td>
<td>0.000</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>787.364</td>
<td>10</td>
<td>78.736</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>2527.847</td>
<td>1</td>
<td>2527.847</td>
<td>279.084**</td>
</tr>
<tr>
<td>Group X gain</td>
<td>54.270</td>
<td>1</td>
<td>54.270</td>
<td>5.992*</td>
</tr>
<tr>
<td>Group X school X gain (Error B)</td>
<td>90.476</td>
<td>10</td>
<td>9.058</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3460.082</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>By objectives scores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>12.456</td>
<td>1</td>
<td>12.456</td>
<td>0.141</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>884.635</td>
<td>10</td>
<td>88.464</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>2338.983</td>
<td>1</td>
<td>2338.983</td>
<td>671.903**</td>
</tr>
<tr>
<td>Group X gain</td>
<td>50.955</td>
<td>1</td>
<td>50.955</td>
<td>14.637**</td>
</tr>
<tr>
<td>Group X school X gain (Error B)</td>
<td>34.811</td>
<td>10</td>
<td>3.481</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3321.840</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant beyond the five percent level.

**Significant beyond the one percent level.
Table 49. Analysis of variance of a two-factor experiment with repeated measures of commercial fertilizers pretest and posttest scores

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>162.136</td>
<td>1</td>
<td>162.136</td>
<td>1.538</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>1053.981</td>
<td>10</td>
<td>105.398</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>1061.089</td>
<td>1</td>
<td>1061.089</td>
<td>84.307**</td>
</tr>
<tr>
<td>Group X gain</td>
<td>5.511</td>
<td>1</td>
<td>5.511</td>
<td>0.318</td>
</tr>
<tr>
<td>Group X school X gain (Error B)</td>
<td>173.306</td>
<td>10</td>
<td>17.331</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2856.023</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>181.112</td>
<td>1</td>
<td>181.112</td>
<td>1.085</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>1669.304</td>
<td>10</td>
<td>166.930</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>2248.656</td>
<td>1</td>
<td>2248.656</td>
<td>97.065**</td>
</tr>
<tr>
<td>Group X gain</td>
<td>1.114</td>
<td>1</td>
<td>1.114</td>
<td>0.048</td>
</tr>
<tr>
<td>Group X school X gain (Error B)</td>
<td>231.665</td>
<td>10</td>
<td>23.166</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4331.852</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.**
indicated that $H_{16}$ also should be rejected. $H_{16}$ was: There is no difference between pretest and posttest scores for the commercial fertilizers unit.

The next hypothesis was stated:

$H_{17}$: There is no difference between the pretest and posttest scores for the small gas engines unit.

The analysis relative to this hypothesis is displayed in Table 50 and produced an $F$-value for gain of 150.61, which was significant beyond the one percent level. When treatment day objectives scores were used, the $F$-value obtained was 154.909 which was also not significant. These results indicated rejection of $H_{17}$ which was: There is no difference between the pretest and posttest scores for the small gas engines unit.

The last hypothesis stated was:

$H_{18}$: There is no difference between the pretest and posttest scores for the farm credit unit.

The analysis of variance using the two-factor experiment technique with repeated measures developed an $F$-value of 69.683, which was significant beyond the one percent level. The treatment day objectives scores also produced an $F$-value which was significant beyond the one percent level. This value was 47.486.

These data as seen in Table 51 indicated rejection of $H_{18}$ which was: There is no difference between the pretest and posttest scores for the farm credit unit.
Table 50. Analysis of variance of a two-factor experiment with repeated measures of small gas engines pretest and posttest scores

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>67.435</td>
<td>1</td>
<td>67.435</td>
<td>0.827</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>815.480</td>
<td>10</td>
<td>81.548</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>3386.496</td>
<td>1</td>
<td>3386.496</td>
<td>150.610**</td>
</tr>
<tr>
<td>Group X gain</td>
<td>235.188</td>
<td>1</td>
<td>235.188</td>
<td>10.460**</td>
</tr>
<tr>
<td>Group X school X gain (Error B)</td>
<td>224.852</td>
<td>10</td>
<td>22.485</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4729.453</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>46.259</td>
<td>1</td>
<td>46.259</td>
<td>0.512</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>903.984</td>
<td>10</td>
<td>90.398</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>4481.012</td>
<td>1</td>
<td>4481.012</td>
<td>154.909**</td>
</tr>
<tr>
<td>Group X gain</td>
<td>184.815</td>
<td>1</td>
<td>184.815</td>
<td>6.389*</td>
</tr>
<tr>
<td>Group X school X gain (Error B)</td>
<td>289.267</td>
<td>10</td>
<td>28.927</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5905.340</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant beyond the five percent level.

**Significant beyond the one percent level.
Table 51. Analysis of variance of a two-factor experiment with repeated measures of farm credit pretest and posttest scores

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By overall scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>9.188</td>
<td>1</td>
<td>9.188</td>
<td>0.094</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>979.881</td>
<td>10</td>
<td>97.988</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>1549.306</td>
<td>1</td>
<td>1549.306</td>
<td>69.683**</td>
</tr>
<tr>
<td>Group X gain</td>
<td>0.002</td>
<td>1</td>
<td>0.002</td>
<td>0.000</td>
</tr>
<tr>
<td>Group X school X gain (Error B)</td>
<td>376.185</td>
<td>10</td>
<td>37.682</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3468.779</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By objectives scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between groups</td>
<td>1.311</td>
<td>1</td>
<td>1.311</td>
<td>0.010</td>
</tr>
<tr>
<td>Schools within groups (Error A)</td>
<td>1298.876</td>
<td>10</td>
<td>129.888</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>1789.338</td>
<td>1</td>
<td>1789.338</td>
<td>47.486**</td>
</tr>
<tr>
<td>Group X gain</td>
<td>2.438</td>
<td>1</td>
<td>2.438</td>
<td>0.065</td>
</tr>
<tr>
<td>Group X school X gain (Error B)</td>
<td>376.815</td>
<td>10</td>
<td>37.682</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3468.779</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.**
DISCUSSION

The first objective of this study was to determine the effectiveness of video-tape in vocational agriculture as measured by student achievement. Relative to this objective, the findings as detailed in the previous chapter indicate that the use of video-tape neither increased or decreased learning. In all cases, there were no differences in achievement due to use of video-tape between the experimental groups when other factors were made equal through the use of covariates. This would lead the researcher to conclude that video-tape is as effective a means of teaching vocational agriculture as those methods currently being used. This conclusion is substantiated by a majority of the results reported in the review of literature and is also based on the use of video-tape as a supplement to instruction, rather than as the total method of presentation.

The data also revealed that a significant increase in learning was attained by both groups during the three-week experiment. This would lead the researcher to conclude that current methods of teaching vocational agriculture supplemented with video-tape is an effective means of teaching. The use of video-tape as an integral part of the normal instructional procedure appears to be justified.

The second objective of this investigation was to determine those factors which are related to achievement in vocational agriculture when video-tape is used. Concerning this second objective, since there were no differences in achievement due to use of video-tape noted between the treatment and control groups, there were no factors identified which were related to achievement when video-tape is used. There were, however, 26 fac-
tors which were selected by the step-wise regression technique which ac-
counted for differences measured between the treatment and control groups.

Of these 26 factors, intelligence quotient was identified as a covari-
ate four times. Those factors which were selected three times were pre-
test, department size, animal units, student skill sheet, social service
interest and noncrop acres. Those selected twice were teacher experience,
scientific interest, mechanical aptitude, number of younger brothers,
teacher tenure, outdoor interest and semesters of science. Those appearing
once were agricultural achievement, artistic interest, abstract reasoning
aptitude, mechanical interest, crop acres, clerical interest, semesters of
mathematics, teacher knowledge, teacher attitude, computational interest,
semesters of industrial arts and number of older sisters. It was noted
that 5 of these were associated with teacher or school factors, 5 were home
farm-family factors and 16 were personal factors such as achievement, apti-
tude, interest and experience.

Those variables which were not selected as covariates were verbal ap-
titude, persuasive interest, literary interest, total farm acres, number of
older brothers, number of younger sisters, total number of brothers and
sisters, semesters of business, semesters of vocational agriculture and
class size.

Of those factors associated with the home farm, large differences were
noted between the treatment and control groups. Large differences were
also noted between the treatment and control groups in intelligence quo-
tient, aptitude and achievement. With the exception of the freshman class,
the means for these factors were higher for the control group. These dif-
ferences may be accounted for by the geographical location of the schools
by economic areas within the State. Most of the control schools were located in Northwest Iowa, whereas, most of the treatment schools were located in Eastern Iowa. In the opinion of the researcher, a systematic random sampling technique by economic areas of the State may have been more effective in distributing the experimental groups equally.

Due to the wide differences in performance of individual schools within both groups, it may have been desirable to attempt to exercise more control over the school-teacher factors. One method of doing this would have been to have each school randomly split classes into two equal sized groups with one being a treatment group and one being a control group. Obviously, each school could not split all classes but each may have been able to split one or two.

During the conduct of the experiment, the researcher was able to visit all schools of the treatment group. The treatment was applied in the manner intended, for the most part. Only one malfunction of the equipment was encountered and this was corrected within 24 hours and did not affect the sequence of presentation of the tapes in that school. The quality of the picture and sound reproduction by the video-tape equipment seemed to be adequate. The instructors were well able to operate the equipment after having only the one morning's training session.

The receivers were, in most cases, correctly placed in the room with no students seated outside a 45 degree angle from the face of the screen and more than 23 feet distant from the set. In one school, some students were seated a few feet over 23 feet from the screen. Criterion for the maximum distance was one foot of distance for each inch of screen width.

Some conflicts with school activities, state contests, weather and
flooding were encountered during the experiment and few of the schools completed the 15 days of instruction within the three-week period. Since both treatment and control schools were delayed, it was assumed that this had no effect on the outcomes of the experiment. All schools continued until they had completed the 15 days of instruction.

Student and teacher reaction toward the use of the video-tape segments was generally favorable with little agreement as to which segment was preferred. Techniques utilized in making the tapes included interviews, discussion, slides, 16mm film, charts, models, actual objects, demonstrations and chalkboard. The researcher acted as the coordinator or host of each of the 16 segments of video-tape. Technical assistance in the form of direction, lighting, camera work and set was given by the staff of WOI-TV. The researcher planned the format of each segment with the consultation of the station program director. Title cards and background music for the introductions to each segment were produced by WOI-TV. Since portable equipment for taping outside of the studio was not available at the time of the preparation of the tapes, slides and 16mm film were used as needed in producing the tapes.

The third objective of this study, namely, to determine the implications of the use of video-tape in vocational agriculture, must by necessity be a matter of judgement on the part of the researcher based on the review of literature, findings and experience gained in preparing for and conducting this experiment. Those which seemed pertinent are:

1. Video-tape will be used to a much greater extent by vocational agriculture teachers as equipment becomes more widely available in schools. Color and portable taping equipment may make it even
more adaptable to vocational agriculture.

2. Video-tape will be used as a supplement to instruction rather than the main method of communication at the high school level.

3. Teachers will use the equipment for other purposes in addition to classroom instruction. These include teacher self-evaluation and image magnification. The preservation of detailed demonstrations from one year to the next may reduce class preparation time.

4. Students will use the equipment for self-evaluation, leadership development and the presentation of classroom reports.

5. Specialists in various disciplines will be brought into the classroom through the use of video-tape. This would require statewide coordination with the preparation of tapes being done at a central location and furnished to schools on a loan or rental basis. This should include the capability for dubbing to all makes of tape and machines. At the beginning, this would probably be used primarily for adult class instruction.

6. Instruction on the use of the equipment will become a regular part of the undergraduate and the inservice training programs for vocational agriculture teachers.

Even though this study did not show differences in favor of the video-tape group, there are reasons further study should be made on the use of video-tape in teaching vocational agriculture. Experimentation with the media encourages teachers in the field to become acquainted with the possibilities of its use in their teaching. The final evaluation of the effectiveness of the technique will be determined by its adoption by a large segment of the teachers. There may also be advantages for using the media
other than its effect on student achievement. Increased interest and motivation of students, savings of preparation time of teachers, and savings in travel time to obtain certain class experiences, may be justifications for the adoption and use of the media.

This researcher makes the following suggestions for further research:

1. Similar studies should be conducted utilizing other subject matter units including those involving manipulative skills.

2. Other dependent variables such as student and teacher attitudes toward the use of the media should be utilized in addition to student achievement in evaluating the technique.

3. Regional differences within the state should be controlled by a systematic random sampling technique.

4. School and teacher differences should be controlled by randomly assigning students within classes to treatment and control groups. This would necessitate adequate planning and coordination with the schools so that the schools may be prepared to split their large classes into two sections to be taught by the same teacher during the experiment.

5. Student achievement should be defined as the gain between pretest and posttest.

6. Personal, teacher, school and home farm-family information should be gathered, as it was in this study, in order to control the differences between experimental groups.
SUMMARY

This research was conducted as a part of a larger overall study enti­
tled "An Experimental Evaluation of the Effectiveness of Selected Tech­
niques and Resources on Instruction in Vocational Agriculture." The over­
all study included eight teaching techniques including (1) audio-tutorial,
(2) single concept films, (3) prepared lesson plans, (4) field trips, (5)
demonstrations, (6) transparencies, (7) video-tape and (8) control. The
project was under the direction of the Department of Agricultural Education
at Iowa State University with funds provided by the Iowa Department of
Public Instruction, Research Coordinating Unit and the Iowa Agriculture and
Home Economics Experiment Station.

The objectives were:

1. To determine the effectiveness of video-tape in vocational agri­
culture as measured by student achievement.
2. To determine those factors which are related to achievement in vo­
cational agriculture when video-tape is used.
3. To determine the implications of the use of video-tape in voca­
tional agriculture.

The review of literature indicated no studies completed associated
with video-tape in teaching vocational agriculture. The majority of the
studies conducted at the elementary, high school and college level found no
significant differences in student achievement resulting from the use of
video-tape. Most of the studies compared video-tape with face to face in­
struction.

Subject matter units common to the four grade levels of vocational ag-
culture were selected to be used as three-week instructional units during the experiment. Units selected and the classes taught were animal health—Vo-Ag I, commercial fertilizers—Vo-Ag II, small gas engines—Vo-Ag III and farm credit—Vo-Ag IV. Unit outlines and daily lesson plans were developed which included daily objectives, problems, assignments and references.

Twelve schools were randomly selected from the Iowa vocational agriculture departments with six assigned to each treatment and control groups. A total of 348 students were in the treatment group and 232 were in the control group.

Four video-taped segments were prepared for each of the four subject matter areas covering specific objectives to be taught on the days the tapes were to be shown. The video-tapes were prepared in the facilities of WOI-TV and with their consultation. The video-tapes were introduced and shown by the individual teacher on the days specified by the researcher.

Before beginning the application of the experiment data were gathered relative to the student's aptitude, interests, experiences, home farm and family. Data were also gathered on the school and instructors. The students were administered the following tests:

1. Otis IQ (short form)
2. Kuder General Interest Survey
3. Differential Aptitude Test (verbal, mechanical and abstract)
4. Pretest

In addition, students were asked to fill out a student skill sheet and survey forms concerning their home farm, family and scholastic background.

Instructors were given a test over the subject matter and the Minnesota Teacher Attitude Inventory Test.
At the end of the experiment the students were administered a posttest identical to the pretest. Specific questions were identified which covered the material taught on the day the video-tapes were shown. These were identified as objectives scores. Both the posttest and gain between pretest and posttest were used as dependent variables to evaluate achievement.

The analysis of the data revealed no differences between the treatment and control groups as measured by the pretest in all four subject matter areas, either in overall scores or objectives scores.

The analysis of the posttest scores identified significant differences in favor of the control group at the five percent level in the small gas engines unit. The F-values obtained were 5.885 and 5.190 for overall and objectives scores, respectively. When three factors identified by the step-wise technique were used as covariates, no differences were found between these scores. Differences between the two groups' posttest scores for the other subject matter units were not significant.

When gain scores were used as the dependent variable, significant differences were found between the groups for the animal health unit in favor of the control group. For the overall scores, the F-value of 5.993 was significant at the five percent level and the F-value of 14.641 for the objective scores was significant beyond the one percent level. When three covariates were used, again selected by the step-wise technique, no significant differences were found due to treatment effects.

The differences in gain scores between the treatment and control groups for small gas engines were also significant in favor of the control group. The F-value of 10.460 was significant at the one percent level and the F-value of 6.389 for the treatment day objective scores was significant
at the five percent level. When the covariance technique was used, with three factors selected by the step-wise technique, no differences were found due to treatment effects.

When the scores of all four subject matter units were used together, no differences in posttest scores were found between groups due to the treatment effects. The subject matter effect was significant but this difference was not identifiable as to source.

Similar results were obtained when gain scores were compared with all subject matters combined. In this case, the treatment by subject matter interaction was also significant. Due to the design of the study, no conclusions could be drawn as to the source of these differences.

The analysis of variance of a two-factor experiment with repeated measures of the pretest and posttest scores resulted in no significant differences due to treatment effects for all subject matter areas. The gain in knowledge during the 15-day experiment was found to be highly significant beyond the one percent level for all subject matter areas.

The data led the researcher to the conclusion that video-tape, when used as a supplement to instruction in vocational agriculture, is an effective technique of teaching. Even though its use did not appear to increase student achievement, the media is expected to be more widely used by vocational agriculture teachers. Further studies should include design factors to overcome the effect of the teacher variable and also should include methods of evaluation in addition to student achievement.


ACKNOWLEDGEMENTS

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The cooperation of WOI-TV through Mr. Jim Davis, Mr. Bob Phillips and Mr. Jim Varnum was of great help in developing the video-taped segments used in this study.

Acknowledgements are also offered to the cooperating schools and teachers for their dedicated efforts towards improvement of instruction through research.

Appreciation is also extended to the author's wife and family for their understanding and support throughout this research effort and graduate study program.
APPENDIX A: OUTLINE OF SUBJECT MATTER UNITS
ANIMAL HEALTH
ANIMAL HEALTH

Problem Area Outline by Days

Day

1  The Economic Importance of Livestock Diseases and Parasites
2  Factors in Maintaining Animal Health
3 & 4 Causes, Symptoms, Prevention and Control of Major Cattle Diseases
5  Life Cycles, Symptoms, Prevention and Control of Major Cattle Parasites
6 & 7 Causes, Symptoms, Prevention and Control of Major Sheep Diseases
8  Life Cycles, Symptoms, Prevention and Control of Major Sheep Parasites
9 & 10 Causes, Symptoms, Prevention and Control of Major Swine Diseases
11 Life Cycles, Symptoms, Prevention and Control of Major Swine Parasites
12 Planning a General Livestock Health Program
13 Occupational Roles of the Veterinarian, Farmer, and Other Animal Health Workers
14 Summary and Review
15 Post-Test
ANIMAL HEALTH

Behavioral Objectives: (understandings and abilities)

Understanding of: 1) The relation between control of diseases and parasites with efficient production of livestock

2) The types, causes, symptoms, prevention and control of the major diseases and parasites of livestock

3) The occupational roles of the veterinarian, farmer, and other animal health workers

4) The possibilities for employment in occupations requiring a knowledge of animal diseases and parasites

Ability to: 1) Recognize normal and abnormal health conditions prevalent in livestock and livestock production

2) Plan an effective program for controlling livestock diseases and parasites

3) Maintain desirable animal health conditions for livestock
ANIMAL HEALTH

Day 1

1. PROBLEM AREA: The Economic Importance of Livestock Diseases and Parasites

Objectives:

To develop an understanding of:

a. The importance of livestock diseases and parasites upon profitable livestock production
b. The amount of damage done to livestock and livestock products by diseases and parasites
c. The cost of controlling livestock diseases and parasites

References:

a. Animal Health, Ch. 1, pp. 1-6

Day 2

2. PROBLEM AREA: Factors in Maintaining Normal Animal Health

Objectives:

To develop an understanding of:

a. The physical characteristics of the healthy animal
b. Characteristics that indicate abnormal health and behavior of animals
c. Proper management steps in preventing and controlling livestock diseases and parasites
d. Desirable livestock health conditions

To develop an ability to:

a. Recognize normal and abnormal livestock and livestock conditions
b. Determine when an animal needs medical attention

References:

a. Animal Health, Ch. 2, pp. 7-12
3. PROBLEM AREA: Causes, Symptoms, Prevention, and Control of Major Cattle Diseases

Objectives:

To develop an understanding of:

a. The types of cattle diseases
b. Causes, symptoms, treatment, and prevention of the following diseases of cattle:

1. Brucellosis
2. Shipping Fever Complex
3. Foot Rot
4. Pinkeye
5. Ringworm
6. Mastitis
7. Leptospirosis
8. Calf Scours
9. Warts
10. Pneumonia
11. Milk Fever
12. Ketosis
13. Bloat

To develop an ability to recognize conditions of cattle that warrant calling a veterinarian

References:

a. Animal Health, Ch. 3, pp. 13-17; Ch. 4, pp. 18-29

Day 5

4. PROBLEM AREA: Life Cycles, Symptoms, Prevention, and Control of Cattle Parasites

Objectives:

To develop an understanding of:

a. The types of cattle parasites
b. The life cycles, symptoms, prevention, and control of major cattle parasites

1. Screw worms
2. Grubs
3. Flies
4. Stomach worms
5. Lice

To develop an ability to:

a. Recognize parasite infestations in cattle
b. Treat cattle parasites
   c. Control cattle parasites
ANIMAL HEALTH

Day 5 (continued)

References:

a. Animal Health, Ch. 7, pp. 49-52; Ch. 8, pp. 53-58

Days 6 and 7

5. PROBLEM AREA: Causes, Symptoms, Prevention, and Control of Major Sheep Diseases

Objectives:

To develop an understanding of:

a. The types of sheep diseases
b. Causes, symptoms, treatment, and prevention of the following diseases of sheep:

1. Foot Rot  3. Sore Mouth  5. Lambing
3. Sore Mouth  5. Lambing

To develop an ability to recognize disease conditions in sheep that warrant calling a veterinarian

References:

a. Animal Health, Ch. 3, pp. 13-17; Ch. 5, pp. 30-35

Day 8

6. PROBLEM AREA: Life Cycles, Symptoms, Prevention, and Control of Major Sheep Parasites

Objectives:

To develop an understanding of:

a. The types of sheep parasites
b. The life cycles, symptoms, prevention, and control of the following major sheep parasites:

1. Screw Worm  4. Scab Mites
2. Lice  5. Stomach Worm
3. Ticks  6. Tapeworms
4. Scab Mites  7. Coccidiosis
ANIMAL HEALTH

Day 8 (continued)

Objectives: (continued)

To develop an ability to:

a. Recognize animal parasite infestations in sheep
b. Treat sheep parasites
c. Control sheep parasites

References:

a. Animal Health, Ch. 7, pp. 49–50; Ch. 9, pp. 59–66

Days 9 and 10

7. PROBLEM AREA: Causes, Symptoms, Prevention, and Control of Major Swine Diseases

Objectives:

To develop an understanding of:

a. The types of swine diseases
b. Causes, symptoms, treatment, and prevention of the following diseases of swine:

1. Cholera 5. Brucellosis
2. Erysipelas 6. Flu
3. Chronic Mycoplasmal Pneumonia 7. TGE
4. Atrophic Rhinitis 8. Leptospirosis

To develop an ability to recognize disease conditions in swine that warrant calling a veterinarian

References:

a. Animal Health, Ch. 3, pp. 13–17; Ch. 6, pp. 36–48
Day 11

8. PROBLEM AREA: Life Cycles, Prevention and Control of Major Swine Parasites

Objectives:

To develop an understanding of:

a. The types of swine parasites
b. The life cycles, symptoms, prevention, and control of the following major swine parasites:
   1. Ascarids
   2. Lungworms
   3. Mange
   4. Lice

To develop an ability to:

a. Recognize parasite infestations in swine
b. Treat swine parasites
c. Control swine parasites

References:

a. Animal Health, Ch. 7, pp. 49-50; Ch. 10, pp. 67-71

Day 12

9. PROBLEM AREA: Planning a General Livestock Health Program

Objectives:

To develop an understanding of:

a. The role of sanitation in an animal health program
b. The importance of preventive medicine

To develop an ability to:

a. Plan general livestock health programs
b. Evaluate current livestock health programs

References:

a. Animal Health, Ch. 11, pp. 73-80
b. Animal Health Handbook, pp. 6-7
Day 13

10. PROBLEM AREA: Occupational Roles of the Veterinarian, Farmer and Other Animal Health Workers

Objectives:

To develop an understanding of:

a. The occupational roles for veterinarians, farmers, and other animal health workers
b. Opportunities for employment in the field of animal health

To develop an ability to care for sick animals

References:

a. Animal Health, Ch. 12, pp. 81-87
b. Animal Health Handbook, pp. 36-38

Day 14

11. PROBLEM AREA: Summary and review

Objectives:

To review previously covered material and answer student questions

References:

a. All previous assignments
Problem Area Outline by Days

Day

1  Influence of Fertilizers on Farming

2 & 3  Essential Plant Food Elements and Their Function in Plant Growth

4  Hunger Signs of Crops

5 & 6  Taking a Soil Sample

7  Liming to Correct Soil Acidity

8 & 9  Understanding the Soil Test Report

10  Determining the Amount of Nutrients Available in the Soil

11  Determining Fertilizer Application Rates

12 & 13  Selecting Fertilizer Materials to Fill Nutrient Needs

14  Summary and Review

15  Post-Test
Behavioral Objectives: (understandings and abilities)

Understanding of: 1) The influence of fertilizers on farming

2) The essential plant food elements and their function in plant growth

3) The effect of soil acidity on crop production

Ability to: 1) Recognize hunger signs of crops

2) Take a soil sample

3) Correct soil acidity by liming

4) Interpret the soil test report

5) Determine the amount of nutrients available in the soil

6) Determine fertilizer application rates

7) Select fertilizer materials to fulfill nutrient needs
Day 1

1. PROBLEM AREA: Influence of Fertilizers on Farming

Objectives:

To develop an understanding of:

a. The benefits to be gained from fertilizing
b. The increase in fertilizer use in Iowa and the local community
c. The need to maintain soil fertility
d. How plant food is lost

References:

a. Our Land and Its Care, pp. 2-21, 62-65, 67-68
b. Fertilizer Use in Iowa Reaches Record Level, Iowa Farm Service Publication No. 1231

Days 2 and 3

2. PROBLEM AREA: Essential Plant Food Elements and Their Function in Plant Growth

Objectives:

To develop an understanding of:

a. The essential plant food elements and their function in plant growth
   (1) Primary nutrients and their function in plant growth
      (a) The function of nitrogen in plant growth
      (b) The function of phosphorus in plant growth
      (c) The function of potassium in plant growth
   (2) Secondary plant nutrients and their function in plant growth
      (a) The function of calcium in plant growth
      (b) The function of magnesium in plant growth
      (c) The function of sulfur in plant growth
   (3) Micro plant nutrients and their function in plant growth

References:

a. Our Land and Its Care, pp. 23, 26-34
b. Growth and Nutrient Uptake by Corn, Pamphlet 277
Day 4

3. PROBLEM AREA: Hunger Signs of Crops

Objectives:

To develop an understanding of nutrient requirements of various crops

To develop an ability to:

a. Recognize primary plant food deficiencies
b. Recognize secondary plant food deficiencies
c. Recognize micro plant food deficiencies

References:

a. Our Land and Its Care, pp. 36-39
b. Be Your Own Corn Doctor -- NPK Bulletin

Days 5 and 6

4. PROBLEM AREA: Taking a Soil Sample

Objectives:

To develop an understanding of:

a. The effect of soil types on soil fertility
b. The effect of cropping sequence on soil fertility
c. Where soil samples may be analyzed

To develop an ability to:

a. Take a uniform and representative soil sample
b. Correctly fill out the soil and cropping information sheet

References:

a. How to take a Soil Sample, NPK Leaflet
b. Our Land and Its Care, p. 42
c. Soil and cropping Information Sheet, ST-8
Day 7

5. PROBLEM AREA: Liming to Correct Soil Acidity

Objectives:

To develop an understanding of:

a. What is soil acidity and how it is measured
b. The optimum pH range for farm crops
c. The effective calcium carbonate equivalent (ECCE) of various liming materials

To develop an ability to:

a. Correct soil acidity
b. Select proper liming materials
c. Determine proper liming rates

References:

a. Our Land and Its Care, pp. 18-19
b. Understanding Your Soil Test Report, Pamphlet 429, p. 5
c. Your Limestone Recommendation, (St-2)

Days 8 and 9

6. PROBLEM AREA: Understanding the Soil Test Report

Objectives:

To develop an understanding of:

a. What a soil test measures
b. How the amount of N, P, and K are determined by a soil test

To develop the ability to:

a. Select the correct soil test nutrient recommendation
b. Adjust soil test recommendations to specific crop yields

References:

a. Understanding Your Soil Test Report, Pamphlet 429, pp. 1-4
b. Soil Test Report, (ST-9)
Day 10

7. PROBLEM AREA: Determining the Amount of Nutrients Available in the Soil

Objectives:

To develop the ability to estimate:

a. The nitrogen credits for 1st or 2nd corn following a legume
b. The amount of carryover available from fertilizer applied the previous year
c. The amount of nutrients supplied from manure that has been applied since soil was sampled

References:

a. Understanding Your Soil Test Report, Pamphlet 429, pp. 1-4
b. Modern Farmers Need to be Accountants in the Cornfield, Iowa Farm Service Publication No. 1049

Day 11

8. PROBLEM AREA: Determining Fertilizer Application Rates

Objectives:

To develop an understanding of the factors that affect fertilizer application rates:

a. Nutrient requirements from soil test report
b. Nutrients available in the soil

to develop the ability to:

a. Calculate proper fertilizer application rates
b. Convert $P_2O_5$ to Phosphorus
c. Convert $K_2O$ to Potassium

References:

a. Understanding Your Soil Test Report, Pamphlet 429, pp. 2-4
b. Better Names for "Phosphate" and "Potash", Iowa Farm Service Publication No. 1050
Days 12 and 13

9. PROBLEM AREA: Selecting Fertilizer Materials to Fill Nutrient Needs

Objectives:

To develop an understanding of the major sources of fertilizer materials available in the community.

To develop the ability to:

a. Change nutrient recommendations into amounts of a fertilizer grade.

b. Select fertilizer materials that will fulfill nutrient needs.

References:

b. Our Land and Its Care, pp. 44-45, 56, 57.

Day 14

10. PROBLEM AREA: Review and Summary

Objectives:

To review previous material covered in this partial unit.

References:

a. Those cited for each of the problem areas studied.
SMALL GASOLINE ENGINES
## SMALL GASOLINE ENGINES

### Problem Area Outline by Days

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<tr>
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</tbody>
</table>
Behavioral Objectives: (understanding and abilities)

Understanding of:
1) Basic principles of small engine operation
2) Difference between two and four-stroke cycle engines
3) Function of piston, rings, crankshaft, camshaft, and valves as related to compression
4) Function of carburetor and component parts
5) Function of small engine ignition systems and component parts
6) Measuring devices used on small engines

Ability to:
1) Identify basic small engine components
2) Perform general maintenance on a small gasoline engine
3) Trouble shoot a small gasoline engine
4) Use various measuring and testing devices
5) Use a service manual
Day 1

1. PROBLEM AREA: Engine principles - Two and Four-Cycle Engines

Objectives:

To develop an understanding of:

a. The history of small gasoline engines
b. The intake stroke, compression stroke, power stroke and exhaust stroke in an engine
c. The principles of operation of a two and four-cycle engine

References:

a. General Theories of Operation, Briggs & Stratton, Corp., pp. 2-3

Day 2

2. PROBLEM AREA: Nomenclature - Compression Factors

Objectives:

To develop an understanding of piston displacement and compression ratio as related to horsepower in a small engine

To develop an ability to:

a. Identify main parts of small engines
b. Calculate piston displacement and compression ratio

References:

a. General Theories of Operation, Briggs & Stratton, Corp., p. 4
b. Small Gasoline Engines Student Handbook, Penn. State Univ. p. 4
Days 3 and 4

3. PROBLEM AREA: Valves, Valve Timing and Camshafts

Objectives:

To develop an understanding of:

a. Valve operating conditions  
b. Valve failures  
c. Timing an engine

To develop an ability to:

a. Identify parts of valve train  
b. Determine usable valve margin and valve seat tolerances

References:

a. General Theories of Operation, Briggs & Stratton, Corp., pp. 4-7  
b. Small Gasoline Engines Student Handbook, Penn. State Univ., pp. 5-7

Day 5

4. PROBLEM AREA: Ring Adjustment

Objectives:

To develop an understanding of:

a. The purpose of rings  
b. Ring types and each's function

To develop an ability to:

a. Measure various ring clearances  
b. Identify types of rings

References:

Day 6

5. PROBLEM AREA: Measuring Devices

Objectives:

To develop an understanding of various measuring devices
To develop an ability to read micrometer and other measuring devices

References:


Days 7, 8, and 9

6. PROBLEM AREA: Carburetion, Carburetor Types and Adjustment, and Governors

Objectives:

To develop an understanding of:

a. Principles of operation of carburetors
b. How gaseous mixture is controlled within the carburetor
c. Governor types and operation

To develop an ability to:

a. Identify basic parts of the carburetor
b. Explain operation of various types of carburetors
c. Governor types and operation

References:

a. General Theories of Operation, Briggs & Stratton, Corp., pp 8-13, 20-21
Day 10

7. PROBLEM AREA: Air Cleaners

Objectives:

To develop an understanding of:

a. The importance of an air cleaner
b. The different types and principles of operations of air cleaners

To develop an ability to service various types of air cleaners

References:

a. General Theories of Operation, Briggs & Stratton, Corp., p. 14

Days 11 and 12

8. PROBLEM AREA: Ignition and the Magneto Cycle

Objectives:

To develop an understanding of:

a. The purpose of ignition systems
b. Types of ignition systems
c. Principles of magneto-ignition systems
d. A complete magneto cycle

To develop an ability to:

a. Identify parts of magneto-ignition system
b. Differentiate between a hot and cold spark plug

References:

a. General Theories of Operation, Briggs & Stratton, Corp., pp. 15-18
Day 13

9. PROBLEM AREA: Preventative Maintenance

Objectives:

To develop an understanding of:

a. The importance of maintenance on small gasoline engines
b. Why clean, fresh, regular gasoline should be used in small gasoline engines
c. API Service Classification and SAE Viscosity rating of oil

To develop an ability to:

a. Determine and analyze engine problem by observation of spark plug
b. Properly service engine at proper time (spark plugs, breaker points, air cleaners and oil)
c. Properly prepare small gasoline engine for storage
d. A service and maintenance schedule

Reference:


Day 14

10. PROBLEM AREA: Trouble Shooting and Review

Objectives:

To develop an understanding of procedures used in trouble shooting

To develop an ability to trouble shoot an engine

Reference:

a. Small Gasoline Engines Student Handbook, Penn. State Univ., pp. 64-65
FARM CREDIT
Problem Area Outline by Days

<table>
<thead>
<tr>
<th>Day</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to Credit, &quot;Problem&quot;</td>
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<td>2</td>
<td>&quot;Problem&quot;, Application for Loan (Financial Statement)</td>
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<td>3</td>
<td>Budgeting Principles</td>
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<td>Budgeting the Problem</td>
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<td>Budgeting, Complete Application for Loan</td>
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<td>6</td>
<td>Types of Loans</td>
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<td>7</td>
<td>Sources of Credit - Short Term &amp; Intermediate</td>
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<td>8</td>
<td>Sources of Credit - Long Term - (Land)</td>
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<td>9</td>
<td>Interest Rates and Loan Costs</td>
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<td>10</td>
<td>Collateral - Short and Intermediate Term</td>
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<td>Collateral - Long Term</td>
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<td>12</td>
<td>Credit Instruments - Short Term - Intermediate</td>
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<td>Credit Instruments - Long Term - (Land)</td>
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<td>14</td>
<td>Summary and Review</td>
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<td>15</td>
<td>Post-Test</td>
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Behavioral Objectives: (understandings and abilities)

Understanding of: 1) The importance of credit in agriculture
2) Types of credit used for specific purposes
3) The sources of credit
4) Interest rates and loan costs
5) Credit instruments
6) The criteria used in granting farm credit
7) The criteria used to evaluate a credit source
8) The career potentials in farm credit

Ability to: 1) Use credit to increase farm income
2) Budget income and expenses to determine credit needs
3) Select correct credit source based on financial position and needs
4) Calculate the cost of various types of loans
5) Use credit instruments
6) Prepare a financial statement
7) Plan a repayment schedule
FARM CREDIT

Days 1 and 2

1. PROBLEM AREA: The Problem

Objectives:

To develop an understanding of the need for credit

To develop an ability to:

a. Analyze a farming situation and determine the financial position of the applicant
b. Prepare a financial statement

References and Materials:

a. Financing Farm & Ranch Activities, pp. 8-11, 15
b. The Problem
c. Financial statement form

Days 3, 4, & 5

2. PROBLEM AREA: Budgeting

Objectives:

To develop an understanding of budgeting principles

To develop an ability to budget a farm credit problem

References and Materials:

a. Financing Farm & Ranch Activities, pp. 34, 36-37
b. The Problem
c. Budget Worksheet
d. Application for loan
3. PROBLEM AREA: Types of Loans (based on length of loan in years)

Objectives:

To develop an understanding of:

a. The three types of loans normally available
b. Disadvantages and advantages of various types of credit

to develop an ability to classify credit requirements into loan types

References and Materials:

a. Financing Farm & Ranch Activities, pp. 12-13

Days 7 & 8

4. PROBLEM AREA: Sources of Credit

Objectives:

To develop an understanding of:

a. The sources of credit
b. An understanding of the criteria used to evaluate a credit source

to develop an ability to determine the type of credit source to use

References and Materials:

a. Financing Farm & Ranch Activities, pp. 32–41, 50–66
5. PROBLEM AREA: Interest Rates and Loan Costs

Objectives:

To develop an ability to calculate the costs of various types of loans

References and Materials:

a. Financing Farm & Ranch Activities, pp. 18-19, 47-50

Days 10 & 11

6. PROBLEM AREA: Collateral

Objectives:

To develop an understanding of the criteria used in granting farm credit

To develop an ability to determine loan value of different types of collateral

References and Materials:

a. Financing Farm & Ranch Activities, pp. 14-17, 44-47
Days 12 and 13

7. PROBLEM AREA: Credit Instruments

Objectives:

To develop an understanding of the types of credit instruments

To develop an ability to use credit instruments

References and Materials:

a. Financing Farm & Ranch Activities, pp. 19-29, 35-39
b. Blank credit instrument forms

Day 14

8. PROBLEM AREA: Summary

Objectives:

To develop an understanding of the career potentials in farm credit work

To review previous problem area objectives

References and Materials:

a. Financing Farm & Ranch Activities
b. The Problem
c. Budget Worksheet
d. Application for loan
e. Credit instruments
FARM CREDIT PROBLEM

Situation

Joe Ernest has been farming part-time while holding a job in town and now has an opportunity to enlarge his farming to a full-time operation. A neighbor's 240 acre farm is offered to Joe to rent with option to buy. Joe can rent the farm for $30 an acre and may purchase the farm within two years at $400 per acre. Joe must now take stock of his goals and financial situation and make his decisions regarding this farm.

For the past four years Joe has been farming 80 acres on a 50-50 crop share lease and has been accumulating machinery and livestock in preparation to start farming full-time. He will be able to use some of his father's machinery and equipment in exchange for his own labor and machinery. Joe is married and has one child.

Joe's Inventory - March 1

Livestock

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<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Value</th>
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<tbody>
<tr>
<td>6 bred sows @ $80</td>
<td>$ 480</td>
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<tr>
<td>54 shoats</td>
<td>1080</td>
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<tr>
<td>10 bred beef cows</td>
<td>2000</td>
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<tr>
<td>6 open beef heifers</td>
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Feed

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<td>25T hay</td>
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<td><strong>Total</strong></td>
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<td><strong>$2500</strong></td>
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Inventory (continued)

Machinery

- Tractor - 4 plow $4500
- Plow - 4 bottom 750
- Disc - 14' tandem 1000
- Cultivator - 4 row 750
- Planter - 4 row (1/2 interest) 600
- 2 wagons and auger 400

Total $8000

Other Assets

- Cash in bank $4000
- Life Insurance (cash value) 2500
- Savings bonds 1000

Total $7500

Debts

- Note on tractor and plow
  (two annual payments left
  of $1250 each plus 7% int.) $2500

Expected Cropping Program

80 acres (50-50 crop share lease) Expected yields

- 40 A corn 120
- 40 A beans 45

240 acres (cash rent $7200) (200 A tillable)

- 80 A corn 120
- 40 A beans 45
- 40 A oats 80
- 40 A hay 4T
Expected Sales

Livestock

- May - 50 hogs $2000
- Oct - 50 hogs 2000
- Oct - 10 feeder calves 1250

Crops

- Dec - 2700 bu. beans $6750
- Feb - 7000 bu. corn 7000

Expected Expenses

Cash rent - March $3600, October $3600

Seed
- March - Oats $80
- May - Corn $450
- May - Beans $180

Fertilizer - May $2400

Herbicide - May $750

Feed - $50 per month

Repairs, gas and oil - $50 per month except May, Oct, Nov - $100

Supplies and Vet expenses - May & Oct, $100, July & Jan, $50

Insurance - April $80


Personal living - $400 per month

Livestock purchases - (boar) - April $150

Payment on tractor and plow - December - $1425

(Note) loan to be set up to maintain $1000 balance in checking account
### Expected Ending Inventory

#### Livestock

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#### Machinery

Same items - Total value $6400

#### Other Assets

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#### Debts

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APPENDIX B: EVALUATION INSTRUMENTS
ANIMAL HEALTH

For each of the questions stated below, select the one most appropriate answer, then blacken in the box on your answer sheet that corresponds with the answer that you have selected.

1. The recommended treatment for an infestation of broad tapeworms in sheep is to:
   a. administer the drug piperazine.
   b. administer the drug thiabendazole.
   c. rotate the pasture every week.
   d. administer the drug Teniatol.
   e. change the feed by increasing the concentrates.

2. Leptospirosis in cattle is spread by:
   a. bacteria entering through the test canal.
   b. damp, drafty, poorly ventilated quarters.
   c. injuries to the udder.
   d. urine of infected animals in the food or waterers.
   e. the hands of the herdsman and on milking equipment.

3. One of the best ways of preventing milk fever is to:
   a. disinfect all pens, stables and chutes.
   b. feed a ration that includes the proper amounts of calcium, phosphorus and salt.
   c. prohibit visitors from entering the cattle pens.
   d. vaccinate annually.
   e. provide clean, well bedded pens.

4. Screw worms of cattle or sheep are:
   a. the adult stage of the heel fly.
   b. the larval stage of the heel fly.
   c. the pupa stage of the screw worm fly.
   d. the adult stage of the screw worm fly.
   e. the larval stage of the screw worm fly.

5. Brucellosis in cattle is also known as:
   a. ketosis.
   b. asymptomatic abortion.
   c. epizootic infertility.
   d. bovine cystitis.
   e. Bang's disease.

6. When applying disinfectants to wounds on animals:
   a. use iodine for all wounds since it is the strongest disinfectant.
   b. use a weaker disinfectant around the sensitive areas like the eyes.
   c. use three or four disinfectants on all wounds.
   d. do not apply disinfectant to the entire wound because it needs to breathe.
   e. never allow the disinfectant to soak into the open wound because it will cause the animal discomfort.
ANIMAL HEALTH

7. Brucellosis in cattle, sheep and hogs:
   a. can be successfully treated by isolating and vaccinating the affected animals.
   b. has no successful treatment.
   c. can be successfully treated with a drastically improved ration.
   d. is caused by drafty quarters.
   e. is caused by a virus that is spread from animal to animal through contaminated feeds.

8. One procedure to help prevent mastitis in cattle is to:
   a. feed a ration that contains the proper amounts of calcium, phosphorus and salt.
   b. be certain that the cows are getting enough carbohydrates.
   c. dip the teats in chlorine after milking.
   d. blood test the animals annually.
   e. inject calcium gluconate into the blood stream.

9. Calf scours are most often caused by:
   a. mastitis infected milk and are seldom fatal.
   b. virus and are not fatal.
   c. virus and are often fatal.
   d. spirillum bacteria and are often fatal.
   e. bacillus bacteria and are often fatal.

10. One material that is helpful in treating pinkeye in cattle is:
    a. sulfa powder.
    b. soap and water.
    c. Terramycin.
    d. castor oil.
    e. intravenous injection of calcium borogluconate.

11. The MMA (mastitis-metritis-agalactia) syndrome in hogs is:
    a. usually fatal.
    b. a new disease affecting the nervous balance of hogs.
    c. caused by excessive exercise.
    d. not treatable.
    e. a term for three disease problems.

12. Cattle and sheep lice usually live on:
    a. only one host and complete the cycle in 4 weeks.
    b. only one host and complete the cycle in 6 weeks.
    c. two different hosts and complete the cycle in 4 weeks.
    d. two different hosts and complete the cycle in 6 weeks.
    e. four different hosts and complete the cycle in 4 weeks.
13. Viruses are:
   a. slightly larger than bacteria and dependent upon living tissue for support.
   b. many times smaller than bacteria and dependent upon living tissue for support.
   c. small flying insects which are red colored when mature.
   d. either rod-shaped or spiral shaped organisms.
   e. parasites transmitted by the bite of an insect.

14. The stance of an animal is:
   a. the posture or way of standing and should be normal and relaxed.
   b. the manner of movement of an animal and should be free of limping.
   c. the posture or way of standing and should be stiff and straight.
   d. the manner of movement of an animal and should be rapid.
   e. the position of the head while the animal is walking and should be lower than the back.

15. Hygromycin, piperazine and dichlorovos are used to control:
   a. roundworms (ascarids) in swine.
   b. tapeworms in sheep.
   c. stomach worms in cattle.
   d. lungworms in swine.
   e. grubs in cattle.

16. The mucous membranes are generally found on an animal:
   a. lining the intestinal tract and should be moist and dark red in color.
   b. lining the openings of the body and should be moist and flesh colored.
   c. lining the openings of the body and should be dry and dark red.
   d. lining the urinary tract and should be dry and yellow colored.
   e. lining the nasal tract and should be dry and flesh colored.

17. A ewe that has contracted pregnancy disease can be successfully treated by:
   a. increasing the grain ration to one-half pound per day.
   b. inducing an abortion.
   c. vaccinating with a double bacterin vaccine.
   d. there is not effective treatment.
   e. feeding a sulfa drug in the feed.

18. Two feeds having a laxative effect on animals are:
   a. linseed oil meal and hay.
   b. oats and linseed oil meal.
   c. hay and oats.
   d. hay and bran.
   e. linseed oil meal and bran.
19. The lungworm in swine spends one stage of its life cycle:
   a. in a soil mite and is thought to be instrumental in the spread of swine influenza.
   b. in the common earth worm and is thought to be instrumental in the spread of swine influenza.
   c. in the intestine of cattle and is thought to be instrumental in the spread of swine rhinitis.
   d. in a soil mite and is thought to be instrumental in the spread of swine rhinitis.
   e. in a cell attached to the animal’s hair and is thought to be instrumental in the spread of pneumonia.

20. The disease caused by a PPLO (pleuro-pneumonia-like organism) which damages the lung tissue of hogs is:
   a. chronic mycoplasmal pneumonia.
   b. flu.
   c. TGE.
   d. brucellosis.
   e. actinomycosis.

21. A useful technique in preventing atrophic rhinitis in swine is to:
   a. fortify the feed with calcium, phosphorus, vitamins, antibiotics and sulfa drugs.
   b. increase the roughage content of the feed ration.
   c. administer piperazine in the water every 550 days.
   d. vaccinate with anti-rhinitis vaccine.
   e. spray the hogs with lindane.

22. To supply an average American family of four people farmers produce:
   a. 3 tons of food per year.
   b. 1 ton of food per year.
   c. 10 tons of food per year.
   d. 29 tons of food per year.
   e. 1/2 tons of food per year.

23. Foot rot in cattle is caused by:
   a. fungus.
   b. soil bacteria.
   c. filterable virus.
   d. low level of sugar in the blood.
   e. lack of exercise.

24. When animal numbers double the disease problem is usually increased by:
   a. 50%.
   b. 100%.
   c. 400%.
   d. 10%.
   e. 33%.
25. The two species of cattle grubs are:
   a. northern and southern cattle grubs.
   b. common and southern cattle grubs.
   c. common and northern cattle grubs.
   d. common and eastern cattle grubs.
   e. western and northern cattle grubs.

26. A good rule of thumb to follow in spraying cattle for external parasites is to mix the concentrated insecticide and water:
   a. exactly as shown on the label.
   b. one-half the amount shown on the label.
   c. twice the amount shown on the label.
   d. with 25% diesel fuel.
   e. 48 hours before spraying the cattle.

27. Lice on cattle are controlled by:
   a. spraying with 2,4-D.
   b. drenching with DDT.
   c. pouring on Dacthal.
   d. feeding stilbestrol.
   e. spraying or dusting with ciodrin.

28. Swine erysipelas can be treated by:
   a. there is no effective treatment.
   b. mixing sulfa drugs in the feed.
   c. applying a tincture of iodine to the affected skin areas.
   d. vaccinating with a modified live virus.
   e. an injection of antibiotics.

29. Contagious diseases are:
   a. capable of being transmitted from one animal to another and are sometimes called infectious diseases.
   b. not capable of being transmitted from one animal to another and are sometimes called infectious diseases.
   c. capable of being transmitted from one animal to another and are sometimes called non-infectious diseases.
   d. capable of being transmitted from one animal to another and are sometimes called non-infectious diseases.
   e. capable of being transmitted from one animal to another and only through an intermediate host.

30. Cattle flies will usually produce:
   a. new generations of flies only in the fall of the year.
   b. one generation of flies in two years.
   c. one generation of flies each year.
   d. several generations of flies each year.
   e. several generations of flies each week.
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31. The most effective arrangements to set up with a local veterinarian is to:

a. have him visit the farm twice each day to check for diseases.
b. have him visit the farm only after the farmer has tried all of the
cures for the animal suggested by neighbors.
c. have him visit the farm on a regular schedule as well as when specific
problems develop.
d. arrange to call him late at night or on Sundays when he is not as busy
with other farmers.
e. assume that all animal health problems need immediate attention and
arrange that he come to the farm within minutes of a call.

32. When an animal is ill and a veterinarian must be called to treat it:

a. give the animal a sedative before the veterinarian arrives so it will
be easier to handle.
b. wait to call the veterinarian until the animal has developed serious
symptoms so the veterinarian will be able to diagnose the disease.
c. do not feel obligated to pay the veterinarian if the animal dies.
d. leave the animal in the pasture or feed lot until the veterinarian
arrives since he will know how to catch it.
e. put the animal in a pen or some other form of restraint so the
veterinarian can treat it immediately.

33. The best prevention for swine influenza is to:

a. disinfect all pens, buildings and chutes.
b. provide warm, clean, properly ventilated housing.
c. vaccinate with an anti-flu vaccine each year.
d. feed a ration that includes the proper amounts of calcium, phosphorus
and salt.
e. buy only breeding stock that has been certified influenza free.

34. An abnormal posture of an animal for several days:

a. indicates the need to call a veterinarian immediately.
b. is a positive indicator of an illness.
c. is usually a good indicator of an illness.
d. is usually only an indication of a tired animal.
e. is considered normal and is not cause for concern.

35. To work in the field of animal health a person:

a. must study to be a veterinarian.
b. must have a Ph. D. degree from the university.
c. must have been raised on a farm in order to understand animals.
d. may be a veterinarian, salesman, teacher, extension agent or researcher.
e. should begin working right after high school and not take time to go
to college.
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36. Cyanosis of the mucous membranes of animals is indicated by:
   a. yellow membranes due to a liver disorder.
   b. yellow membranes due to an excess of oxygen in the blood.
   c. dark red membranes due to a liver disorder.
   d. dark red membranes due to a lack of oxygen in the blood.
   e. a pale colored membrane due to anemia.

37. One of the most effective ways to prevent poisoning by plants is to:
   a. have the stocking rate high enough to keep all plants eaten off.
   b. keep all ranges grazed off at all times.
   c. rotate the ranges.
   d. vaccinate against all possible poisonous plants.
   e. do not graze any land that might contain poisonous plants.

38. Animals which have died of contagious diseases on the farm should be disposed of by:
   a. butchering the animal immediately before the meat spoils.
   b. calling the rendering works to haul the carcass away.
   c. calling the state veterinarian inspector who will dispose of the carcass.
   d. pushing the carcass into an eroded gully on the farm.
   e. burning or burying the animal four feet deep on the spot of death and covering with quicklime.

39. Stress in animals is:
   a. a nutritional disease caused by a lack of a particular nutrient.
   b. the result of an anemic mucous membrane.
   c. the presence of a parasitic microorganism in the body system.
   d. an undesirable outside influence of an animal lowering its resistance.
   e. a hereditary condition that can be improved only by improved breeding.

40. When a case of mild bloat is observed the first treatment should be to:
   a. keep the animal on its feet and slowly walking.
   b. induce belching by tying a wooden gag in the animal’s mouth and elevating the feet.
   c. drench with mineral oil or a mixture of turpentine and aromatic spirits of ammonia and water.
   d. puncture the rumen with a trocar and canula just behind the last rib.
   e. inject with an antibiotic to stop the gas formation.

41. A common way for cattle to become infested with stomach worms is by:
   a. ingesting the larvae while grazing.
   b. ingesting the egg while grazing.
   c. having the fly lay eggs on the hairs from where the hatched larvae burrow into the body.
   d. inheriting the worms from the mother.
   e. rubbing against the same fences as other cattle.
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42. Overeating disease in lambs usually occurs when the animal is:
   a. forced to walk too far for grazing.
   b. castrated or docked.
   c. suddenly switched to a high energy ration.
   d. switched to a high energy ration too slowly.
   e. moved to a new flock.

43. When new animals are to be added to a herd it is advisable to isolate them and watch for disease:
   a. for two weeks which also allows the farmer to see if the animal is sterile or a breeder.
   b. three weeks which will also prevent them from fighting with other animals on the farm.
   c. for three days which will also prevent them from fighting with other animals on the farm.
   d. for three weeks which will also allow time to adjust them to new feeding programs.
   e. for three days which will also allow time to adjust them to new feeding programs.

44. The sheep parasite with one of the stages in its life cycle spent in a soil mite is the:
   a. stomach worm.
   b. broad tapeworm.
   c. coccidiosis.
   d. tick.
   e. lice.

45. Mange on swine can be treated by:
   a. applying Smear MS 52.
   b. dusting with famfur.
   c. spraying with copper sulfate and formalin.
   d. spraying with DDT.
   e. spraying with malathion.

46. Adequate ventilation of the housing for animals is important in the winter because it:
   a. keeps the temperature near that of the air outside.
   b. increases the moisture content of unheated buildings to reduce the respiratory problems.
   c. reduces moisture which is favorable medium for the growth of disease organisms.
   d. keeps the walls damp.
   e. allows the disease organisms to move out of the building with the moving air.
47. Coccidiosis is:
   a. an infectious disease caused by a filterable virus.
   b. a metabolic disease caused by a low level of sugar in the blood.
   c. a parasitic disease caused by a protozoan organism.
   d. a flat parasite about three quarters of an inch wide and up to twenty feet long.
   e. the accumulation of too much gas in the abomasum.

48. Hog cholera is caused by:
   a. a fungi and may be spread by direct contact of infected animals.
   b. a bacteria and may be spread only by direct contact of infected animals.
   c. a virus and may be spread by trucks, animals, visitors and birds on a farm.
   d. a virus and may be spread only by the urine of infected animals.
   e. a fungi and may be spread only by the urine of infected animals.

49. In phase four, or the final stage, of the four-phase hog cholera eradication program some of the requirements for being declared a hog-cholera-free state are to:
   a. closely control the importation of bacon and use only crystal violet vaccines.
   b. closely control the importation of bacon and use only modified virus vaccines.
   c. closely control the importation of feeder pigs and use only modified virus vaccines.
   d. closely control the importation of feeder pigs and use no modified virus vaccines.
   e. establish a hog cholera committee and distribute information on hog cholera.

50. Mastitis in sheep is sometimes called:
   a. black quarter and is caused by two different strains of bacteria.
   b. bluebag and is caused by two different strains of bacteria.
   c. bluebag and is caused by two different strains of virus.
   d. ketosis and is caused by two different strains of virus.
   e. salmonellosis and is caused by one strain of fungi.

51. The incubation period for TGE is:
   a. 4 to 5 hours.
   b. 4 to 5 days.
   c. 18 to 24 hours.
   d. 18 to 24 days.
   e. 1 to 2 weeks.
52. What is the annual estimated loss to livestock diseases and parasites on the average farm?

a. $50 to $100.
b. $1,000 to $1,500.
c. $2,000 to $4,000.
d. $5,000 to $10,000.
e. $20,000 to $25,000.

53. Leptospirosis in hogs has the same cause and should be treated essentially the same as leptospirosis in:

a. monogastric animals only.
b. carnivorous animals only.
c. ruminant animals only.
d. all other farm animals.
e. no other farm animals.

54. Zoonoses refers to diseases whose causative agents are transmitted:

a. by bacteria.
b. naturally between all classes of domestic animals.
c. by insect bites.
d. naturally between man and animals.
e. only through an intermediate host.

55. Ringworm in cattle may be treated by:

a. feeding a ration that contains the proper amounts of calcium, phosphorus and salt.
b. administering an intravenous injection of calcium borogluconate.
c. spraying with malathion at a pressure of 350 pounds per square inch.
d. spraying with malathion at a pressure of 125 pounds per square inch.
e. clipping the hair, washing the infected area and painting with a tincture of iodine.

56. Two of the most common drugs to use for treating calf pneumonia are:

a. aureomycin and terramycin.
b. glucose injections and sodium propionate.
c. cortisone injections and formalin solutions.
d. anti-pneumonia serum and anti-pneumonia vaccine.
e. penicillin and arsenicals.

57. A farmer can check the heartbeat of an animal by:

a. holding a stethoscope over the top of the shoulders.
b. holding his ear against the lower left side of the chest.
c. attaching an electrocardiograph to the animal's chest.
d. holding his ear against the side of the animal just behind the last rib.
e. holding a stethoscope against the left side of the face.
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58. When testing animals to determine if a veterinarian is needed remember that:
   a. younger animals normally have slower heart beats than older animals.
   b. the animals temperature varies too much to indicate any illness.
   c. the animals should not be checked immediately after rough handling or excitement.
   d. the normal breathing rate for cattle is 52 to 60 breaths per minute.
   e. the normal temperature for hogs is 95 to 97°F.

59. A living organism which lives at the expense of another living organism is known as a:
   a. bryophyte.
   b. dendrite.
   c. saprophyte.
   d. parasite.
   e. hermaphrodite.

60. When speaking of swine the term SPF means:
   a. Successful Pig Farmer and indicates a good source of breeding stock.
   b. Self Pig Feeder and indicates a good source of breeding stock.
   c. Sheep-Pig Farm and indicates a diversified farm.
   d. Specific Pathogen Free and indicates that the animal is free of all diseases.
   e. Specific Pathogen Free and indicates that the animal is free of certain specific diseases.
Test on Commercial Fertilizers

For each of the questions stated below, select the one most appropriate answer, then blacken in the box on your answer sheet that corresponds with the answer that you have selected.

1. The chief supporter of life on earth is:
   a. the sub-soil
   b. the top 18 inches of soil
   c. the parent material
   d. the top seven inches of soil
   e. all of the above

2. Short and much branched roots in plants signals a possible deficiency of:
   a. nitrogen
   b. calcium
   c. phosphorus
   d. copper
   e. zinc

3. N, P, and K needs for a specific field are determined from:
   a. information provided by the local county agent after visiting the farm
   b. information provided on the soil and cropping information sheet and the soil test results
   c. information on previous cropping program on the field
   d. soil analysis information provided by the local ASCS office
   e. past sales records on other farms in the community available at the local fertilizer dealers office

4. Since 1960, which one of the following plant nutrients has been applied in the largest amounts by farmers in Iowa:
   a. nitrogen
   b. calcium
   c. phosphorus
   d. lime
   e. potassium

5. The high basic fertilizer recommendation provides nutrients for corn under favorable moisture and good management conditions up to a yield of:
   a. 250 bu. per acre
   b. 115 bu. per acre
   c. 175 bu. per acre
   d. 135 bu. per acre
   e. 150 bu. per acre

6. In corn, the uptake of nitrogen is:
   a. rapid early in the season, then becomes slow and continues as such until near maturity
   b. rapid throughout the growing season of the plant
   c. slow early in the season, then becomes rapid and continues until near maturity
   d. slow but strong throughout the growing season of the plant
   e. none of the above
7. Formation of sugar by plants from carbon dioxide and water in the presence of sunlight is a function of:
   a. calcium
   b. sulfur
   c. magnesium
   d. nitrogen
   e. potassium

8. Fertilizer recommendations for a given crop will vary across Iowa according to:
   a. soil test level
   b. soil type
   c. distribution of P and K in the sub-soil
   d. area within the state
   e. all of the above

9. The use of fertilizer controls erosion by:
   a. increasing the per acre yields of crops, thus reducing the need to crop poorer lands
   b. increasing the structure of the soil to allow more water penetration
   c. promoting rapid and heavier growth of grass, cover crops and other vegetation
   d. building up existing plant nutrients in the soil, thus promoting plant growth
   e. all of the above

10. In plants, phosphorus:
    a. stimulates early root formation and growth
    b. gives rapid and vigorous start to plants
    c. hastens maturity
    d. is extremely important to germinating seedlings
    e. all of the above

11. A phosphorus deficiency in plants is most easily identified by:
    a. dwarfism in the plant
    b. leaves that curl upward
    c. purplish leaves, stems and branches
    d. extremely tall growing plants
    e. none of the above

12. Information on the soil and cropping information sheet that should accompany a soil sample to the soil testing laboratory:
    a. provides a 10 year history on the land from which the soil sample is taken
    b. has no bearing on the results obtained from the tests made on the soil sample
    c. is used by the soil testing laboratory for developing soil maps only
    d. is used by the soil testing laboratory in making fertilizer recommendations based on the test results obtained from the soil sample
    e. is used to record the farmers participation in the soil testing program in the state
13. Soil test recommendations provided by the soil test report are adjusted to specific crop yields by:
   a. consulting the local soil conservation agent about the soil test report
   b. determining the per acre crop yield desired and adding that amount of fertilizer per acre
   c. determining the plant population desired, dividing that figure by the number of acres and applying that amount of fertilizer per acre
   d. determining the desired yield per acre and then consulting the table on the back of the soil test report
   e. none of the above

14. Nutrients supplied by manure being applied to the soil are determined by:
   a. how uniformly it was applied to the soil
   b. the type of implement used to spread the manure on the soil
   c. whether it is in liquid or solid form
   d. kind of manure and tons applied per acre
   e. laboratory analysis of a manure sample

15. Which of the following will not contribute to a loss of plant food in the soil:
   a. leaching
   b. erosion by wind and water
   c. cropping
   d. improper soil drainage
   e. soil micro-organisms

16. America owes her position as a great nation to:
   a. the size of her country
   b. the many kinds of people who live within her boundaries
   c. her soil and its productivity
   d. the increase in the amount of top soil over the last 150 years
   e. the variety of crops grown by her farmers

17. Which of the following is not a function of calcium in the growth of the plant:
   a. is an essential part of chlorophyll
   b. promotes early root formation and growth
   c. influences intake of other plant foods
   d. neutralizes poisons produced in the plant
   e. encourages grain and seed production

18. Sulfur is noted for doing which of the following in plants:
   a. promoting early root formation and growth
   b. regulating uptake of other plant foods
   c. playing a part in the translocation of starch
   d. promoting nodule formation in legumes
   e. neutralizing poisons produced in the plant
19. With the exception of alfalfa and sweet clover, for all commonly grown field crops in Iowa, a suitable pH range in the soil is:
   a. 6.5 to 7.5
   b. 6.0 to 7.0
   c. 5.5 to 7.0
   d. 6.0 to 6.5
   e. 5.0 to 7.0

20. Lime, when added to the soil:
   a. will increase soil acidity
   b. will reduce erosion
   c. will control plant diseases and control weeds
   d. slow down harmful soil bacterial action
   e. with fertilizers, will produce high yields and better quality crops

21. Acid soils are found in humid regions of the country and are caused by:
   a. over tilling the soil
   b. the use of high yielding hybrid crops
   c. losses by leaching and crop removal of calcium, magnesium, and potassium
   d. excessive tilth buildup
   e. high organic matter in the soil

22. Effective calcium carbonate equivalent (ECCE) of a limestone is determined by:
   a. the area of the country that the limestone is mined
   b. the amount of leaching that the limestone has been subjected to
   c. the fineness of the limestone that is applied to the field before cropping takes place
   d. the purity or composition and fineness of the limestone when compared to pure, fine, calcium carbonate
   e. the local ASCS office when making a liming recommendation for a farmer

23. Sulfur deficiency in plants is indicated when:
   a. young leaves are light green in color and have even lighter veins
   b. short, slender stalks develop
   c. growth is slow and stunted
   d. fruit has not fully developed at maturity and is light green in color
   e. all of the above

24. Adverse moisture conditions would suggest to a farmer that he:
   a. use either the high or medium rate in determining the amount of fertilizer to apply to a field
   b. use the high rate for determining the amount of fertilizer to apply to a field
   c. plant a legume crop instead of cash cropping the soil
   d. use the medium rate in determining the amount of fertilizer to apply to a field
   e. plant a crop, that when harvested, would leave the field clean of any crop residue
25. If your soil test report indicates a need for 60 pounds of $P_2O_5$ per acre and you wish to use 0-46-0 as the fertilizer to supply this need, how much 0-46-0 will you need to apply to the soil:
   a. 250 lbs. per acre
   b. 130 lbs. per acre
   c. 174 lbs. per acre
   d. 152 lbs. per acre
   e. 95 lbs. per acre

26. Maintaining the soil fertility level of our soils:
   a. reduces erosion losses
   b. returns crop residues to the soil to replenish organic matter
   c. provides efficient use of fertilizer and lime
   d. reduces damages from plant diseases, insects, and weeds
   e. all of the above

27. Micro-plant nutrients are:
   a. not essential for proper plant growth
   b. generally present in all soils in needed quantities to promote proper plant growth
   c. are essential in large amounts in order to insure proper plant growth
   d. included in all commercial fertilizer mixes
   e. none of the above

28. Which of the following areas in a field should be avoided when taking a soil sample:
   a. dead furrows
   b. terrace channels
   c. windbreaks
   d. wet spots
   e. all of the above

29. The medium rate for applying lime to the soil is recommended for:
   a. establishment of legume seedlings
   b. uncertainty in tenancy
   c. land that will not be farmed for at least a 3-year period of time
   d. limited money in the farmer's pocket
   e. all of the above

30. Carryover fertilizer refers to:
   a. the amount of a soil nutrient available added to the soil by the previous crop
   b. plant nutrients that are moved from one area of the plant to another as growth of the plant continues
   c. the portion of a nutrient applied previously that comes into succeeding years
   d. fertilizer returned to the soil through manure
   e. all of the above

31. The main cause of plant food losses in our soils is:
   a. over cultivation
   b. heavy infestations of weeds in croplands
   c. wind and water erosion
   d. a lack of properly applied commercial fertilizers
   e. plant diseases and insects
32. Which one of the following pH values would reveal a "sweet" soil:
   a. 6.9
   b. 5.5
   c. 7.0
   d. 4.1
   e. 7.3

33. In the young corn plant, firing due to potassium deficiency is due to:
   a. uptake by the plant of unusable forms of potassium
   b. translocation of potassium from older, mature plant parts to
      the newer growing parts
   c. an excess of potassium in the soil
   d. a lack of sunshine to stimulate the photosynthetic process and
      the use of potassium in the plant
   e. a variety of corn requiring large amounts of potassium

34. The amount of fertilizer available in the soil is estimated from:
   a. carryover fertilizer and manure
   b. normal rainfall and crop response the previous year
   c. both of the above
   d. tillage practices applied to the soil
   e. the depth of the top soil

35. When taking a soil sample from an area within a field, a minimum of:
   a. 15 probes should be taken
   b. 25 probes should be taken
   c. 10 probes should be taken
   d. 5 probes should be taken
   e. none of the above

36. Proper fertilizer application rates are calculated by:
   a. subtracting available soil nutrients from needed soil nutrients
   b. adding available soil nutrients and needed soil nutrients and
      converting to elemental form
   c. adding available soil nutrients from needed soil nutrients and
      multiplying according to method of application
   d. subtracting available soil nutrients from needed soil nutrients,
      then multiplying the fertilizer analysis
   e. none of the above

37. The use of fertilizer is important in:
   a. making the soil more permeable
   b. erosion control and soil improvement
   c. the process of breaking down the soil structure
   d. stopping soil leaching
   e. all of these

38. Sickly, yellowish green color, a distinctly slow and dwarfed growth, and
drying up or "firing" of leaves are symptoms of a:
   a. high acid soil
   b. nitrogen deficiency
   c. water logged soil
   d. calcium deficiency
   e. hot dry spell in the weather
39. A cash grain crop has the effect of:
   a. building up the fertility level of the soil
   b. building the tilth of the soil thus reducing losses due to soil leaching
   c. controlling wind and water erosion
   d. removing nutrients from the soil in large amounts
   e. none of the above

40. In Iowa, over the past seven years, the nitrogen application rate per acre of corn fertilized increased from 28 pounds to:
   a. 38 lbs.
   b. 45 lbs.
   c. 60 lbs.
   d. 70 lbs.
   e. 82 lbs.

41. Definite and sharply defined series of yellowish-green, light yellow, or even white streaks throughout the entire leaf of a corn plant signals a deficiency of:
   a. phosphorus
   b. potassium
   c. magnesium
   d. boron
   e. zinc

42. A farmer received a recommendation from the soil test laboratory that he add 6000 lbs. of calcium carbonate to his soil. The limestone material that he planned to apply to his soil was considered to be 80 percent effective over the next three year period. How much of his limestone material will he need to provide to meet the recommendations made by the soil test laboratory?
   a. 9000 lbs.
   b. 2500 lbs.
   c. 5000 lbs.
   d. 7500 lbs.
   e. 12000 lbs.

43. Nutrient needs of a corn field are determined from:
   a. good soil sample representative of a given land area
   b. soil test procedures that measure nutrient availability
   c. soil test results that are properly interpreted
   d. fertilizer recommendations made for different management situations
   e. all of the above

44. Nitrogen, when in the soil in the nitrate form, has the feature of:
   a. being very inexpensive to apply
   b. being very quickly available to plants
   c. not being subject to loss due to leaching
   d. increasing the nitrogen content of straw and corn stalks
   e. none of the above

45. Which of the following is not a source of calcium:
   a. limestone
   b. sulfate of ammonia
   c. shells
   d. phosphate rock
   e. gypsum
46. The pH value of most soils falls in the range:
   a. 4.0 to 6.0
   b. 5.0 to 7.0
   c. 6.0 to 8.0
   d. 7.0 to 9.0
   e. 5.0 to 9.0

47. The soil test report from Iowa State University measures which of the following plant nutrients in a soil sample:
   a. P, K, Ca, Buffer pH
   b. N, P, K, Zn, Ca, Su
   c. P, K, Buffer pH
   d. P, K, Ca, Mg, N
   e. all of the above

48. If good practices have been used for previously applied limestone, which one of the following allowances cannot be made when determining from the soil test report how much lime to apply to a soil:
   a. within 6 months after application, deduct the full amount applied from the recommended rate
   b. one year after application, deduct one-half of the amount applied from the recommended rate
   c. more than one year after application, use the recommended rate
   d. two years after application, deduct one-fourth of the limestone previously applied from the recommended rate
   e. none of the above

49. In the growth of plants, the plant nutrient potassium is known to:
   a. cause the plants dark green color
   b. induce rapid growth at the beginning of the growing period
   c. cause leaves of young plants to turn reddish-purple
   d. inhibit plant maturity
   e. be essential to the formation and transfer of starches, sugars, and oils

50. Potassium deficiency in plants is recognizable by:
   a. mottling, spotting, streaking or curling leaves
   b. lower leaves scorched or burned on margins and tips
   c. premature loss of leaves
   d. plants, like corn, falling down prior to maturity due to poor root development
   e. all of the above

51. The soil test report provides information concerning the rate at which lime should be applied to the soil. The high rate is designed for:
   a. increasing the soil acidity to near neutrality (pH 7.9)
   b. decreasing yields
   c. farmers who will receive the benefits over a short period of time (1 to 2 years)
   d. situations where money is limited
   e. none of the above
52. Commercial fertilizers, when applied to the soil properly during the growing season generally:
   a. increases the per acre cost of producing a crop and increases the gross income per acre of crop produced
   b. decreases the per acre cost of producing a crop and increases the gross income per acre of crop produced
   c. decreases the per acre cost of producing a crop and decreases the gross income per acre of crop produced
   d. increases the per acre cost of producing a crop and decreases the gross income per acre of crop produced
   e. none of the above

53. Which of the following factors is not used when making a high fertilizer recommendation on the soil test report:
   a. a limited money situation
   b. a desired yield of 135 bushels per acre
   c. favorable moisture conditions
   d. good management practices
   e. careful variety selection

54. Proper soil management will reduce the loss of plant food in the soil by:
   a. reducing erosion losses
   b. returning crop residues to replenish organic matter
   c. maintaining or improving the physical conditions of the soil
   d. reducing damages from plant diseases, insects, and weeds
   e. all of the above

55. A highly acid soil can most economically be corrected by:
   a. changing the tillage practices used on the soil
   b. adding proper amounts of lime
   c. adding organic matter to the soil
   d. plowing deeper in the fall or spring
   e. none of the above

56. The primary plant nutrients are:
   a. nitrogen, calcium, iron
   b. nitrogen, chlorine, potassium
   c. lime, calcium, phosphorus
   d. nitrogen, magnesium, sulfur
   e. nitrogen, potassium, phosphorus

57. To convert K to K₂O:
   a. multiply the soil test recommendation per acre by 1.2
   b. divide the soil test recommendation per acre by .83
   c. multiply the soil test recommendation per acre by .83
   d. divide the soil test recommendation per acre by 1.2
   e. multiply the soil test recommendation per acre by 2.29

58. The available N in the soil is determined on the soil test report by:
   a. soil sample tests made in the soil test laboratories
   b. determining the nitrogen credits available in the soil based on the previous cropping history of the field
   c. consulting the column entitled "N" on the soil test report
   d. laboratory analysis of the soil sample
   e. observing the depth of the green color of the crop the previous year that was grown on the field from which the sample was taken
59. Phosphorus and potassium may be expressed on the soil report form as an:
   a. oxide
   b. elemental
   c. both of the above
   d. combustible
   e. catalyst

60. Each soil sample should not represent more than:
   a. 1 to 5 acres
   b. 30 to 40 acres
   c. 20 to 25 acres
   d. 10 to 20 acres
   e. 5 to 10 acres
Test on Small Gasoline Engines

For each of the questions stated below, select the one most appropriate answer, then blacken in the box on your answer sheet that corresponds with the answer that you have selected.

1. An engine with a 2.5 inch bore and a stroke of two inches has a displacement of:
   a. 8.248 cubic inches
   b. 5.897 cubic inches
   c. 6.557 cubic inches
   d. 7.854 cubic inches
   e. 6.629 cubic inches

2. The outside micrometer is used to measure:
   a. metal thicknesses
   b. spark gap
   c. ring clearances
   d. valve clearances
   e. none of the above

3. Plasti-gauge can be used to measure:
   a. spark plug gap
   b. ring clearance
   c. valve clearance
   d. bearing clearance
   e. crankshaft thickness

4. The top ring on a piston in a small gasoline engine is called:
   a. scraper rings
   b. compression rings
   c. oil rings
   d. exhaust rings
   e. none of the above

5. End clearance on rings is necessary so that:
   a. oil may enter the cylinder
   b. the ring can exert pressure on the cylinder wall, yet allowing room for expansion when it becomes hot
   c. the piston will have room to expand when it becomes hot
   d. exhaust gases may escape the combustion chamber after the compression stroke
   e. excess carbon may leave the combustion chamber

6. When the air-fuel mixture in the cylinder has been compressed to one-sixth its original size the compression ratio would be:
   a. 8 to 1
   b. 5 to 1
   c. 6 to 2
   d. 6 to 1
   e. 4 to 2
7. In the above diagram, the part identified by the letter "A" is the:
   a. coil
   b. breaker points
   c. condenser
   d. armature
   e. primary circuit

8. In the above diagram, the part identified by the letter "D" is the:
   a. coil
   b. breaker points
   c. condenser
   d. armature
   e. secondary circuit

9. In the above diagram, the part identified by the letter "G" is the:
   a. coil
   b. breaker points
   c. condenser
   d. armature
   e. none of the above

10. Using a fuel with too low an octane rating may cause:
    a. occasional missing at high speeds
    b. missing under slow hard pull
    c. engine knocking
    d. hard starting
    e. engine not idling properly

11. What of the following parts are included in the primary circuit of a small gasoline engine?
    a. breaker points, condenser, and the primary winding
    b. secondary coil and the frame
    c. breaker points, condenser and the armature
    d. Armature, spark plug wire, and frame
    e. breaker points, condenser, and secondary winding
12. A four stroke cycle engine is so called because:
   a. the piston makes four complete revolutions delivering power to
      the crankshaft
   b. the crankshaft makes one complete revolution to each power stroke
      of the piston
   c. spark plug fires twice to ignite the air-fuel mixture
   d. the piston makes a complete revolution for each of the four cycles
   e. the piston makes four strokes, two up and two down to deliver
      power to the crankshaft

13. Good compression depends on:
   a. the diameter of the valve stems
   b. the thickness of the valve heads
   c. proper seating of the valves
   d. proper clearance between the valve-stem and valve guide
   e. all of the above

14. The path of electricity in the spark plug is:
   a. down the ceramic insulator to the center electrode to the ground
      electrode
   b. down the center electrode, across the air gap, to the ground
      electrode
   c. down the center electrode to the ground electrode and across the
      air gap
   d. down the shell across the air gap to the main electrode
   e. none of the above

15. The operating temperature of an air-cooled engine may vary greatly with
    changes in:
    a. air temperature, load, and engine speed
    b. type of gas used, load, and engine speed
    c. viscosity of oil, load, and engine speed
    d. size of piston, ring clearance, and horsepower of engine
    e. none of the above

16. The function of the governor on a small gasoline engine is to:
    a. control the flow of fuel into the carburetor
    b. regulate the speed of air flow in the carburetor
    c. reduce the amount of heat generated during engine operation
    d. regulate the richness of the fuel entering the cylinder
    e. maintain a desired speed of engine operation regardless of load

17. As the piston moves down in the cylinder of a suction feed carburetor:
    a. a low pressure area is created in the carburetor throat and fuel
       is drawn up the fuel nozzle into the carburetor
    b. a high pressure area is created in the fuel tank forcing the
       float down to allow the fuel to flow into the fuel nozzle
    c. a high pressure area is created in the carburetor throat and
       fuel is forced into the fuel line into the carburetor
    d. a low pressure area is created in the fuel tank forcing the float
       down to allow the fuel to flow into the fuel nozzle
    e. a low pressure area is created in the carburetor throat causing
       the fuel pump to engage and begin pumping fuel
18. In outside temperatures above 32°F, which of the following oils is recommended for use in small gasoline engines?
   a. SAE 5 W
   b. SAE 10 W
   c. SAE 10-30
   d. SAE 30
   e. SAE 15

19. On the oil bath type of air cleaner, air entering the engine is cleaned by:
   a. the air passing through an oil cleaner
   b. the air passing through a oil foam
   c. the air passing through wire mesh saturated with oil
   d. the air drawn through a paper element
   e. none of the above

20. The basic purpose of a carburetor is:
   a. clean the air entering the engine of all foreign material
   b. produce a mixture of fuel and air
   c. regulate the amount of fuel entering the engine
   d. equalize atmospheric pressure in the carburetor
   e. preheat the air-fuel mixture before it enters the cylinder

21. The middle ring on a piston in a small gasoline engine serves as a compression ring and also:
   a. scrapes the cylinder wall to keep the oil from getting into the combustion chamber
   b. scrapes the carbon off of the cylinder walls
   c. filters the impurities from the oil that has splashed on the cylinder wall
   d. absorbs excess heat in the piston
   e. smooths out any scars that occur in the cylinder wall

22. When the engine is operating at 3000 rpm, the valves open and close in about:
   a. 1/25 of a second
   b. 1/30 of a second
   c. 1/40 of a second
   d. 1/50 of a second
   e. 1/60 of a second

23. On a suction feed carburetor fuel enters the carburetor as a result of:
   a. gravity
   b. a fuel pump
   c. atmospheric pressure
   d. carburetor jets
   e. none of the above

24. In the operation of a two stroke cycle engine:
   a. the exhaust gases help ignite incoming air-fuel mixtures
   b. the exhaust gases are forced out of the carburetor chamber by the downward movement of the piston
   c. the exhaust gases are forced out of the combustion chamber through the exhaust port in the crankcase
   d. the incoming fuel helps force the exhaust gases out the exhaust port
   e. the fuel inlet valve opens due to the high pressure in the crankcase
25. The main purpose of rings is to:
   a. prevent oil in the crankcase from entering the carburetor chamber
   b. cause the cylinder to move smoothly up and down in the cylinder
   c. seal the piston and cylinder wall, thus maintaining a tight combustion chamber
   d. oil in the forcing of exhaust gases from the combustion chamber
   e. scrap the carbon deposits off of the cylinder wall

26. Exhaust valves will need to be replaced more often than the intake valve because:
   a. they are subject to extreme temperature changes more than intake valve
   b. they are air cooled by air from the flywheel fins
   c. they are cooled by oil from the crankcase
   d. they are not cooled by air from the flywheel fins and oil from the crankcase
   e. they are made of more combustible materials

27. Ring clearances are determined with a:
   a. micrometer
   b. steel ruler
   c. steel tape
   d. feeler guage
   e. vernier calipers

28. On a gravity feed carburetor as the fuel enters the carburetor bowl:
   a. the float raises forcing the needle down thus shutting off the flow of fuel
   b. the float raises until the needle touches the seat shutting off the flow of fuel
   c. the atmospheric pressure forces the needle into the seat closing off the flow of fuel
   d. the float raises forcing the needle to an open position allowing the fuel to flow into the venturi
   e. none of the above

29. The use of clean, fresh, regular grade gasoline is recommended for use in small air-cooled engines because it:
   a. has sufficient octane rating for the compression ratio
   b. has a satisfactory storage characteristic
   c. isn't so apt to cause a vapor lock in the fuel line when the engine is hot
   d. isn't so apt to leave deposits on valve seats, spark plug electrodes and in the cylinder
   e. all of the above

30. When trouble shooting a small gasoline engine, overheating may be due to which of the following:
   a. lack of cool air
   b. dirty air cleaner and cooling fins
   c. improper fuel
   d. fuel mixture to lean
   e. all of the above
31. Which of the following is not a part of the valve:
   a. head
   b. margin
   c. seat
   d. face
   e. stem

32. The oil ring serves the purpose of:
   a. filtering the impurities out of the oil that splashes up against the cylinder wall
   b. scraping the excess oil off of the cylinder wall on the downward stroke of the piston
   c. keeping the viscosity of the oil in the crankcase at a high level
   d. spreading oil on the cylinder wall
   e. none of the above

33. Dry, fluffy, black deposits on the electrodes of a spark plug indicate:
   a. oil fouling
   b. carbon fouling
   c. gas fouling
   d. lead fouling
   e. burned electrodes

34. Which one of the following conditions will decrease the power and speed of the engine:
   a. a throttle in open position
   b. a needle that is stuck in the seat
   c. a plugged fuel nozzle
   d. a partially closed throttle
   e. all of the above

35. The air vane governor is operated by:
   a. changes in atmospheric pressure in the carburetor
   b. changes in the level of the float in the carburetor
   c. the force of the air from the flywheel fins
   d. centrifugal weights
   e. the speed of the flywheel

36. The best guide for servicing small gasoline engines is that of:
   a. miles traveled by the engine
   b. number of jobs completed by the engine
   c. sound of the engine while in operation
   d. operating hours
   e. an odometer

37. The purpose of the ignition system on a small gasoline engine is:
   a. to create a magnetic field whereby a spark is cooled in the cylinder
   b. to stepdown the voltage between the coil and the spark plug
   c. to generate power that will in turn operate the engine
   d. increase the distance the spark will travel between spark plug points
   e. to produce the electric current required to ignite the air-fuel mixture in the combustion chamber
38. Compression loss in a small gasoline engine may be caused by:
   a. lack of cool air
   b. improper ignition timing
   c. faulty spark plug
   d. valves leaking or sticking
   e. faulty condenser or coil

39. Which of the following tools should be used to install rings on the piston:
   a. ring compressor
   b. ringing pliers
   c. ring groover
   d. pair of pliers
   e. ring expander

40. In the above diagram, the part identified as number 46 is the:
   a. venturi
   b. choke
   c. fuel nozzle
   d. float
   e. throttle

41. In the above diagram, the part identified by the arrow and number 47 is the:
   a. venturi
   b. choke
   c. needle and seat valve
   d. float
   e. fuel bowl

42. In the above diagram, the part identified by the arrow and number 48 is the:
   a. venturi
   b. choke
   c. needle and seat valve
   d. fuel nozzle
   e. throttle
43. What is the reading on the one inch micrometer diagram below?
   a. .325
   b. .361
   c. .376
   d. .386
   e. .380

44. The exhaust valve opens and the upward movement of the piston forces the burnt gases out of the cylinder on the:
   a. intake stroke
   b. compression stroke
   c. both of the above
   d. exhaust stroke
   e. power stroke

45. As compression ratios increase:
   a. loads and stresses upon the engine parts become more severe
   b. loads and stresses upon the engine parts become less severe
   c. gasoline consumption by the engine increases
   d. a richer air-fuel is required by the engine
   e. none of the above

46. On most small gasoline engines, an engine is correctly timed by aligning the timing marks on the:
   a. flywheel fins and the connecting rod
   b. cam gear and the flywheel gear
   c. cam gear and crankshaft gear
   d. crankshaft and connecting rod
   e. crankshaft and flywheel gear

47. Which of the following procedures is not recommended when preparing a small gasoline engine for storage?
   a. drain all fuel out of the fuel system
   b. drain oil from crankcase and refill with the proper grade of fresh oil
   c. pour a tablespoon of alcohol into spark plug hole, crank engine slowly by hand and replace spark plug
   d. store engine in dry place
   e. remove, clean and regap spark plug

48. Which one of the following types of air cleaners is more commonly found on larger engines:
   a. oil bath type
   b. oil saturated type
   c. both of the above
   d. dry element type
   e. dry element and oil saturated types
49. Which of the following activities is out of sequence in describing the complete magneto cycle?

- (magnet moves close to primary coil) → (magnetic field increases) →
- (current flows in the primary coil) → (A) current passes through breaker points to ground) → (permanent magnet moves opposite coil) →
- (B) magnetic field around both coils reaches its peak) → (piston is at the top of its stroke) → (fuel mixture is compressed) →
- ((C) electricity stops flowing) → (breaker points open) →
- (primary circuit is broken) → (D) magnetic field collapse) → (high voltage is induced into secondary coil) → (E) spark jumps spark gap.

a. A  
b. B  
c. C  
d. D  
e. E

50. During the compression stroke:

- the intake valve closes and the piston moves upward  
- the intake valve opens and the piston moves downward  
- the exhaust valve opens and the piston moves upward  
- the exhaust valve closes and the piston moves downward  
- none of the above

51. The intake valve is cooled by:

- air from the flywheel fins  
- oil from the crankcase  
- both of the above  
- air circulating around the outside case of the engine  
- incoming air-fuel mixture

52. The two electrodes on a spark plug are separated by a gap of:

- .015 to .030 of an inch  
- .020 to .045 of an inch  
- .025 to .030 of an inch  
- .035 to .055 of an inch  
- .015 to .055 of an inch

53. You are cleaning the fuel system of a small gasoline engine and find gum deposits in the sediment bowl and carburetor. Which of the following solvents could you use to remove the gum deposits?

- alcohol  
- acetone  
- both of the above  
- household detergent  
- gasoline

54. Compression ratio refers to:

- the distance the piston travels on the compression stroke  
- the amount the gaseous mixture is reduced in the cylinder during the compression stroke  
- the amount the gaseous mixture is expanded in the cylinder during the compression stroke  
- the general inefficiency of the engine  
- none of the above
55. If you were going to check the spark plug gap on a used plug, which of the following gauges would you use?
   a. micrometer
   b. feeler gauge
   c. round wire gauge
   d. plasti-gauge
   e. armature air gap gauge

56. The major cause of engine wear is:
   a. continuous operation at high speeds
   b. dirt and dust
   c. fuel mixtures that are too rich in gasolines
   d. overloading
   e. improper timing

57. When the breaker points open during the operation of a small gasoline engine:
   a. high voltage is induced into the secondary winding of the coil and current flows to the spark plug
   b. the current flows to a grounding point
   c. the coil goes dead
   d. the primary winding carries electricity to the spark plug
   e. none of the above

58. The first cycle in the operation of the four-cycle engine is the:
   a. compression stroke
   b. exhaust stroke
   c. power stroke
   d. intake stroke
   e. none of the above

59. The main function of the coil on a small gasoline engine is:
   a. to decrease amperage
   b. to step down the voltage at the spark plug
   c. to provide an interrupted flow of electricity that can be used when it is needed by the spark plug
   d. to increase the voltage so that a spark will jump across the gap between spark plug electrodes
   e. to increase the amperage so that a spark will jump across the gap between spark plug electrodes

60. The purpose of the condenser in the ignition system is to:
   a. aid in the collapse of the magnetic field in the primary circuit
   b. keep breaker points from arching
   c. both of the above
   d. step up voltage in the ignition system
   e. energize the armature core
For each of the questions stated below, select the one most appropriate answer, then blacken in the box on your answer sheet that corresponds with the answer that you have selected.

1. Which of the following could be used for collateral on a loan?
   a. land
   b. livestock
   c. machinery
   d. growing crops
   e. all of the above

2. One of the disadvantages of charge account credit is:
   a. there are no notes, written contracts or other promissory notes to pay
   b. the convenience of buying everyday needs
   c. stores are charging additional interest for the use of credit
   d. saves time
   e. enables you to take advantage of sales

3. The man, financial position, repayment capacity, purpose of loan, security for the loan are qualifications that a:
   a. borrower looks for in a lender
   b. borrower needs in a lender
   c. lender looks for in a borrower
   d. both a and b
   e. none of the above

4. A farmer has more grain than he can store on his farm. He puts his grain in a licensed elevator and receives a slip of paper specifying the quantity and grade. This slip of paper is called a:
   a. bill of lading
   b. warehouse receipt
   c. sales contract
   d. security agreement
   e. financing statement

5. In addition to interest charges you should include the following in the cost of the loan:
   a. carrying charges
   b. "time differential" charges
   c. finance charges
   d. sales commissions
   e. all of the above

6. During the month of June, Farmer Brown anticipated selling 100 head of market hogs and estimated he would receive $45 a head. During that month his estimated total expenses were $850. His anticipated net cash flow for the month of June would be:
   a. $3350
   b. $-5050
   c. $-850
   d. $-3350
   e. $5050
7. Which of the following is not true of collateral:
   a. it will prevent some other creditor from seizing the working capital of the borrower
   b. if the borrower does not repay the money he has borrowed the lender may take the collateral to recover his loan
   c. collateral is not always required for short term loans
   d. when property is pledged as collateral for a loan, the lender obtains certain rights to that property
   e. collateral is always required for a short term loan

8. Production or short-term credit and intermediate-term credit is obtained principally from:
   a. federal land bank and production credit associations
   b. production credit association and commercial banks
   c. federal land bank and insurance companies
   d. federal land bank and commercial banks
   e. insurance companies only

9. Which of the following is an indication of moral responsibility:
   a. unpaid bills of long standing
   b. items left out of the financial statement
   c. compromise of debts to avoid payments
   d. loan is made on borrowers reputation
   e. false statements about past production

10. A short term loan is used generally to buy such items as:
    a. seed and fertilizer
    b. land
    c. tractors
    d. automobiles
    e. none of the above

11. When a debt secured by a security agreement or financing statement has been paid it is the creditors duty to give the borrower the cancelled agreement and also a special receipt called a:
    a. sales contract
    b. release
    c. receipt
    d. financing statement
    e. promissory note

12. The true rate of interest on a discounted loan compared to a non-discounted loan with the same rate of interest is:
    a. always lower true rate of interest
    b. always higher true rate of interest
    c. the same true rate of interest
    d. sometimes a lower true rate of interest
    e. none of the above

13. Money could not be obtained through a mortgage on a farmer’s collateral to:
    a. purchase land
    b. construct a new corn crib
    c. build a terrace
    d. pay debts which are 110% of collateral
    e. purchase 500 head of feeder cattle
14. John Hall has purchased a used 4020 John Deere from his dealer. He borrowed $1000 to make this purchase. Where did John likely borrow the money?
   a. New York Life Insurance Company
   b. Federal Land Bank
   c. Production Credit Association
   d. none of the above
   e. a and b

15. When a short term loan is used to buy livestock, the length of time that the loan covers is:
   a. a year
   b. the production period
   c. two years
   d. the production period plus the reinvestment period
   e. one-half the production period

16. The amortization repayment plan calls for:
   a. interest payments each year for 5 years and the entire principal due at the end of 5 years
   b. the amount due depends on earning of the farmer each year
   c. regular payments which will repay the entire amount of the loan by the final maturity date
   d. a second mortgage loan
   e. a future payment fund

17. A financial statement prepared by a farmer in support of the need for a loan includes a statement of:
   a. unpledged cash income
   b. family living costs
   c. personal property
   d. purpose of the loan
   e. all of the above

18. Which of the following would be a favorable condition for granting a farmer a loan?
   a. small-sized business yielding a small gross income
   b. low cash production costs
   c. high living costs due to extravagance
   d. high cash production costs due to poor marketing
   e. low production per unit

19. Becoming established in farming today is more difficult because of:
   a. a lack of high quality livestock and improved crop varieties
   b. uncertain weather conditions
   c. a lack of farms available
   d. high interest rates
   e. the large amount of capital needed to finance a modern farming operation

20. Checks, drafts, notes, financing statements, security agreements, warehouse receipts and bills of lading are called:
   a. credit instruments
   b. sales contracts
   c. receipts
   d. promissory notes
   e. judgments
21. Which would help build and maintain a good credit standing:
   a. getting your credit from specialists, keeping your credit in one place.
   b. taking an annual inventory, planning to repay loans from operating income
   c. planning ahead on your credit needs, using the right kind of credit
   d. meeting your payments when due, being frank with your lender
   e. all of the above

22. A farmer wants to expand his livestock operation by adding 50 cows to his existing cow-calf operation. The purchase price of the cows is $10,000. What type of loan should the farmer seek?
   a. intermediate-term loan
   b. installment loan
   c. long-term loan
   d. short-term loan
   e. none of the above

23. An intermediate-term loan is defined as:
   a. one-half the length of a long-term loan
   b. a loan that does not involve extensive amount of money
   c. a loan used only to finance the purchase of land
   d. short-term loan extended over several years
   e. a loan with low interest rates

24. Except for Federal Land Bank loans, which of the following does not affect the rate of interest on a loan to finance land in various parts of the country?
   a. location of the farm
   b. amount of risk
   c. lender
   d. irregular and limited rainfall
   e. none of the above

25. If a creditor wanted an unconditional written promise signed by you to pay upon demand or at a fixed time, a certain sum in money to the bearer on the designated payee he would have you sign a:
   a. bill of sight draft
   b. promissory note
   c. check
   d. draft
   e. mortgage

26. A contract or receipt signed by a common carrier (such as a truck line) agreeing to deliver the described freight to a given person or a stated place is called a:
   a. sales contract
   b. bill of lading
   c. warehouse receipt
   d. bill of sale sight draft
   e. promissory note
27. Mr. Green wishes to borrow money to buy 100 head of feeder steers. Which lender should he eliminate before starting to look for money for the feeder cattle?
   a. farmers home administration
   b. federal land bank
   c. both of the above
   d. production credit association
   e. commercial bank

28. Which item is not a condition resulting in good repayment ability?
   a. adequate sized business yielding an adequate gross income
   b. efficient production per unit
   c. low cash overhead cost
   d. good home and farm management
   e. overestimating the amount of loan that can be repaid each year

29. A loan used to purchase land is called:
   a. a short-term loan
   b. an intermediate-term loan
   c. both of the above
   d. a loan on a "demand" repayment plan
   e. a long-term loan

30. Feed accounts would be entered under which area of the financial statement in an application for a loan?
   a. personal property
   b. estimated operating costs
   c. cash income
   d. net worth
   e. current debts

31. A good credit rating is established by:
   a. knowing the right people
   b. demonstrating ability to use money wisely both when borrowing and repaying the amount borrowed
   c. borrowing more money than is needed to provide an operating cushion
   d. borrowing money at time when interest rates are low
   e. borrowing about one-half the amount of money needed to start a business venture and then proving that you can make this amount meet your entire needs

32. If you were to borrow $1000 for 35 years at 6% interest:
   a. in a "even payment plan" the installments are the same every year
   b. in a "even payment plan" the amount of interest decreases every year
   c. in a "decreasing payment plan" the installments are the same every year
   d. in a "decreasing payment plan" the amount payed on the principal decreases
   e. both a and b

33. How will the value of level farm land with deep top soil, steeply rolling land with an erosive soil, farm buildings and machinery change in the next 40 years?
   a. land will remain steady in value, buildings and equipment will increase
   b. land will remain the same and buildings and equipment will decrease
   c. values will be in a constant state of change
   d. land, buildings and equipment will increase in value
   e. land, buildings and equipment will gradually decrease in value
34. Which lending agency has the most dollars invested in farm mortgage loans in Iowa?
   a. life insurance companies
   b. federal land bank
   c. FHA
   d. commercial banks
   e. savings banks

35. Before a person invests in farming, he should:
   a. determine whether he has sufficient capital to farm
   b. determine where he can get the most for his money
   c. consider alternative uses for his money
   d. consider whether by borrowing money he could increase his income
   e. all of the above

36. In financing land, the lender will want to know:
   a. purposes of the loan
   b. amount of the loan
   c. value of the farm
   d. all of the above
   e. none of the above

37. Which lenders might a person contact in borrowing money to buy a farm?
   a. life insurance company
   b. farmers home administration
   c. federal land bank
   d. a rich uncle
   e. all of the above

38. An advantage of using installment credit is:
   a. goods purchased are of higher quality
   b. changes are made to cover store losses on other accounts.
   c. the high-pressure selling that it induces
   d. it forces savings for those who can't discipline themselves
   e. that it encourages over-spending for goods and services not needed

39. Which of the following are not considered by a lender when determining the financial situation of a farmer:
   a. value of livestock handled during the year
   b. amount of rent paid annually
   c. annual contributions to charitable organizations
   d. anticipated expenditures on such items as fertilizer and herbicides
   e. anticipated expenditures on utilities

40. A disadvantage of checks compared to money is:
   a. there is less danger of loss or theft than carrying money
   b. checks are more convenient than money except for small amounts
   c. it is much easier to keep records when checks are used
   d. a cancelled check is good evidence of payment
   e. all of the above
41. A signed written order on a bank to pay a certain sum of money on demand to the bearer is called a:
a. bill of lading
b. warehouse receipt
c. check
d. bill of sale sight draft
e. receipt

42. If you borrowed $2000 and paid it back in 24 monthly payments of $101 each, what is the true annual interest rate?
a. 10%
b. 20%
c. 23%
d. 25%
e. 19%

43. A budget plan upon which a loan is planned is based on:
a. past farm expenditures
b. personal property only
c. the reputation of the farmer
d. estimated operating costs
e. purpose of the loan

44. Character, lending policies, permanence, experience and knowledge of farming and cost of the loan are what a:
a. borrower looks for in a lender
b. production credit association wants in a borrower
c. lender looks for in a borrower
d. federal land bank needs in a borrower
e. none of the above

45. Credit used by farmers may be divided into which of the following types?
a. financing crop and livestock production
b. financing land
c. consumer credit on installment buying
d. financing farming cooperatives
e. all of the above

46. One of the advantages of a farmer borrowing money on the budget plan is that:
a. he can borrow any amount of money that he desires
b. he pays interest only on the amount of credit actually in use and for the period needed
c. he pays interest on the amount of credit that he is eligible to receive
d. he doesn't have to worry about expenditures due to a sure source of credit
e. interest rates are high but the amount he pays is low due to the short duration of the loan

47. Farmers use credit because:
a. they are poor, having no money to use in farming
b. their farming methods are not sound
c. credit will help expand their operations to better utilize management ability, labor and equipment
d. inflation makes its use mandatory
e. none of the above
48. An agreement by one party to sell a property or a service to a second party for a stated price and under stated conditions is called a:
   a. bill of sale sight draft
   b. mortgage contract
   c. security agreement
   d. sales contract
   e. none of the above

49. If several farmers had the following Federal Land Bank loans at 1 1/2% interest in which case would the most total interest be paid?
   a. a loan of 10 years
   b. a loan of 35 years
   c. a loan of 20 years
   d. a loan of 15 years
   e. the one that was paid off the earliest

50. In writing checks, which of the following would not be a recommended procedure?
   a. write all checks in ink
   b. write plainly
   c. make check payable to cash
   d. never sign a blank check
   e. show for what the check is given

51. Which would be the best collateral if all items were worth $10,000 today?
   a. land
   b. remodeled barn
   c. I. H. 806
   d. 10,000 bushel of corn
   e. 80 acres of soybeans

52. When a lender analyzes a man’s farming situation, he considers only:
   a. the number of livestock and bushels of grain on hand only
   b. the farm’s inventory of assets
   c. the farm’s ending inventory
   d. the farmer’s beginning and ending inventory
   e. the farmer’s beginning inventory, expected cropping programs, expected soils, expected expenses and ending inventory

53. Credit is a desirable and useful farm tool when it will:
   a. cause the farmer to borrow more money later
   b. improve the economic and social well being of the farmer’s family
   c. add to the prestige of the lending agency
   d. force the farmer to adhere to the guidelines for purchasing of high quality livestock prescribed by the lender
   e. none of the above

54. Included among the estimated operating costs on a financial statement when applying for a loan is:
   a. number of livestock on hand
   b. judgments
   c. crop yield per acre
   d. machine hire
   e. landlord share of farm profits
55. The amount which is borrowed on a farm mortgage should not:
   a. be greater than what the long-run, normal value of the farm will justify
   b. be greater than what the year-to-year earnings of the farm will carry
   c. create a debt too large for the ability and circumstances of the
      borrower
   d. so small that it doesn't cover the farmer's needs
   e. all of the above

56. Carrying charges, finance charges, sales, commissions, discounts, and "time
differential" charges should all be used to evaluate:
   a. character
   b. experience and knowledge of farming
   c. permanence and dependability
   d. lending policies
   e. cost of the loan

57. The Uniform Commercial Code states that in a security agreement there shall
be a statement signed by the debtor and the secured party (creditor) to the
effect that the secured party intends to finance the debtor. This agreement
is called the:
   a. security agreement
   b. warehouse receipt
   c. sales contract
   d. releases and satisfactions
   e. financing statement

58. Where might a student look for a job in farm credit work after high school
    graduation?
   a. federal land bank
   b. production credit association
   c. local bank
   d. life insurance companies
   e. all of these

59. The order when paid by the bank is not charged to the signer but to a third
    person named. This is called a:
   a. promissory note
   b. bill of sight draft
   c. check
   d. warehouse receipt
   e. none of the above

60. In planning to borrow money one might save money by checking with:
   a. federal land bank
   b. PCA
   c. local bank
   d. insurance companies
   e. all of the above