INDIVIDUAL INSTRUCTION FOR EMPLOYEES OF COMMERCIAL FERTILIZER DISTRIBUTION AND COMBINE MAINTENANCE AND ADJUSTMENT AT THE VALLEY HEIGHTS HIGH SCHOOL

by

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Chapter 1

INTRODUCTION

The National Vocational Act of 1917 provided a program of training for persons fourteen years of age or older who were engaged in or preparing to engage in production agriculture. This act was later enlarged by the National Vocational Education Act of 1963, to provide training for agricultural related occupations. In 1964, a Committee of the American Vocational Association revised the major objectives of vocational and technical education to include a program of training to develop agricultural competencies needed by individuals engaged in or preparing to engage in agricultural occupations other than production agriculture.[1]

One of the major programs of training growing out of the 1963 National Vocational Education Act was training in agricultural related occupations. With the advent of this training program, new educational media had to be developed and teaching techniques and materials had to be considered concurrently with the development of instructional materials.

This study was concerned with Commercial Fertilizer Distribution and Combine Maintenance and Adjustment. Curriculum materials in these areas were not available for individualized instruction. Vocational

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[1]Joint Committee of the U.S. Office of Education and the American Vocational Association, Objectives for Vocational and Technical Education in Agriculture (Washington, D.C.,: United States Department of Health, Education, and Welfare, 1966), pp. 5-6.

objectives of junior and senior high school students in vocational agriculture vary and lend themselves to independent study. Materials for individualized instruction in Commercial Fertilizer Distribution and Combine Maintenance and Adjustment were developed for use in this study.

Materials for the instruction of other agricultural related occupations were being developed in other regions of the country. Juergenson of California indicated the National Vocational Education Act of 1963 created funds to develop many instructional materials, expecially in agriculture. He further indicated that some excellent materials were developed and ordered by many schools, but never used.[2]

Warmbrod reported instructional material developed in agriculture varied from traditional student reference materials to innovations such as programmed instruction, single-concept film loops, and audio-tutorial systems. He further stated that many efforts were built around the concept of individualizing education. Warmbrod's report concerned a study of the learning and retention rates of individualized study programs. The study centered on the assumption that for most efficient learning, students must progress in areas of study at their own rate and speed.[3]

If agricultural related occupations programs were to meet the objectives of vocational and technical education, they must utilize the most effective educational techniques available in the development

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[2]E. M. Juergenson, "Instructional Materials and the Teacher," The Agricultural Education Magazine, (May, 1968), 243.

[3]J. Robert Warmbrod, "Appropriate Uses of Methods and Materials," The Agricultural Education Magazine, (May, 1968), 243-244.

of educational media, teaching techniques, and teaching materials.

Statement of the Problem

The problem for study and reported herein was to compare individualized instruction for employment in Commercial Fertilizer Distribution and Combine Maintenance and Adjustment areas of agricultural related occupations classes with conventional methods of group classroom instruction.

Objectives

The purpose of this study was to compare knowledge retention rates by individualized instruction with those of conventional group methods of instruction. The assumption of the study was that students who learned at their own speed would retain more than those in group classroom situations in agricultural related occupations classes.

Limitations of the Study

This study was limited to the vocational agriculture III and vocational agriculture IV class members in Valley Heights High School, District 498, Blue Rapids, Kansas. Valley Heights High School was a class 2A high school with an enrollment of approximately 175 students. This study was also limited to the areas of individual instruction necessary for employment in Commercial Fertilizer Distribution and Combine Maintenance and Adjustment. The investigator was employed by the Valley Heights High School, District 498, Blue Rapids, Kansas.

Blue Rapids, located in Marshall County of Northeast Kansas, had an estimated population of 1500. The basic industry of Marshall County was crop and livestock production.

As reported in the 1970 Kansas Statistical Abstract, Marshall County contained 1574 farms which averaged 361 acres. The county had 1402 acres under irrigation. Only 27.3 percent of the county's 13,139 population was urban. Marshall County was active in manufacturing as it contained eight establishments which gave an added value of 2,400,000 dollars.[4]

The vocational agriculture department was established in Waterville in 1931. The Waterville and Blue Rapids High Schools were unified in 1966 and became the Valley Heights High School. The vocational agriculture department served the new unified high school and was moved to the present location at Blue Rapids. The agricultural related occupations class was incorporated into the vocational agriculture program in 1969. A new high school, which included a vocational agriculture building was being constructed halfway between Blue Rapids and Waterville, and was to be completed in the fall of 1972.

Definition of Terms

The following terms may have special definitions as they are applied to this study and may vary somewhat from those in ordinary usage. The references, Audio-Visual Methods in Teaching,[5] "Definitions of Terms Used in Vocational, Technical, and Practical Arts Education,"[6]

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[4]Institute for Social and Environmental Studies, Kansas Statistical Abstract (Lawrence, Kansas: The University of Kansas, 1971), pp. 151-156.

[5]Edgar Dale, Audio-Visual Methods in Teaching (New York: The Dryden Press, 1946), pp. 37-52.

[6]Committee of Publications, "Definitions of Terms Used in Vocational, Technical, and Practical Arts Education," (Washington, D.C.: American Vocational Association, Inc., n.d.), pp. 3-23.

and Audio-Visual Instruction: Media and Methods[7] were helpful in defining the following terms:

Audio-Visual Media. Instructional materials that were either projected visually or presented auditorally.

Contrived Experience. A simulation of reality which made the reality easier to understand. A model of the actual object or a mock-up which changed and simplified the real object.

Demonstration. A process whereby the instructor showed students how a certain thing was done, regardless of whether the student only observed or was asked to do what he had been shown.

Field Trip. A planned student visitation to some establishment outside the classroom for the purpose of observing or seeking firsthand information about its operation or of acquiring skills and experiences not possible in the classroom.

Individualized Instruction. The organization of instructional materials in a manner which permitted student self-instruction as he progressed in accord with his own abilities and interests.

Laboratory or Work Experience. Learning by direct participation with responsibility for the desired outcome. An experience that was seen, handled, tasted, felt, touched, or smelled.

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[7]James W. Brown, Richard B. Lewis, Fred, F. Harcleroad, Audio-Visual Instruction: Media and Methods (New York: McGraw-Hill Book Company, 1969), pp. 589-596.

Motion Pictures. All variations of pictures which involved motion whether the motion was silent, combined sight and sound, and combined sound with three-dimensional sight. The motion pictures were either in full color or black and white.

Programmed Instruction. Instructional material broken down into an ordered sequence of small units where the student responded in some specified way to each unit. Student responses were reinforced by immediate knowledge of the correctness of response and the student moved in small steps at his own pace.

Still Pictures. One-dimensional aid, specifically, photographs, slides, and filmstrips.

Tape Recorder. A one-dimensional audio aid where instructional material was first recorded on a tape and played back to the student, either individually or to a group of students.

Verbal Symbol. Designation that had no resemblance to the object for which it stands. It may be a word, concept, scientific principle, formula, or any other representation of experience that has been classified in some verbal symbolism. Included were textbooks, bulletins, and manuals.

Visual Symbol. An abstract representation of literal reality, specifically, charts, graphs, and maps.

Chapter 2

RELATED LITERATURE

In preparation for the study, a survey of literature was made and no studies were found to be closely similar to this report. The information available indicated that there were three main categories with relation to individualized instruction. The areas were: individualized instructional techniques in use; application of individualized instructional techniques; and development of individualized instruction.

Individualized Instructional Techniques in Use

Instructional media is valued differently by educators from one time period to another. In a 1962 nationwide study of school practices and expectations, Lange reported secondary school principals gave the top rank to textbooks when asked to rank the usefulness of the various resources to secondary schools. However, by 1965-66, the principals expected locally produced curriculum materials to be most useful. The principals also indicated that films and filmstrips were used the most and the greatest expected increase was the use of tape recorders.[1]

Dale indicated sensory materials could be readily classified as they moved from the most abstract to the most direct kind of

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[1]Phil C. Lange, "The Use of Printed and Audio-Visual Materials for Instructional Purposes: Secondary Education." (Paper read at the Conference on the Use of Printed and Audio-Visual Materials for Instructional Purposes, Columbia University, February, 1966.)

learning. He developed the "cone of experience" to explain the interrelationships between the various types of audio-visual materials, as well as their individual positions in the learning process. Each position of the cone represented a stage between direct experience and pure abstraction. Beginning with the most direct to the most abstract, he listed ten divisions as follows: direct, purposeful experiences; contrived experiences; dramatic participation; demonstrations; field trips; exhibits; motion pictures; radio, recordings, and still pictures; visual symbols; and verbal symbols. He indicated that direct experiences, contrived experiences, and dramatic participation involved doing. Demonstrations, field trips, exhibits, motion pictures, radio, recordings, and still pictures involved observing. Visual symbols and verbal symbols were indicated as symbolizing.[2]

Pautz reported that eighty-five percent of what we know came from sight, eleven percent through hearing, and four percent via touch, taste, and smell. He further indicated that media must be planned to fit the learning situation and the proper techniques and media must be selected to fit the situation.[3]

The future of programmed instruction appeared hopeful, reported Nordmann. He indicated many advantages in the use of programmed instruction: immediate feedback to the student; allowing the teacher to determine exactly what part of the instruction sequence needed improvement when students did not learn a specific item; more and

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[2]Edgar Dale, Audio-Visual Methods in Teaching (New York: The Dryden Press, 1946), pp. 37-52.

[3]Norman Pautz, "For More Effective Teaching, Use Audio-Visual Materials," The Agricultural Education Magazine, (April, 1969), 238.

better education provided for both advanced and retarded students by allowing students to proceed at their own pace with program sequences adjusted to their own work level; and reduced drudgery work for the teacher.[4]

Application of Individualized Instructional Techniques

Stetler indicated that educational media should be related to the specific educational objectives in the context of the teaching-learning situation. With a variety of media available, the teacher should select the stimuli which was most likely to be effective for each student. In so doing, more effective utilization of the teacher's talent was facilitated through the use of new educational media. The media was used to implement concepts of large and small group instruction and individualized learning.[5]

Warmbrod indicated some of the newer individualized instructional materials emphasized content of instruction primarily in terms of basic principles likely to lead to subject-centered curriculum and deductive strategies of teaching in contrast to student-centered instructional programs and inductive approaches of learning. He further stated that there was a second danger in current development of instructional material. An effort to individualize instruction could fail to take into consideration the individual abilities, interests, and needs of students. With regard to material development

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[4]Bernard J. Nordmann, Jr., Teaching Machines and Programmed Instruction: An Introduction and Review, (Urbana, Illinois: Department of Computer Science, 1968), p. 19.

[5]Byron F. Stetler, Developing the Use of New Educational Media, (Washington, D.C.: Council of Chief State School Officers, n.d.),pp. 5-7.

enhancing the teaching-learning process, the first concern was the student and an effective approach to teaching and learning.[6]

Doll said that learning experiences should be of the self-activating type as students needed opportunities to proceed at their own rate through subject matter which suited them. He indicated that invention and creativeness were aided by individual study.[7]

In a 1961-63 study by McClay which used programmed instruction to teach farm credit to high school and adult students, it was found that factual information could be effectively self taught by programmed materials. However, students preferred learning the subject with the help of a teacher. He further indicated good programmed materials preparation involved considerable time and effort of competent teachers.[8]

Development of Individualized Instruction

Clymer and Kearney stated the teacher was the key to curriculum and instructional provisions, and that material centers, time blocks, small classes, scheduling, grouping, curriculum guides, and audio-visual aids were only devised to facilitate teaching. Only as the teacher utilized the resources available to him in organizing his class and carrying out an instructional program, adjusted to needs of students, could progress be made in developing the potential of

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[6] J. Robert Warmbrod, "Appropriate Uses of Methods and Materials," The Agricultural Education Magazine, (April, 1969), 238.

[7] Ronald C. Doll, Curriculum Improvement: Decision Making and Process, (Boston: Allyn and Bacon, Inc., 1970), p. 32.

[8] David R. McClay, "A Test of Programmed Instruction in Farm Credit," The Agricultural Education Magazine, (October, 1964), 100-101.

students.[9] Individualized instruction nurtures independent learning and a learning environment adapted to the needs of each student reported Glaser.[10]

Lambert stated certain changes in teacher role and responsibility had to come about when attempting to develop an individualized instructional program. He indicated teacher knowledge of the definition of individualized instruction had to be up-graded to mean instruction based on the needs, interests, and abilities of the individual student. Expectations for the student's role in learning had to change as the student became responsible for his own learning and required more freedon of movement in school and outside the school as his learning experiences required. Operation of audio-visual equipment, certain kinds of field trips, small group study sessions, and laboratory or work experience programs could be incorporated into the student's learning experiences.[11]

Lambert further indicated certain steps were involved in the development of individualized instruction. The students had to be prepared for individualized instruction and understand the fundamental principles involved. Secondly, students had to set realistic

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[9]Theodore Clymer and Norman C. Kearney, "Curricular and Instructional Provisions for Individual Differences," Individualizing Instruction, Nelson B. Henry, editor (The Sixty-First Yearbook of the National Society for the Study of Education, Chicago: The University of Chicago Press, 1962), p. 282.

[10]Robert Glaser, The Education of Individuals, (Pittsburgh: Learning Research and Development Center, University of Pittsburgh, 1966), pp. 5-9.

[11]Roger Lambert, "Helping Teachers Use Units to Individualize Instruction." (Paper read at the Central State Seminar in Agricultural Education, Chicago, Illinois, February 16, 1970.)

objectives. Student learning results had to be shared with the whole class and evaluation of accomplishment had to be on the basis of how well the student met his stated objectives.[12]

Summary

It would appear there has been considerable information on the use, application, and development of individualized instructional techniques. The related information also indicated that in setting up an individualized instructional program, the teacher's role in the classroom had to be changed from a disseminator of information to a coordinator of instruction. To be effective the student had to be prepared for individualized instruction, set realistic objectives, and develop a plan for accomplishment of the selected objectives.

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[12]Ibid.

Chapter 3

PROCEDURES AND METHODOLOGY

In order to meet the objectives set forth in the study, two individualized programmed manuals were prepared with the assistance of Dr. James Albracht and Professor Paul Stevenson, of Kansas State University.

Hypothesis

The null hypothesis for the study was: There will be no difference between the average achievement scores of individualized and conventional group methods of teaching Commercial Fertilizer Distribution and Combine Maintenance and Adjustment.

Design of the Study

The study was conducted in a Northeastern Kansas rural high school. Individualized programmed manuals were designed for two areas of agricultural related occupations. The study was composed of two parts: Commercial Fertilizer Distribution and Combine Maintenance and Adjustment.

The study required two groups, neither of which had studied in the areas of Commercial Fertilizer Distribution and Combine Maintenance and Adjustment. For comparison, a vocational agriculture III class of six students and a vocational agriculture IV class of six students were selected. These classes were chosen because of identical size and neither had been exposed to class work in these two areas.

Information concerning the background and abilities was obtained and tabulated into the following six selected areas: Verbal I.Q., Mechanical Aptitude Percentile, Overall Grade Point Average, Vocational Agriculture Grade Point Average, Biology Grade, and Size of Home Farm. The average score was determined in each area and compared to determine if there was a difference in the background and abilities of the two classes.

A pre-test of fifty objective type questions was administered to each class member to measure the entry level of knowledge in each of the two areas. A post-test of the same fifty objective type questions was administered to each member to measure the level of knowledge at the end of each study area.

Study Procedure

The first part of the study was in the area of Commercial Fertilizer Distribution. A pre-test was administered and the average correct score determined for both the vocational agriculture III and the vocational agriculture IV class members.

The vocational agriculture III class members used the individualized study method of instruction for Commercial Fertilizer Distribution. The vocational agriculture IV class members studied Commercial Fertilizer Distribution in a conventional group teaching setting. The instructional time for the Commercial Fertilizer Distribution was approximately forty hours. At the end of this time, the same fifty objective type questions were administered as a post-test, and the average correct score was determined for each class.

The second part of the study involved instruction for employment in Combine Maintenance and Adjustment. A pre-test of fifty objective type questions was administered and the average correct score determined. The study groups were reversed from those used in the Commercial Fertilizer Distribution. In this part the vocational agriculture III class members were involved in the conventional group teaching setting, and the vocational agriculture IV class members participated in the individualized study group. The instructional time for this part was approximately forty hours. At the end of this time the same fifty objective type questions were used as a post-test and the average correct score determined for each class.

The difference between the average correct scores of the individualized and the conventional group teaching methods for each class was found and the difference determined.

Both groups used the following audio-visual media: verbal symbols, visual symbols, still pictures, motion pictures, field trips, demonstrations, contrived experiences, and laboratory exercises.

Summary

A comparative study of the results of individualized programmed instruction with conventional group instruction was developed for the areas of Commercial Fertilizer Distribution and Combine Maintenance and Adjustment. Two groups were used and each group was involved in both methods of teaching. The teaching methods were reversed for the two groups in the second part of the study on Combine Maintenance and Adjustment.

Both groups were pre-tested and post-tested with the same fifty objective type questions for both parts of the study and the average correct scores determined for each test. At the completion of the study the differences between the average correct scores for both classes and both parts of the study were determined.

Chapter 4

ANALYSIS OF DATA

The problem studied was to compare individualized programmed study for employment in Commercial Fertilizer Distribution and Combine Maintenance and Adjustment with conventional group methods of instruction. The study compared retention rates of individualized instruction with conventional group instruction assuming that students who learned at their own speed would retain more than those in the conventional group method of instruction.

The compared groups were a vocational agriculture III class of six members and six vocational agriculture IV class members. None of the class members had studied in the two areas.

Information concerning the background and abilities of the six vocational agriculture III class members and the six vocational agriculture IV class members were obtained and tabulated into six selected areas. The selected areas were: Verbal I.Q., Mechanical Aptitude Percentile, Overall Grade Point Average, Vocational Agriculture Grade Point Average, Biology Grade, and the Size of Home Farm. Each area was totaled and the average score was determined by dividing each total by six. The averages were then compared to determine if there was a difference in the background and abilities of the two classes.

Background and Abilities

A summary of selected background and abilities of the vocational agriculture III class members was tabulated and averaged in Table 1.

Table 1

A Summary of Selected Background and Abilities of the Vocational Agriculture III Class Members

Student Number	I.Q.[1] (Verbal)	Mechanical[2] Aptitude (Percentile)	G.P.A.[3] Overall	G.P.A.[3] Vo-Ag	Biology[3] Grade	Size of Farm (Acres)
1.	104	25	2.33	2.71	2.00	240
2.	122	85	3.03	3.71	3.00	960
3.	103	15	2.12	2.71	2.00	540
4.	119	30	1.58	1.86	2.00	320
5.	100	30	2.02	2.85	1.00	820
6.	103	40	2.18	3.00	1.00	670
Average	108.50	37.50	2.21	2.80	1.83	591.6

[1]I.Q. - Lorge-Thorndike

[2]Mechanical Aptitude - Differential Aptitude Test normed on a national sample of eighth graders.

[3]Grade Point Average Scale equals A = 4.0
B = 3.0
C = 2.0
D = 1.0
F = 0.0

Using Lorge-Thorndike Verbal I.Q. scores, it was found that the vocational agriculture III class members had a 108.50 average I.Q. score. The average mechanical aptitude percentile was 37.50, taken from the Differential Aptitude Test normed on a national sample of eighth graders. The vocational agriculture III class members had a 2.21 overall grade point average, while their vocational agriculture grade point average was 2.80. The biology grade averaged 1.83 grade points. The grade point averages were determined on a grade scale of: A equals 4.0, B equals 3.0, C equals 2.0, D equals 1.0, and F equals 0.0. The number of acres in their home farms was 591.6 acre average.

A summary of selected background and abilities of the vocational agriculture IV class members was tabulated and averaged in Table 2. The Lorge-Thorndike I.Q. Test scores were used and the vocational agriculture IV class members had 117 average verbal I.Q. test score. The scores for the mechanical aptitude average percentile were taken from the Differential Aptitude Test normed on a national sample of eighth graders and the vocational agriculture IV class members averaged 65 percentile. The class members' overall grade point average was 2.62, their vocational agriculture grade point average was 2.90, and their biology grade average was found to be 2.00. All grade point averages were determined using the same scale as for the vocational agriculture III class. It was found that the vocational agriculture IV class members had an average of 461.6 acres in their home farm.

Table 2

A Summary of Selected Background and Abilities of the Vocational Agriculture IV Class Members

Student Number	I.Q.[1] (Verbal)	Mechanical[2] Aptitude (Percentile)	G.P.A.[3] Overall	G.P.A.[3] Vo-Ag	Biology Grade	Size of Farm (Acres)
1.	115	55	2.97	3.20	3.00	490
2.	123	95	2.56	2.60	2.00	240
3.	115	90	2.86	3.30	2.00	360
4.	99	50	1.95	2.10	1.00	720
5.	129	45	3.25	4.00	3.00	480
6.	121	55	2.16	2.20	1.00	480
Average	117	65	2.62	2.90	2.00	461.6

[1]I.Q. - Lorge-Thorndike

[2]Mechanical Aptitude - Differential Aptitude Test normed on a national sample of eighth graders.

[3]Grade Point Average Scale equals A = 4.0
B = 3.0
C = 2.0
D = 1.0
F = 0.0

A comparison of the average scores of the selected background and abilities of the vocational agriculture III and the vocational agriculture IV class members was tabulated in Table 3. It was found that the average scores for the vocational agriculture III class members was lower than the vocational agriculture IV class members in all of the selected areas except for the size of the home farm.

Table 3

A Comparison of the Average Scores of Selected Background and Abilities of the Vocational Agriculture III and Vocational Agriculture IV Class Members

	I.Q. Verbal	Mechanical Aptitude (Percentile)	G.P.A. Overall	G.P.A. Vo-Ag	Biology Grade	Size of Farm (Acres)
Vo-Ag III	108.50	37.50	2.21	2.80	1.83	591.6
Vo-Ag IV	117.00	65.00	2.62	2.90	2.00	461.6
Average	112.75	51.25	2.41	2.85	1.91	526.6

In verbal I.Q., the students in the vocational agriculture IV class had an advantage of 8.5 points. The average I.Q. per student was 112.75. The vocational agriculture IV class members had an adventage of 27.5 on the mechanical aptitude test and all students averaged in the 51.25 percentile. The overall grade point average was higher for the students in the vocational agriculture IV class by 0.41 of a point. The overall average per student was 2.41. The vocational agriculture grade point average for the vocational agriculture IV class members was 0.10 points higher than the vocational agriculture III class members with an overall average of 2.85. The biology grade average for students in the vocational agriculture IV class was 0.17 higher than the grade average for students in the vocational agriculture III class. The biology grade average was 1.91 for all the students in this study.

The average size of farm for the vocational agriculture III class members was 130 acres more than the acreage for the vocational agriculture IV class members. The average home farm size was 526.6 acres for the combined groups.

The analysis of these results indicated that the vocational agriculture IV class had a very small, if any, advantage over the vocational agriculture III class in background and abilities, except in the area of mechanical aptitude average percentile.

Commercial Fertilizer Distribution

The first part of the study compared the results of conventional group teaching methods with individualized methods on the subject of Commercial Fertilizer Distribution.

A pre-test of fifty objective type questions, Appendix A, was administered to the vocational agriculture III class members and the vocational agriculture IV class members covering the Commercial Fertilizer Distribution material to be presented in the unit. The pre-test results were summarized, tabulated, and averaged in Table 4. The vocational agriculture III class members had an average of 30.66 correct answers and the vocational agriculture IV class members had an average of 33.66 correct answers. Thus, the vocational agriculture IV class members had three more correct answers than the vocational agriculture III class members on the pre-test of Commercial Fertilizer Distribution.

Table 4

Pre-Test and Post-Test Data for the Commercial Fertilizer Distribution Unit

Student Number	PRE-TEST Vo-Ag III Individual[1]	PRE-TEST Vo-Ag IV Group[2]	POST-TEST Vo-Ag III Individual[1]	POST-TEST Vo-Ag IV Group[2]	DIFFERENCE Vo-Ag III Individual[1]	DIFFERENCE Vo-Ag IV Group[2]
1.	28	34	26	43	-2	+9
2.	38	33	44	37	+6	+4
3.	31	29	39	36	+8	+7
4.	25	31	27	34	+2	+3
5.	30	38	39	46	+9	+8
6.	32	37	30	34	-2	-3
Average	30.66	33.66	34.16	38.33	+3.50	+4.67

[1]Individualized Programmed Manual--used by the vocational agriculture III class members.

[2]Conventional Group Methods of Instruction--used by the vocational agriculture IV class members.

During this part, the vocational agriculture III class members were given the Commercial Fertilizer Distribution individualized programmed manual, sample lesson in Appendix A, and presented with all visual aids and supplies pertinent to the individualized manual of instruction. It was explained that forty hours would be devoted to the individualized study manual. The investigator then taught the same material to the vocational agriculture IV class members with the conventional group method for the allotted forty hours of instructional time.

At the end of the forty hours, a post-test of the same fifty objective type questions was administered to both classes. The average scores were determined, tabulated, and averaged in Table 4.

It was found, on the post-test, that the vocational agriculture III class members obtained an average of 34.16 correct answers. The vocational agriculture IV class members averaged 38.33 correct answers. This gave the vocational agriculture III class members, using individualized study, an average difference of a plus 3.50 correct answers. The vocational agriculture IV class members, using conventional group teaching methods, obtained an average difference of a plus 4.67 correct answers. This gave a 1.17 average correct answer advantage between the average differences in favor of the conventional group methods of teaching.

Combine Maintenance and Adjustment

The second part of the study compared the results of conventional group teaching methods with the individualized study method on the subject of Combine Maintenance and Adjustment.

A pre-test, Appendix B, of fifty objective type questions was administered to the vocational agriculture III class members and the vocational agriculture IV class members on the same day, covering the material to be presented in the unit. The pre-test results were summarized, tabulated, and averaged in Table 5. The vocational agriculture III class members had an average of 22.83 correct answers and the vocational agriculture IV class members had an average of 26.66 correct answers. This gave the vocational agriculture IV class members a 3.83 correct answer higher average on the pre-test than the vocational agriculture III class members.

During this part, the vocational agriculture IV class members were given the Combine Maintenance and Adjustment individualized programmed manual, sample lesson in Appendix B, and presented with all visual aids and supplies pertinent to the individualized manual of instruction. It was explained that forty hours would be devoted to the individualized study manual. The investigator then taught the same material to the vocational agriculture III class members using the conventional group teaching mathod for the allotted forty hours of instructional time.

At the end of the forty hours, a post-test of the same fifty objective type questions was administered to both classes. The average scores were determined, tabulated, and averaged in Table 5.

It was found, on the post-test, that the vocational agriculture III class members obtained an average score of 31.16 correct answers. The vocational agriculture IV class members averaged 33.83 on the post-test. This gave the vocational agriculture III class members, using conventional group teaching methods, an average difference of a plus

Table 5

Pre-Test and Post-Test Data for the Combine Maintenance and Adjustment Unit

Student Number	PRE-TEST Vo-Ag III Group[1]	PRE-TEST Vo-Ag IV Individual[2]	POST-TEST Vo-Ag III Group[1]	POST-TEST Vo-Ag IV Individual[2]	DIFFERENCE Vo-Ag III Group[1]	DIFFERENCE Vo-Ag IV Individual[2]
1.	16	26	25	37	+9	+11
2.	25	30	40	36	+15	+6
3.	26	32	31	40	+5	+8
4.	16	22	23	24	+7	+2
5.	27	29	34	38	+7	+9
6.	27	21	34	28	+7	+7
Average	22.83	26.66	31.16	33.83	+8.33	+7.17

[1]Conventional Group Methods of Instruction--used by the vocational agriculture III class members.

[2]Individualized Programmed Manual--used by the vocational agriculture IV class members.

8.33 correct answers. The vocational agriculture IV class members, using individualized study methods, obtained an average difference of a plus 7.17 correct answers. This gave a 1.16 correct answer average difference in favor of conventional group methods of teaching.

A comparison of individual and group methods of instruction for the vocational agriculture III and vocational agriculture IV class members was tabulated in Table 6. This indicated a small average difference of 1.17 correct answers in Commercial Fertilizer Distribution and an average difference of 1.16 correct answers in Combine Maintenance and Adjustment for the conventional group method of instruction.

Table 6

A Comparison of Individual and Group Methods of Instruction for the Vocational Agriculture III and Vocational Agriculture IV Class Members

	Individual	Group	Vo-Ag III	Vo-Ag IV
	Gain	Gain	Gain	Gain
Commercial Fertilizer Distribution				
Vo-Ag III	3.50		3.50	
Vo-Ag IV		4.67		4.67
Combine Maintenance and Adjustment				
Vo-Ag III		8.33	8.33	
Vo-Ag IV	7.17			7.17
Total	10.67	13.00	11.83	11.84

The gain for individualized instructional methods was 10.67 and the gain for the conventional group method of instruction was 13.00. This indicated a 2.33 advantage in favor of the conventional group method of instruction.

The vocational agriculture III class members had an average gain of 11.83 correct answers, and the vocational agriculture IV class members had an average gain of 11.84 correct answers. This indicated a 0.01 advantage for the vocational agriculture IV class members.

The small average difference in results of 2.33 correct answers in favor of conventional group instruction would indicate little difference between the two methods of instruction used in this study.

Summary

This study compared individualized programmed instruction with conventional group instruction for the preparation of personnel for Commercial Fertilizer Distribution and Combine Maintenance and Adjustment areas of employment.

Two groups were used, composed of six vocational agriculture III class members and six vocational agriculture IV class members. None of the class members had studied in the two areas. It was found that the vocational agriculture III class members had a lower average score in all six areas of background and abilities information except for the size of the home farm. Analysis of the factors, however, indicated that the advantage of the vocational agriculture IV class members over the vocational agriculture III class members was slight.

Both groups were pre-tested and post-tested with the same fifty objective type questions for each area of instruction. The average scores and the average differences were compared. Forty hours of instructional time was devoted to each area, and both groups of students were involved with both methods of instruction.

The average difference in the test results of 2.33 correct answers in favor of conventional group teaching methods indicated little difference in the results of the two teaching methods compared in this study.

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study compared individualized and conventional group instructional methods for the preparation of personnel for employment in Commercial Fertilizer Distribution and Combine Maintenance and Adjustment areas of agricultural related occupations. The study centered on the assumption that students who learned at their own speed would retain more than those in conventional group instruction in agricultural related occupations classes. Two individualized programmed manuals were developed for the areas of Commercial Fertilizer Distribution and Combine Maintenance and Adjustment in agricultural related occupations.

Two groups consisting of six vocational agriculture III and six vocational agriculture IV class members were used, neither of which had studied in the areas of Commercial Fertilizer Distribution and Combine Maintenance and Adjustment, and each group was involved in both methods of teaching. The teaching methods were reversed for the two groups in the second part of the study on Combine Maintenance and Adjustment.

Information concerning the background and abilities of the six vocational agriculture III class members and the six vocational agriculture IV class members were tabulated, summarized, and averaged into six selected areas. The six selected areas were: Verbal I.Q., Mechanical Aptitude Percentile, Overall Grade Point Average, Vocational Agriculture Grade Point Average, Biology Grade, and Size of the Home Farm in Acres. It was found there was little difference in the average scores between the two groups in background and abilities except in mechanical aptitude average percentile and in the size of the home farm. The vocational agriculture IV class members had an average test score of 65 percentile and the vocational agriculture III class members had an average test score of 37.50 percentile. The vocational agriculture III class members came from farms averaging 591.6 acres and the vocational agriculture IV class members came from farms averaging 461.6 acres.

A pre-test of fifty objective type questions was administered to each class member to measure the entry level of knowledge in each of the two areas. A post-test of the same fifty objective type questions was administered to each class member to measure the level of knowledge at the end of forty hours of instruction in each study area. The average scores and the average differences were then determined.

The first part of the study which compared teaching methods was in the area of Commercial Fertilizer Distribution. The vocational agriculture III class members used the individualized method of instruction and the vocational agriculture IV class members were taught with conventional methods of group instruction for the allotted forty hours.

The pre-test results indicated the vocational agriculture III class members had an average of 30.66 correct answers out of fifty questions and the vocational agriculture IV class members had an average of 33.66 correct answers. The post-test results indicated 34.16 correct answers for the vocational agriculture III class members and 38.33 correct answers for the vocational agriculture IV class members. This gave the vocational agriculture III class members an average difference of a plus 3.50 correct answers and the vocational agriculture IV class members an average difference of a plus 4.67 correct answers. The average difference in the gain in the test scores at the end of this unit was a 1.17 average correct answers more for the vocational agriculture IV class members who were taught by conventional methods of group instruction.

The second part of the study compared teaching methods in the area of Combine Maintenance and Adjustment. The two groups were reversed with the vocational agriculture IV class members participating in the individualized method of instruction and the vocational agriculture III class members involved in the conventional group method.

The pre-test showed the vocational agriculture III class members averaged 22.83 correct answers and the vocational agriculture IV class members had an average of 26.66 correct answers out of the fifty objective type questions. The post-test indicated the vocational agriculture III class members had a 31.16 correct average score while the vocational agriculture IV class members obtained a 33.83 correct answer average. This gave an average difference of a plus 8.33 correct answers for the vocational agriculture III class members and a plus 7.17 average difference for the vocational agriculture IV class members. The average difference in the gain in the test scores at the end of this unit was 1.16 higher for the vocational agriculture III class members who had conventional group instruction.

The compared gain of individual and group instruction showed the individual gain to be 10.67 correct answers and the group gain to be 13.00 correct answers. This indicated a total of 2.33 correct answer gain in favor of conventional group methods of instruction. The vocational agriculture III class members gained a total average of 11.83 correct answers and the vocational agriculture IV class members had a total average of 11.84 correct answer gain. This indicated a .01 average gain advantage for the vocational agriculture IV class members.

Conclusions

As a result of the findings of this study to compare the results of individualized instruction for employment in Commercial Fertilizer Distribution and Combine Maintenance and Adjustment areas with conventional methods of group classroom instruction, the following conclusions were made:

1. There was little difference in the results of the two methods of instruction.

2. There was an average difference of 1.17 in Commercial Fertilizer Distribution in favor of the group instruction and an average of 1.16 in Combine Maintenance and Adjustment for a total of 2.33 in favor of group instruction.

Recommendations

After analyzing the findings and conclusions of this study, the author made the following recommendations:

1. Studies need to be made of the individualized instructional materials available for agricultural related occupations courses of study.

2. Similar studies need to be made involving instructors of other agricultural related occupations.

3. Agricultural related occupations instructors need to be made more aware of the principles of individualized instruction.

4. Individualized instructional materials need to be developed in the area of agricultural related occupations.

5. Additional instructional materials for group instruction need to be developed for agricultural related occupations.

SELECTED BIBLIOGRAPHY

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Brown, James W., Richard B. Lewis, and Fred F. Harcleroad. Audio-Visual Instruction: Media and Methods. New York: McGraw-Hill Book Company, 1969.

Clymer, Theodore and Norman C. Kearney. "Curriculum and Instructional Provisions for Individual Differences," Individualizing Instruction, ed. Nelson B. Henry. The Sixty-First Yearbook of the National Society for the Study of Education. Chicago: The University of Chicago Press, 1962.

Committee of Publications. Definitions of Terms Used in Vocational, Technical, and Practical Arts Education. Washington, D.C.: American Vocational Association, Inc., n.d.

Dale, Edgar. Audio-Visual Methods in Teaching. New York: The Dryden Press, 1946.

Doll, Ronald C. Curriculum Improvement: Decision Making and Process. 2d ed. Boston: Allyn and Bacon, Inc., 1970.

Glaser, Robert. The Education of Individuals. Pittsburgh: Learning Research and Development Center, University of Pittsburgh, 1966.

Hartenberger, Walter L. "Developing an Individualized Instructional Program," The College of Education Record, December, 1965.

Institute for Social and Environmental Studies. Kansas Statistical Abstract. Lawrence, Kansas: The University of Kansas, 1971.

Joint Committee of the U.S. Office of Education and the American Vocational Association. Objectives for Vocational and Technical Education in Agriculture. Washington, D.C.: United States Department of Health, Education, and Welfare, 1966.

Juergenson, E. M. "Instructional Materials and the Teacher," The Agricultural Education Magazine, May, 1968.

Lambert, Roger. "Helping Teachers Use Units to Individualize Instruction," Paper read at the Central State Seminar in Agricultural Education, February, 1970, Chicago, Illinois.

Lange, Phil C. "The Use of Printed and Audio-Visual Materials for Instructional Purposes: Secondary Education," Paper read at the Conference on the Use of Printed and Audio-Visual Materials for Instructional Purposes, February 1966, Columbia, University.

McClay, David R. "A Test of Programmed Instruction in Farm Credit," The Agricultural Education Magazine, October, 1964.

Nordmann, Bernard J. Jr. Teaching Machines and Programmed Instruction: An Introduction and Review. Urbana, Illinois: University of Illinois, 1968.

Pautz, Norman. "For More Effective Teaching, Use Audio-Visual Materials," The Agricultural Education Magazine, April, 1969.

Stetler, Byron F. Developing the Use of New Educational Media. Washington, D.C.: Council of Chief State Officers, n.d.

Warmbrod, Robert J. "Appropriate Uses of Methods and Materials," The Agricultural Education Magazine, May, 1968.

________. "Appropriate Uses of Methods and Materials," The Agricultural Education Magazine, April, 1969.

APPENDIX A

Technical Information Sheet
on
METHODS OF APPLYING FERTILIZERS

Much emphasis is placed on the selection of the correct fertilizer ratio and on the adequate and economical amounts of the various fertilizers to be used. However, the method of application is usually as important and must not be overlooked. In order to be used by plants, nutrients must be placed where they can be dissolved by moisture in the soil. The rate and distance that plant food elements can move within the soil depend on the chemical nature of the material that furnishes the nutrients and the character of the soil. Generally, phosphates move only short distances from the point of placement, so to be available they must be placed where they will be utilized by the plant. Nitrogen moves rather readily, and the movement of potash is intermediate between phosphate and nitrogen. In commonly used fertilizer, the nitrogen and potash carriers are more readily soluble than the phosphate material, therefore, they cannot be safely concentrated in as large amounts near the seed or roots of the plant because of the danger of salt damage. Likewise, a reduction of soil moisture increases the concentration of the soil solution; therefore, relatively large amounts of fertilizer placed too near the seed or seedling roots are likely to cause injury during dry periods, particularly when such periods occur soon after the fertilizer is applied. For most efficient results, it frequently may be necessary to make two or more applications for a single crop and to use a combination of methods.

How fertilizer is applied to the crop is just as important as using the proper analysis or the correct amount. Many methods of fertilizer application are available to the farmer. These methods vary with the time of application, crop, climate, equipment available, type of soil, stage of plant growth, and nutrients to be applied.

Two broad categories of fertilizer application are surface application and sub-surface application. Several methods within each of these categories will be discussed.

Surface Application

This type of application refers to the placement of the fertilizer material, dry or liquid, on the surface of the soil. The time of application and nutrients applied give rise to the use of the following terms.

Broadcast application. This refers to the uniform distribution of dry or liquid fertilizers on the surface of the soil. Broadcast spreading may be done prior to planting or after the crop has emerged.

It is commonly accomplished by the use of truck mounted or pull type spreaders. Truck spreading has become quite popular as the same truck can haul the bulk material from the warehouse and then spread the material. Broadcasting permits a large acreage to be fertilized in a short time. Use of airplanes has been practical for broadcasting if the ground is too wet or rough for use of ground equipment.

Plowdown application. This fertilizer is broadcast prior to discing or plowing of the soil in preparation of the seed bed. It is a desirable method of applying phosphorus, potassium, and other nutrients for deep rooted crops. It is especially desirable for use in areas where hot and dry weather conditions result in a moisture shortage in the surface of the soil. Large amounts of fertilizer may be applied in this manner without risk of germination injury. Depending on the time of application and texture of the soil, it may or may not be desirable to plow down nitrogen fertilizers. Anhydrous ammonia may be applied at the time of plowing by releasing the ammonia underneath the furrow slice. This combines two jobs into one and eliminates a trip across the field. Application of ammonia in this manner is safe, simple, and efficient regardless of time of application. Other nitrogen carriers may be susceptible to leaching losses from excessive rainfall if applied too far in advance of crop use.

Topdress application. This is a broadcast application of material, generally applied to a growing crop, although it may be in a dormant stage. This type of application depends on rainfall to move the applied nutrients into the root zone. This is an effective way of applying nitrogen to small grains, pastures, and forages. However, the dependence on rainfall can lead to poor results in dry seasons. Other nutrients such as phosphorus and potassium move very little in most soils, irregardless of the amount of rainfall. Thus, topdressing of small grains with these two elements is generally very ineffective. A notable exception to the topdress application of phosphorus and potassium is that of forage crop fertilization. These crops are able to absorb phosphorus and potassium through the crown of the plants and their very shallow, almost surface, root system.

Foliar application. This is a broadcast application of soluble fertilizer nutrients applied directly to the foliage of growing crops. The plant nutrients may then be absorbed through the leaves. In some cases, foliar applications have given a more rapid utilization of applied nutrients. It will almost always correct visual deficiencies more rapidly than will soil treatments.

To date, foliage sprays have been beneficial in the correction of micro-nutrient deficiencies on fruit trees and certain field crops. This is particularly the case in the correction of iron and manganese deficiencies. Foliar applications of urea solutions have been effective on small grains, but no more effective than soil applications of an equal amount of nitrogen. In other than light sprays, foliar applications have caused severe burning of leaves. This has proven to be the main difficulty in attempting to supply the total nitrogen, phosphorus, and potassium needs of a crop without an unduly large number of applications. With the present techniques for foliage application, it is impractical as a method of application to supply the requirements of other than the micro-nutrients to field crops.

Irrigation application. This is a broadcast application of fertilizer materials at the same time irrigation waters are being applied. Liquid materials are normally used, although dry materials may be dissolved and then injected into the system. The type of irrigation system, open-ditch, gated pipe, or sprinkler, will dictate the type of fertilizer material applied in this manner. Several advantages are apparent with this type of application:

1. Less labor and equipment are needed than for any other type of application.
2. Allows fertilization during the growing season and after the crop is too large for other application methods.
3. Reduces the number of trips across the field.
4. Allows constant feeding of crops throughout the growing season on soils of low nutrient holding capacity.

Some disadvantages must also be recognized:

1. Uniform application is dependent upon uniform water distribution.
2. Nutrients applied in this manner, if not absorbed by the leaves must be sufficiently mobile to move to the crop root system.
3. Chemical reactions in hard water may cause precipitation of calcium and magnesium salts that may clog valves and gates of irrigation equipment.

Normally, sufficient phosphorus and potassium can be applied at or prior to planting. However, irrigation applications of nitrogen may serve as a stop gap measure in the event a nitrogen shortage develops late in the growing season.

Sub-surface Application

This type of application refers to the placement of fertilizer materials below the surface of the soil. As in the case of surface applications, the time of applications, and nutrients applied give rise to the following terms.

Band application. This method refers to the placement of fertilizer materials in a localized zone below the surface of the soil. Band applications may be made with dry or liquid materials depending on the equipment available.

Starter application. This is a band application of fertilizer one or two inches to one or both sides of the seed at planting time. This method of application is commonly used on corn, cotton, and potatoes. Starter fertilizers normally contain nitrogen and phosphorus or nitrogen, phosphorus, and potassium and are applied as either dry or liquid materials.

The starter method of application provides a readily available source of nutrients in the close proximity of young plant roots to promote rapid early growth. When used in combination with a plowdown application, the two methods of application combine to provide a fast start and continued nitrogen throughout the growing season.

Seed contact application. This method of applying starter fertilizer material to small grains has been used for years. In the case of small grains, fertilizer is applied right with the seed by mixing of the seed and fertilizer or by using a combination fertilizer grain drill. This has proven to be a most efficient method of application for small grains. At rates usually applied, there is no danger of germination injury to the small grain.

In recent years, the use of this method for row crops has received considerable attention. The term "pop-up" has been used to describe this application to row crops. Generally, the amount of fertilizer applied is quite small. Either liquid or dry materials may be used.

At the present time this method of starter application should be viewed with caution. Some definite precautions should be observed:

1. Seed contact fertilizer alone is not sufficient. It should be used in combination with a plowdown application.
2. A total of 15 pounds of nitrogen plus potash per acre appears to be the maximum to be applied to corn.
3. Excess nitrogen and potash will injure germination and reduce stand.
4. Soybeans are much more susceptible to salt injury than corn. Use of seed contact fertilizer on soybeans is not recommended at this time except in the state of Minnesota.

Sidedress application. This method of application refers to the application of fertilizer in a band to growing row crops such as corn, sorghum, or cotton. The fertilizer, usually a nitrogen material, is applied below the surface of the soil and along or between the rows of the crop. It may be combined with a cultivation or be a separate operation. Dry or liquid nitrogen materials have been applied in this manner in the past, however, sidedressing today is accomplished mainly with either anhydrous ammonia or nitrogen solutions.

This method provides for the application of nitrogen close to the time of greatest need and utilization by the crop. In areas where leaching losses of nitrogen may reach economical proportions, sidedressing may be of considerable advantage. However, pruning of roots and the possibility of crop becoming too large for a sidedress application, as well as coming at the time of peak labor load, have caused many farmers to consider application of nitrogen at another time of the year, either in the fall or spring.

Time of Application

The time of fertilizer application depends on the soil, climate, crop grown, and the nutrients applied.

Percolation of water through a soil profile may be of particular importance when considering the time of application of mobile nutrients such as nitrates and sulfates. Sandy soils will be much more susceptible to leaching losses than clay soils. They will be very different in their ability to fix other plant nutrients.

Climate is important to time of application from the standpoint of rainfall and temperature. Water movement through the soil (whether the water comes from rainfall, melting of snow, or from supplemental irrigation) is necessary for leaching, denitrification, and erosion losses to occur. The amount and quantity of rainfall between time of fertilizer application and plant utilization of the applied nutrients will affect the efficiency of the applied material. Temperature affects the availability of several nutrients, generally by the indirect effect on micro-organism activity in the soil. Micro-organism activity, in turn, is responsible for organic matter breakdown, nitrification and denitrification.

The type of crop grown may dictate a particular time of fertilizer application. A single application of primary nutrients is usually satisfactory for most fast growing annual crops such as corn and soybeans. However, split applications of nitrogen, one in the spring and one in the fall, may be desirable for perennial cool season grasses such as bluegrass and bromegrass.

The particular plant nutrients applied as well as the source of the plant nutrient may also influence the time of application. Mobile nutrients such as nitrates and sulfates are more susceptible to leaching losses than phosphates or potash. Nitrogen applied in the ammonia form must be nitrified before leaching or denitrification can take place, whereas application of nitrogen from nitrate sources are readily susceptible to these losses if such conditions exist after application.

Todays agriculturist is aware of and able to utilize the benefits of a four season fertilizer application program. Available labor and equipment, climate, and soil type may all affect the economic choice of time of application.

Fall application. Starter fertilizer for fall sown small grains, topdressing of legumes and cool grasses, plowdown for spring small grains and or spring row crops may all be economically applied in the fall months.

Fall application of phosphorus and potassium is relatively safe in most areas of the midwest. These elements are rather immobile and thus the chances of leaching losses are quite small. Texture of the soil and fall or winter precipitation will have little influence on the losses of these nutrients. Larger applications may be applied in this manner to aid in building the level of these elements in the soil. Crops with tap root systems, such as soybeans and peanuts, have been found to respond more to plowdown applications of potassium. The uncertainty, in some areas, of spring applications owing to excessively wet fields may often offset the economic consideration of investing fertilizer dollars in the fall. Labor may also be more available in the fall of the year.

Fall application of nitrogen is susceptible to leaching loss under conditions of adequate rainfall. However, several factors in addition to rainfall must be considered in an evaluation of fall applied nitrogen. The texture of the soil, average fall and winter temperature, and nitrogen carrier all influence possible leaching losses.

Temperature becomes a major factor in fall application of nitrogen in that it exerts a governing influence on the rate of nitrification. Nitrification will occur in the soil at above freezing temperatures. However, once the temperature of the soil is below about 50 degrees at a depth of four inches, the conversion of nitrogen to the nitrate form will be relatively slow until the soil temperatures again rise above 50 degrees in the spring. Coarse textured soils allow more rapid percolation of water than do clay soils. Application of any nitrogen materials in the fall to sandy soils is normally discouraged because of this. In any discussion of leaching losses, the main factor is the rainfall pattern over the winter months. Areas that normally have low or medium amounts of rainfall during the winter and early spring months will have little or no leaching losses of nitrogen.

Anhydrous ammonia is an excellent nitrogen material for use in fall application in light of the previous discussion on leaching losses. When applied to soils of medium to heavy texture, the nitrogen remains in the ammonium form and resists leaching until converted to the nitrate form. Applied after the soil temperature at a depth of four inches is below 50 degrees, the conversion to nitrate is relatively slow and of little consequences. These two factors combine to reduce the susceptibility of ammonia to leaching regardless of rainfall during the winter and early spring months. From the agronomic standpoint, fall application of nitrogen in the ammonium form has given comparable results on row crops to spring or sidedress applications. On irrigated corn in Nebraska, 160 pounds of nitrogen applied as anhydrous ammonia in the fall gave comparable yields to 160 pounds applied as a summer sidedress application. In addition, labor and equipment may again be more available in the fall.

Winter application. The winter months are normally a rather slow period for many farmers. Applications of fertilizer also is normally slow during this period. However, supplies of fertilizer are usually good and labor sources more plentiful than during any other period of the year.

In areas of marginal or inconsistent spring rainfall, topdress applications of nitrogen may be effectively applied to small grains during this period. The extra moisture from snowfall may well mean the difference between response or no response. The additional moisture utilized in this way will be able to move nitrogen into the root zone. Forages can also economically be topdressed during this period. In addition to nitrogen, phosphorus and potassium may also be applied. The freezing and thawing combined with the winter moisture will move the nutrients closer to the roots and promote a rapid early spring growth. Plowdown applications and application of anhydrous ammonia can continue until the ground becomes frozen. In some areas, these methods of applications continue throughout the winter.

Spring application. For most farmers, spring is the busiest time of the year. And yet this is the most popular period for applying fertilizers today. Many farmers have found it desirable however to apply their fertilizer prior to this period. They are then able to concentrate on seedbed preparation and planting of their crops in the spring.

Broadcast applications for plowdown or disc in on row crops, preplant applications of anhydrous ammonia for row crops, topdress applications to small grains and pastures, and starter applications for spring small grains or row crops are commonly applied at this time of the year.

Summer application. Summer time applications of fertilizer are mainly confined to providing supplemental amounts of plant nutrients not applied previously. Sidedressing with nitrogen, and irrigation water applications are normally used. Broadcast applications of phosphorus and potash may be applied to small grain stubble and plowed under to provide nutrients for fall seeded small grains. Topdressing of forages and cool season grasses is also popular during this period.

Enterprise: ACE
Unit: Commercial Fertilizer Distribution
Lesson 6: Methods of Applying Fertilizers
Objective: To become familiar with the methods of fertilizer application.
Reference: Technical Information Sheet

Study Guide Questions

1. Where should fertilizer be placed in the soil?

2. List the methods of surface applications.

3. Name the methods of sub-surface applications.

4. What is a "pop-up" fertilizer?

5. What determines the time of fertilizer application?

6. What plant foods may be put on safely in the fall in most types of soil?

7. What nitrogen material should be used for fall application?

Lesson 6: Methods of Applying Fertilizers

<u>Quiz</u> - Circle the correct answers

T F 1. The method of application is as important as the amount of fertilizer.

T F 2. Fertilizer is applied to the surface for best plant use.

T F 3. The mobility of nutrients has no bearing on application.

T F 4. Nitrogen and phosphorus have about the same rate of movement.

T F 5. Potash is more soluble than phosphate.

T F 6. There are two broad categories of application.

T F 7. Broadcasting is normally on the surface and enables the operator to cover large acreages in short time.

T F 8. Plowdown is a good method of applying nitrogen in the fall.

T F 9. Plowdown is recommended for use in hot, dry areas.

T F 10. Topdressing is generally applied to a growing crop.

T F 11. Topdressing is a good practice to use with phosphate and potash.

T F 12. Foliar spraying shows best results with micro-nutrients.

T F 13. When applying fertilizers we may use either liquid or dry.

T F 14. Starters are usually placed to one or both sides and below the seed.

T F 15. Starters should be used in combination with plowdown.

T F 16. Pop-up is a good practice for corn and soybeans as it gets off to a faster start and yields more.

T F 17. Excess nitrogen and potash may injure germination.

T F 18. Sidedressing may be combined with cultivation.

T F 19. Time of application depends on the area.

T F 20. Leaching is not important when applying nitrogen.

Unit Test

Commercial Fertilizer Distribution

Name ______________________________ Grade ______

General Instructions: This test is made up of two sections. Section I is true and false questions. Section II is a mathematical problem. You will find directions for each section of the test at the start of the section. Each item in the test counts two (2) points on the score.

Section I. True and False

Read each of the following statements carefully. If all or any part of the statement is false, circle the F in front of the statement. If the statement is completely true, circle the T in front of the statement.

T F 1. A bushel of corn contains one pound of actual nitrogen.

T F 2. Organic matter has plant food that is all readily available.

T F 3. Fertilizer is any substance applied to soils to increase productivity and growth of crops.

T F 4. Fertilizers must be used in combination with other good management practices.

T F 5. Burning represents a good economical management practice.

T F 6. Without fertilizers, we would still be on a subsistance type of farming.

T F 7. All plant food is obtained from the soil.

T F 8. Plants are about 50% carbon.

T F 9. Minerals account for about 5% of plant composition.

T F 10. Oxygen makes up most of the earths crust.

T F 11. There are 16 essential plant nutrients.

T F 12. The greatest concentration of phosphorus in plants is in the seed and roots.

T F 13. The average soil contains more potash than any of the other primary nutrients.

T F 14. Most of our sulfur needs are returned to the soil by rain.

T F 15. Plants require more chlorine than other micro-nutrients.

T F 16. Anhydrous ammonia fertilizer grade is 21-0-0.

T F 17. Ammonia is the starting point for most nitrogen fertilizers.

T F 18. Ammonia sticks to the soil particles.

T F 19. Ammonium nitrate increases the acidity of the soil.

T F 20. In recent years the non-pressure solutions are losing out.

T F 21. Rock phosphate is a highly available form of phosphate.

T F 22. DAP is a good source of both nitrogen and phosphorus.

T F 23. Lime supplies calcium and magnesium.

T F 24. Lime aids the fixation of nitrogen in the soil.

T F 25. An application of lime has a short term effect.

T F 26. The effect of lime is measured by a change in pH.

T F 27. Lime dissolves rapidly in the soil.

T F 28. The law requires the producer to give purity and fineness of his lime.

T F 29. Lime is best applied and left on the surface.

T F 30. Legumes show the quickest response to lime.

T F 31. Nitrogen and phosphorus has about the same rate of movement.

T F 32. Potash is more soluble than phosphate.

T F 33. Plowdown is a good method of applying nitrogen in the fall.

T F 34. Topdressing is generally applied to a growing crop.

T F 35. Foliar spraying shows best results with micro-nutrients.

T F 36. Starters should be used in combination with plowdown.

T F 37. Pop-up is a good practice for corn and soybeans as it gets off to a faster start and yields more.

T F 38. Excess nitrogen and potash may injure germination.

T F 39. No maintenance is required on Carbon Steel liquid storage tanks.

T F 40. Anti-freeze is recommended for use in pumps.

T F 41. When handling any nitrogen solution, try to stay on the downward side of the operation.

T F 42. Anhydrous ammonia leaks may be found by the color of the material.

T F 43. The maximum capacity of anhydrous ammonia tanks is 85%.

T F 44. Most blend plants now use a rotary mixer.

T F 45. Two types of railroad cars may be used to deliver dry fertilizer.

T F 46. A plant that has a good maintenance program has less equipment problems.

T F 47. A major problem of bulk blend is the build up of materials on all contact parts.

T F 48. A sprayer should be cleaned with ammonia and water.

T F 49. Trailer type bulk spreaders range from 1 to 4 tons.

Section II Mathematical Problems

Complete the following mathematical problems. Show your work under the problem.

50. Determine the materials needed for the following.

a. 30 acres at 60-40-30 per acre
Use: Urea 45-0-0
18-46-0
Muriate of potash 0-0-60

b. What is the total cost if plant food cost.
Actual nitrogen at 8¢
Actual phosphate at 7¢
Actual potash at 4¢

APPENDIX B

Enterprise: Agriculture Mechanics
Unit: Combine Maintenance and Adjustment
Problem: What is the value of doing a good job of combining?
Reference: Technical Information Sheet
Objective: 1. To determine how harvesting efficiency effects profit.
2. To learn the kind of losses due to adjustment.
3. To become familiar with the characteristics of a good job of combining.

Information	Key Points
1. Harvesting efficiency tables	a. Corn, Soybeans, Wheat charts. b. Average--average harvesting efficiency of that crop. c. Ideal--97% or better efficiency is desired.
2. Losses due to poor operation and adjustment.	a. Field loss b. Marketing loss c. Increased cost of harvesting d. Shorter life of machine
3. Field losses	a. Field loss graph b. Some will always be left in the field. c. Get as much as possible. At least 97%.
4. Marketing loss	a. Damaged grain--lower price. b. Can be less by proper timing and machine adjustment.
5. Increased machine cost	a. Improper adjustment increases wear. b. Improper adjustment causes excessive power requirements.
6. Characteristics of a good job of combining.	a. The field: 1. No uncut grain left standing. 2. A few grains left in some of the heads. 3. Straw and heads are not excessively chewed up. b. The machine: 1. Very few unthreshed heads at the rear of the machine. 2. Material spread evenly over the rack. 3. Little or no grain found coming from the shoe or rack.

4. A small amount of material in the tailings auger.

c. The grain tank:
1. The grain is not cracked.
2. There is a small amount of chaff and other foreign matter in the grain.
3. Grain has satisfactory moisture content for storage or marketing.

7. Effects the kind of job we do.

a. The combine:
1. Constant r.p.m.
2. Speed of forward travel.
3. Adjustments.
4. Operator skill.
5. Width of the combine.

b. The natural setting:
1. Topography.
2. Condition of the crop.
3. Stand of the crop.
4. Variety of the crop.

8. What we need to know to become efficient operators.

a. Functional design of the combine.
b. Basic principles of operation.
c. Able to identify combine losses.
d. Able to make proper adjustments.
e. Keep in operating condition.
f. Able to determine the need for a combine.

Technical Information Sheet

WHAT IS THE VALUE OF DOING A GOOD JOB OF COMBINING?

The combine can be adapted to harvest any of our seed growing crops. The machine can be easily changed from one crop to another by use of the appropriate attachments and by making the proper adjustments. The principles of operation are the same for each of the crops even though different attachments may be used. The combine is widely used in the harvesting of our grain crops. This means that we must understand how to operate the combine properly if we are to avoid large losses of grain at harvest time. The large investment the farmer has in grain crops makes it important to harvest all the high quality grain he can from his fields.

The following tables show the effect of harvesting efficiency upon profits received from corn, soybeans, and wheat. The labor charge was $2.00 per hour.

HARVESTING EFFICIENCY EFFECTS CORN PROFITS

Corn Production Costs $52.00 Per Acre Yield 60 Bu./A

Price $1.00/Bu.

HARVESTING EFFICIENCY	HARVEST YIELD	PROFIT PER ACRE
88%	52 Bu.	Exercise
90%	54 Bu.	$ 2.00
92% average	55 Bu.	3.00
94%	56 Bu.	4.00
96%	57 Bu.	5.00
97% ideal	58 Bu.	6.00
100%	60 Bu.	8.00

HARVESTING EFFICIENCY EFFECTS SOYBEAN PROFITS

Soybean Production Costs $50.00 Per Acre   Yield 30 Bu./A

Price $2.00/Bu.

HARVESTING EFFICIENCY	HARVEST YIELD	PROFIT PER ACRE
84%	25.2 Bu.	Exercise
87% average	26 Bu.	$ 2.00
90%	27 Bu.	4.00
93%	28 Bu.	6.00
97% ideal	29 Bu.	8.00
100%	30 Bu.	10.00

HARVESTING EFFICIENCY EFFECTS WHEAT PROFITS

Wheat Production Costs $28.00 per acre   Yield 35 Bu./A

Price $1.00/Bu.

HARVESTING EFFICIENCY	HARVEST YIELD	PROFIT PER ACRE
80%	28 Bu.	Exercise
85%	30 Bu.	$ 2.00
90% average	31 Bu.	3.00
92%	32 Bu.	4.00
94%	33 Bu.	5.00
96%	33.5 Bu.	5.50
97% ideal	34 Bu.	6.00
100%	35 Bu.	7.00

WHAT KIND OF LOSSES DO WE HAVE BECAUSE OF POOR COMBINE OPERATION AND ADJUSTMENT?

1. Field losses of grain.

No matter how careful we are some grain will always be left in the field. Some will be lost on the ground before combining, some will be missed by the combine because of cutting too high or poor driving, while some will be lost through the machine because the heads are not completely threshed out or the kernels thrown out of the machine. These losses will be greater than necessary unless the combine is properly operated and adjusted.

2. Marketing losses caused by poor quality grain.

Poor adjustment and operation of the combine may cause damaged grain that will lower the sale price or storage quality. This will cause an economic loss to the farmer. By understanding the principles of operation of the combine these losses can be kept to a minimum.

Grain damage that will cause the price to be discounted include the following: low test weight per bushel, high moisture content, heat damage, foreign material, shrunken-broken kernels and fines, and split grain in the case of soybeans. These losses can be kept to a minimum by proper timing of the combine operation and by having the machine in proper adjustment.

3. Operating the combine with improper adjustments or under poor conditions may require excessive amounts of power. This will increase the cost of harvesting the crop.

4. Operating the combine under poor conditions with improper adjustments will increase the wear on the machine. This will shorten the life of the combine and increase repair bills.

CHARACTERISTICS OF A GOOD JOB OF COMBINING

A poor job of combining means that too much grain will be left in the field and that some will be damaged so much that the market grade will be lowered. Both of these losses means that we will not receive as much for our work and investment as we would if we did a good job of combining. The cost of doing a good job is not more than for doing a poor job.

Let us see if we can tell what a good job of combining should be like. Where would you look?

<u>The field</u>

1. No uncut grain left standing.
2. A few grains left in some of the heads.
3. Straw and heads are not excessively chewed up.

<u>The Machine</u>

1. Very few unthreshed heads at the rear of the machine.
2. Material spread evenly over the rack.
3. Little or no grain found coming from shoe or rack.
4. A small amount of material in the tailings auger.

<u>The grain tank</u>

1. The grain is not cracked.
2. There is a small amount of chaff and other foreign matter in the grain.
3. The grain has satisfactory moisture content for storage or marketing without excessive losses.

WHAT ARE THE THINGS THAT EFFECT THE KIND OF JOB OF COMBINING WE SHOULD DO?

1. The combine
   a. The power needed to run the combine at constant r.p.m. (revolutions per minute.)

b. The speed of forward travel.
c. The adjustment of the combine.
d. The skill of the operator.
e. The width of the combine.

2. The natural conditions.
a. The lay of the land. (Topography)
b. The condition of the crop for threshing.
c. The stand of the crop.
d. The variety of the crop.

THERE ARE SEVERAL THINGS WE NEED TO KNOW ABOUT A COMBINE IF WE ARE TO BECOME EFFICIENT OPERATORS WITH THE ABILITY TO DO THE KIND OF JOB WE DESCRIBED.

Even if we hire our combining done we should be able to tell whether or not the custom operator is doing a good job for us.

Some of the things we need to know are listed here. They will be studied in more detail later.

1. To understand the functional design of the combine.

2. To understand the basic principles of operation of the combine.

3. To have the ability to identify combine losses.

4. To have the ability to make the proper adjustments on the combine to keep the losses as low as possible.

5. To have the ability to maintain the combine in efficient operating condition.

6. To have the ability to determine the need for a combine in the farming operation and to select the machine that best meets the need.

STUDY GUIDE

1. What is considered to be the minimum ideal harvesting efficiency percentage?

2. How much will it cost to loose eight bushels of corn per acre at $1.50 per bushel on 150 acres?

3. Name at least five reasons causing grain to be discounted at the market.

4. What is meant by "a poor job of combining"?

5. Where would you look to tell if it is a good job of combining?

6. What do we need to know about a combine if we are to become efficient operators?

Enterprise: Agriculture Mechanics
Unit: Combine Maintenance and Adjustment
Skill: Determining production cost of our crops.
Reference: Record Book.

1. Study your record books to find your cost of production for the crops you will be harvesting with the combine.
   Record the cost per acre below.

   Corn ___________

   Grain Sorghum ___________

   Soybeans ___________

   Wheat ___________

2. Does this make it seem important to save all the high quality grain you can?

Unit Test

Combine Maintenance and Adjustment

Name ____________________ Grade ________

General Instructions: This test is made up of 50 items of several different types. You will find directions for each section of the test at the start of the section. Each item in the test counts two (2) points on the score.

Section I. True and False

Read each of the following statements carefully. If all or any part of the statement is false, circle the F in front of the statement. If the statement is completely true, circle the T in front of the statement.

T F 1. The seed of grain crops is mature or fully developed before the seed is dry enough for safe storage without artificial drying.

T F 2. If the straw rack of the combine is operating too fast some of the grain will be cracked in the separating area of the combine.

T F 3. Such grain defects as foreign matter, heat damage, and high moisture content are beyond the control of the combine operator.

T F 4. When the variable speed sheave that drives the combine reel is closed (pulley size made larger) the reel speed will be increased.

T F 5. The function of the beater behind the cylinder is to beat the remaining kernels out of the heads of grain.

T F 6. In finding the cutter bar loss from a combine the grain per square foot found on the ground in front of the combine, in the standing grain, should be subtracted from the grain per square foot found under the combine.

T F 7. The tailings elevator carries grain from the rear of the shoe to the grain tanks.

T F 8. When the cylinder is set to over thresh, the threshing area of the combine will have the greatest source of loss.

T F 9. The fan wind deflectors or windboards, as they are sometimes called, are special attachments that can be put on the fan blades to change the direction of the air blast.

T F 10. If the rack loss is high, it can usually be reduced by increasing the cylinder speed.

T F 11. Rack loss is the loose grain which has not been separated from the straw as it passes over the straw rack and is carried out of the machine with the straw.

T F 12. Cylinder loss can be determined by looking for kernels of grain which are left in the heads and carried out over the rear of the straw rack.

T F 13. The shoe loss is called tailings and can be found by catching all the material coming from the cleaning shoe.

T F 14. The shoe loss will usually be increased when the cylinder clearance is decreased.

T F 15. The straw rack check flaps or deflectors stop grain which might be thrown out of a straight through machine by the cylinder or cylinder beater.

T F 16. The cutter bar knife is registered properly when a knife section comes to rest over adjoining guards at each end of the pitman stroke.

T F 17. The threshing action in the combine is caused by the rapidly revolving cylinder throwing the heads of grain against the cylinder beater and knocking the kernels out.

T F 18. In harvesting clean, weed free crops the greatest source of loss is usually at the cutter bar.

T F 19. The straw rack carries the straw from the threshing area out of the rear of the combine.

T F 20. The loose grain that is separated from the straw in the separating area falls through the rack onto the chaffer.

Section II. Multiple Choice

Read each item and decide which choices answers the question. Place the letter or letters that shows your choice in the blank at the left of the question number.

_____ 21. The purpose of the air blast of the fan being directed through the sieve is to:
a. Regulate the flow of material into the cleaning area of the combine.
b. Cool the operator in the cab of a self-propelled combine.
c. Agitate or float the material on the chaffer as an aid in cleaning the grain.
d. Blow the chaff into the tailings auger trough for removal from the combine.

_____22. The types of cylinders currently being used in combines are.
a. Flail
b. Rasp-bar
c. Full-width and narrow
d. Ball bearing and plain bearing
e. Spike tooth

_____23. A delay in wheat harvest beyond the time the grain is dry causes a reduction in test weight per bushel. The main cause of this is due to:
a. The weathering of the grain causing a loss in dry matter content.
b. Weevils getting into the heads and eating out the germ of the kernels.
c. The kernels shattering out of the heads and falling on the ground.
d. The kernels pick up moisture and don't redry down to their original size.

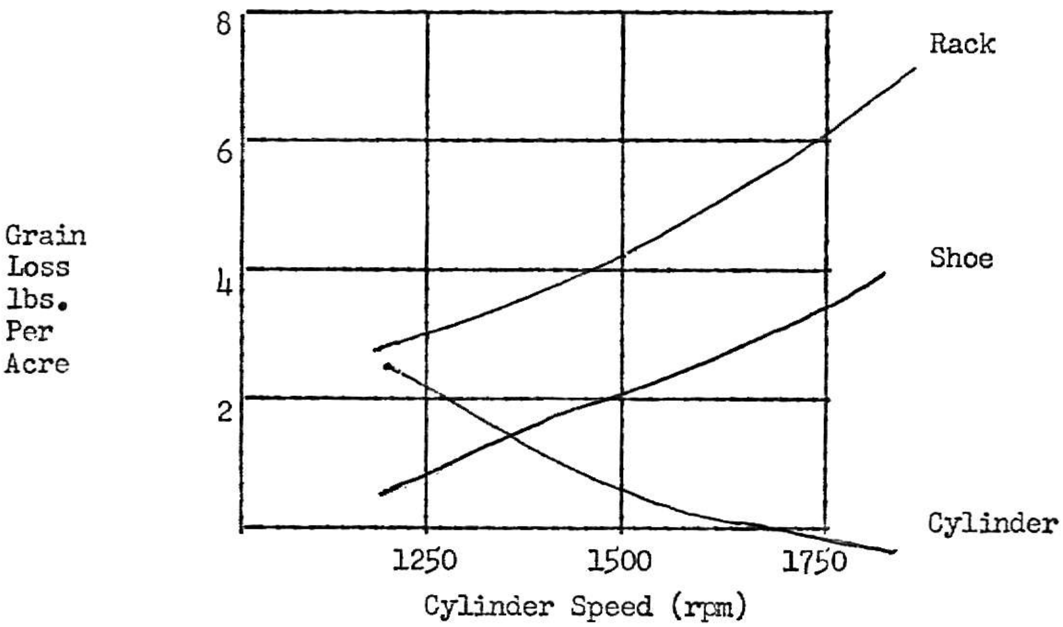
_____24. In harvesting wheat which of the following sources of loss is most affected by the height of cut?
a. cutter bar
b. rack
c. shoe
d. cylinder

_____25. When collecting a sample of grain for moisture testing, how will the moisture test of a hand threshed sample compare with the moisture test from a combined sample taken at the same time?
a. There will be no difference.
b. The hand threshed sample will have the most moisture.
c. The combine threshed sample will have the most moisture.
d. If several samples are taken first one then the other will test highest in moisture.

_____26. The straw is moved to the rear of the straw rack and out of the combine by:
a. The oscillating movement of the rack.
b. The air blast from the fan.
c. By the cylinder beater throwing the straw to the rear of the machine.
d. None of these.

_____27. There are many different items that make up the cost of owning a combine. If you have just purchased a new self-propelled combine for $10,000, which of the following items would cost you the most per year?
a. Repairs
b. Operating expense (fuel and oil)
c. Housing, insurance, taxes
d. Depreciation

____28. The following graph shows the relationship between cylinder speed and different combine losses. Four statements are listed below. Select only the one statement that can be proven by the information given in the graph. Do not select the others even though they may be true.



a. The total loss in the rack, shoe, and cylinder areas is less as the cylinder speed is reduced from 1750 rpm to 1250 rpm.
b. The rack loss increases because the higher speed breaks up the straw more and causes overloading.
c. The shoe loss is increased because increased cylinder speed causes more material to collect on the sieves.
d. The cylinder speed can be reduced by making the size of the driven pulley smaller.

Section III. Matching

A. In the blank in front of the number of each cause of loss in Column I, place the letter of the source of loss in Column II that indicates the greatest source of loss.

Column I Cause of loss	Column II Source of loss
____29. Cylinder breaking up straw too much.	a. cutter bar
____30. Sieves closed too much.	b. cylinder
____31. Reel speed too fast for ground speed.	c. rack
____32. Combine traveling too fast.	d. shoe
____33. Cylinder clearance too great.	
____34. Cylinder clearance too small.	
____35. Poor knife register.	
____36. Machine speed too slow for proper straw rack action.	
____37. Too much air blast.	
____38. Cracked grain in grain tank.	

B. In the blank in front of the number of each cause of loss or trouble in Column I, place the letter of the remedy in Column II that should correct the loss or trouble. Use a remedy only once. There are more remedies than there are causes of loss or trouble.

Column I

Cause of loss or trouble

____39. Too much foreign material in the clean grain.

____40. Material is being over threshed.

____41. Ragged and uneven cutting of crop.

____42. Reel carries straw around.

____43. Cylinder speed too fast causing over threshing.

____44. The cylinder is wrapping.

____45. Grain not threshed from heads.

____46. Material builds up on cutter bar.

____47. Combine overloaded causing too much rack loss.

____48. Clean grain is being blown over the shoe.

Column II

Remedy

a. Reduce speed of combine forward travel.

b. Adjust wearing plates so knife back is snug to guard.

c. Reduce the size of the driven sprocket or pulley.

d. Increase the size of the driven sprocket or pulley.

e. Decrease cylinder clearance.

f. Set the cylinder stripper.

g. Increase fan speed or open fan shutters to increase air blast.

h. Lower the reel height.

i. Adjust the windboards, change direction of the air blast.

j. Remove the reel bats.

k. Reduce the reel speed.

l. Increase cylinder clearance.

Section IV. Mathematical Problems

Complete the following mathematical problems. Show your work under the problem.

49. Mr. Jones is selling his soybeans direct from the combine. The local grain dealer is offering $2.00 per bushel for soybeans with the following discounts being used.

Test weight	1/2¢ for each pound or fraction under 54 lbs.
Moisture	2¢ for each 1/2% or fraction over 13%.
Splits	1/4¢ for each 5% or fraction over 20%.

Mr. Jones' soybeans have been graded as follows:

Test weight . . . . 53 pounds
Moisture 15%
Splits 30%

What is the price the grain dealer offers him? ______________

50. A vocational agriculture class took a field trip to measure the losses from a combine operating in a soybean field. Their instructor told them that four soybeans per square foot equaled one bushel loss per acre. The combine was 10 feet wide and the class ran the combine 10 feet for the test. They counted a total of 2,000 soybeans lost in the test area. What was the loss in bushels per acre? ____________ bu.

INDIVIDUAL INSTRUCTION FOR EMPLOYEES OF COMMERCIAL FERTILIZER DISTRIBUTION AND COMBINE MAINTENANCE AND ADJUSTMENT AT THE VALLEY HEIGHTS HIGH SCHOOL

by

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AN ABSTRACT OF A MASTER'S REPORT

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This study was designed to compare individualized and conventional group instructional methods for the preparation of personnel for employment in Commercial Fertilizer Distribution and Combine Maintenance and Adjustment areas of agricultural related occupations. Two individualized programmed manuals were developed with the assistance of Dr. James Albracht and Professor Paul Stevenson, both of Kansas State University. The manuals were in the areas of Commercial Fertilizer Distribution and Combine Maintenance and Adjustment.

Two groups consisting of the vocational agriculture III and the vocational agriculture IV class members were used, neither of which had studied in the two areas, and each group was involved in both methods of teaching. The teaching methods were reversed for the two groups in the second part of the study on Combine Maintenance and Adjustment.

Information concerning the background and abilities of the vocational agriculture III and the vocational agriculture IV class members was tabulated into six areas. The six areas were Verbal I.Q., Mechanical Aptitude Percentile, Overall Grade Point Average, Vocational Agriculture Grade Point Average, Biology Grade, and Size of the Home Farm. It was found there was little difference in the average scores between the two groups in background and abilities except in mechanical aptitude average percentile and in the size of the home farm. The vocational agriculture IV class members had an average test score of 65 percentile and the vocational agriculture III class members had an average test score of 37.50 percentile. The vocational agriculture III class members came from farms averaging 591.6 acres and the vocational agriculture IV class members came from farms averaging 461.6 acres.

A pre-test of fifty objective type questions was administered to each class member to measure the entry level of knowledge in each of the two areas. A post-test of the same fifty objective type questions was administered to each class member to measure the level of knowledge at the end of forty hours of instruction in each study area. The average scores and the average differences were then determined.

The first part of the study which compared teaching methods was in the area of Commercial Fertilizer Distribution. The vocational agriculture III class members used the individualized method of instruction and the vocational agriculture IV class members were taught with conventional methods of group instruction for the allotted forty hours. The average difference in the gain in the tests scores at the end of this unit was a 1.17 more for the vocational agriculture IV class members who were taught by conventional methods of group instruction.

The second part of the study compared teaching methods in the area of Combine Maintenance and Adjustment. The two groups were reversed with the vocational agriculture IV class members participating in the individualized method of instruction and the vocational agriculture III class members involved in the conventional group method. The average difference in the gain in the test scores at the end of this unit was 1.16 higher for the vocational agriculture III class members who had conventional group instruction. The results of the study indicated that there was little difference between the two teaching methods used in this study.

Since the results of this study indicated that individualized instruction was about equal to conventional group instruction in test score accomplishment then it appears that either method would be satisfactory for instruction in agricultural related occupations. If the occupational objectives of the class members differ then individualized instruction might be more suitable while a group with similar occupational objectives might have their objectives met better by conventional group instruction. The conventional group instruction was found to be slightly better in this study.

It was recommended that further studies be made of the individualized instructional materials which are available and similar types of studies should be made. It was further recommended that more individualized and group instructional materials be developed in agricultural related occupations.

The results of this study appeared to have implications for teacher education and curriculum planning. If individual objectives are identified and adequate programmed materials are available, successful instruction for agricultural related occupations should occur. As few individualized and group instructional materials appeared to be developed for classroom utilization, the instructor should be able to develop his own individualized and group instructional materials.