A COMPARISON OF THE LECTURE AND THE INDEPENDENT STUDY METHODS OF TEACHING GRAIN STORAGE ON THE FARM

by

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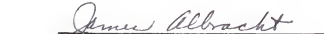

Major Professor

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John E. Tibbs

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CHAPTER I

INTRODUCTION

Cereal grains are a major source of food for humans and for animals. In terms of total pounds produced, wheat was the leading cereal grain in the world. Corn was raised on more acres and had a larger production than other cereal grain in the United States. Other important cereal grains were barley, oats, rye and sorghums. The production of cereal grain per acre had been increasing rapidly and had at least doubled in the past twenty years, largely as a result of new varieties, fertilizers and weed and insect control measures. Brooker reported that an increase in yield necessitated continued emphasis on harvesting, handling and drying to economically preserve the crop produced. (Brooker, 1974)

Many factors such as marketing schedules, transportation cost, government loans and on-farm use have caused renewed interest in on-farm storage of grain. Holmes emphasized that farm stored grain needed planned management. (Holmes, 1973)

Other factors which influenced farmers to store grain were the low price of grain at harvest time and having to cut grain early because of inclement weather conditions. Under these conditions, farmers lose thousands of dollars each year from improperly storing their grain. This loss was due to lack of knowledge in handling cereal grain

storage in the areas of checking grain temperature, the time for insect control, bacteria and mold growth which are caused by changing weather conditions. Smith reported that for on-farm stored grain eighty-eight percent had some insect damage. (Smith, 1978)

Problem

Brooker wrote that the annual on-the-farm grain storage losses in the United States amounted to four and one-half percent. With this serious loss of grain in the United States and to the individual farmer, there was great economic loss for civilization. The author, having this knowledge of grain losses while in storage, made a survey of farmers in the area through personal contact to discuss their grain storage problems. The problem that emerged was that the farmers lacked the management and technical knowledge needed for successful grain storage. The subject for this research then was to teach the farmers how to store their farm grains properly. The author desired to test which of two teaching methods, lecture or independent study, would be the most effective for teaching this knowledge to the farmers twenty to seventy years of age. (Brooker, 1974)

Need

Farmers experienced a great loss of grain in grain storage bins that hold two thousand bushels or more of cereal grains. Large storage bins need more management

techniques to control heating and insect damage, than do storage bins for grain holding less than two thousand bushels. Weather interfered with the optimum time of harvest at least once in every three years for all areas of Kansas where grain sorghum, wheat, corn and soybeans were grown. Without commercial or on-farm drying facilities, a large portion of these crops were lost in the field while waiting for the grain to become dry enough to store or sell on the grain market. Holmes reported that crop losses occurred from birds, wind scatter, fallen stalks, vines, and general grain quality deteriorated. In Kansas, many variables, such as hauling distance to a commercial drier, scheduling of drying time, availability of hauling trucks, commercial drying costs and labor problems have justified on-farm drying for a wide range of crops. (Holmes, 1974)

With these variables confronting the farmer, the research indicated a need for education in on-the-farm grain storage and handling. The goals to be accomplished by the study were: The producer should be able to check stored grain for moisture, check the grain for heating, and be able to control the heating of grain. The farmer would also be able to understand the different methods of grain drying systems.

Research in the area of adult farmer teaching methods can be beneficial for educational programs such as vocational agriculture, Agriculture Extension Service, and Federal Government Programs where there was a need for up-dating

farming methods. A large amount of the information made available to farmers was not being successfully digested. This research compared the face-to-face elective method of learning to that of independent study for determining the most learning.

Definition of Terms:

The terms utilized in this research study will be defined as follows: (Good, 1973)

1. Adult Agriculture class: one of a group of classes in agriculture evening school.
2. Adult Farmer: a status of relative stability as a farm operator, whether owner, tenant or manager.
3. Analysis of Variance: a statistical method of segregating from comparable groups of data the variance in the dependent variable traceable to specified classes of groups.
4. t-test: a statistical test that allows for comparing two means to determine the probability that the difference between the means is a real difference rather, than a chance difference.
5. Multiple Regression: a linear equation for predicting a criterion or dependent variable from two or more independent variables, the coefficient of the independent variables being so chosen as to make the sum of the squares of the difference between the actual and the predicted values of the dependent

variable a minimum, an equation expressing the relations between a dependent variable and a number of independent variables.

6. Pearson Correlation Coefficient: a pure number limited by the value + 1.00 and - 1.00 that expresses the degree of relationship between two variables.
7. Grain storage: the placing of grain in a container of undetermined size and held there maintaining grain quality by controlling moisture, insects and temperature until grain is needed for use at some future time.
8. Independent Study: study carried on with a minimum or a complete absence of external guidance.
9. Lecture Method: an instructional procedure by which the lecturer seeks to create interest to influence, stimulate or mold opinion by the use of the verbal message with minimum of class participation.
10. School District: a state government unit within a definable boundary which was formed for the express purpose of educating children of school age within that boundary.

Research Hypotheses

To accomplish the above set of objectives two methods of teaching were used to determine whether the lecture

method of teaching or the independent study method was most effective. The subjects for this study were adults who were well established in the farming occupation. Previous experience indicated the lecture method of teaching was more widely used than the independent study method.

The following three hypotheses were tested in this research:

1. There is no significant difference in the test scores for the lecture and independent study methods of teaching grain storage to farmers.
2. There is no significant difference in the farm storage test scores of farmers when compared by age, acres, bushels, education, farm experience and storage experience.
3. There is no significant relationship between the predictor variables of age, acres, bushels, education, farm experience, storage experience and test scores.

CHAPTER II

REVIEW OF RELATED LITERATURE

A review of the literature pertaining to methods by which people learn indicated that no one method exceeded over other methods. The common method of knowledge was by the use of the lecture method of teaching.

Kuschenbaun in a report on an experimental research into learning methods stated that "For richer or poorer the lecture was, and always had been, the mainstay of college teaching" "It can be a truly exciting cognitive and personal experience if done well." (Kuschenbaun, 1969)

Belzer conducted an experiment designed to compare the traditional lecture and group-paced multimedia non-lecture method to compare the speed and retention of knowledge. The lecture group was found to be better overall, and the lecture method and quiz combination of instruction and evaluation produced the highest degree of academic success and lowest rate of attrition. (Belzer, 1976)

Research on the lecture method of teaching indicated it could be a faster method in learning information than other methods used. McKeachie concluded that lecturing could sometimes, perhaps because of increased rate of transmission, help students learn more detailed information faster than in a discussion-type situation. (McKeachie, 1969)

One reason for this increase in learning could be due to the attention of the student. Reed, in a study on basic educational psychology, conducted a study on the effects of microteaching by direct and non-directive methods on the achievement and attitudes in basic educational psychology. The results indicated that attitudes were more favorable as a result of the lecture methods than the microteaching method. (Reed, 1970)

The lecture method of classroom teaching was still, the most effective method. Dornish did a study with a group of subjects ranging in age from fifteen to thirty years of age in the field of effectiveness of instructional television as a supplement to the face-to-face teaching of functional illiterates at the University of Lehigh. A group of subjects were taught by lecture and another group by instructional television and no significant difference in achievement gain emerged between the groups except that there was a larger drop-out rate of subjects for the instructional television method. (Dornish, 1969)

The research studies that have been reviewed for independent methods of learning indicated that no significant improvement over the lecture method was evident for the general population.

Belzer of Pasadena City College in a study covering the traditional lecture and non-lecture methods of teaching, concluded that, the individual study method did not produce

the same degree of academic success that the traditional lecture method had produced. (Belzer, 1976)

At Wisconsin University, Pellett compared the effectiveness of the educational telephone network and face-to-face lecture. In this experiment, it was found that there were no significant differences between the lecture and remote training methods of instruction. (Pellett, 1970)

Halverson reported that a college sociology class at Spokane Community College, conducted a study on the cognitive approach to teaching introductory sociology versus the traditional lecture-discussion method to determine which of the two methods would produce the best academic success. In this experiment with college students it was found that there was no significant difference between the classes for the lecture and the cognitive (system-analysis) methods of teaching sociology. (Halverson, 1969)

Olmstead did an experiment with the subject of "Theory and State of the Art of Small-Group Method of Instruction." In this study, a small group of six subjects and a control group for the standard size of thirty students in a lecture class was used. The findings in this study indicated that the small group method of teaching adults was no more effective than the lecture method for transmitting information and concepts. (Olmstead, 1970)

CHAPTER III

METHODS

Subjects

The subjects utilized in this investigation consisted of sixteen male adults who were actively engaged in farming and storing of grain. The subjects were asked to participate in an educational course of study for on-the-farm grain storage and handling. These subjects were informed of the location, amount of time required for participation, and assured that their identities would remain anonymous. After agreeing to participate, the subjects were scheduled to meet for class at the Udall High School Vocational Agriculture Building. The class for the lecture method consisted of a two night session of three hours each and the third night of one hour for testing. Night classes were selected for the convenience of the subjects and the researcher. The independent study group met with the researcher for orientation and given independent study materials and were told when and where to meet for the test. The subjects were selected from the telephone directory for the Udall School District 463 in Kansas.

People with rural addresses were chosen and the names were sorted so only names of farmers that operated over one hundred sixty acres or more were considered. Names were then drawn from this list and contacted by a questionnaire

until sixteen subjects were selected and agreed to participate.

Materials

The instrument for the research was compiled by the researcher. The unit was developed by using the most effective literature available. At this time, specialists in grain drying at Kansas State University served as a panel of experts to develop and refine the unit used in this study.

The author had extensive experience in the storage of farm grains. The author was a practicing farmer and had consulted specialists in grain storage equipment and farmers who had used the equipment to store grain in this study.

The instrument was proofread by Agriculture Education Staff members at Kansas State University. The author was an instructor of Vocational Agriculture at Udall High School and had been employed there for the previous fourteen years. At the end of the study, subjects were presented with a card stating the approximate time for the analysis of the data. The subjects were given phone numbers where they could call to obtain information concerning the results of the study.

Procedure

The research was conducted in School District 463. The class using the lecture method of instruction was held in the Udall High School Vocational Agriculture classroom. The independent study group met once with the author to receive information for conducting the study and the materials needed

to complete the study. The subjects were also given the length of time allocated for the study and when and where to report for testing.

At the first meeting the subjects were informed of their rights as human subjects for a research study and given a written consent form to be signed allowing the researcher to use the data which was obtained.

The material used in the study was the same for the lecture and independent study groups. Each group received the same amount of time for covering the material, and for taking the test which was given to both groups at the same time and location. The same grading system was used to grade all tests.

The research design for this study was the post-test-only control group design. This design was selected because it gave controls for selection and mortality.

The design was ideal, in that it gave the best control for threats of validity and sources of bias. In this study there was random selection from the farm population of Unified School District 463 and random assignment to groups.

The post test given to each group consisted of twenty-five multiple choice questions. The test papers were graded and recorded by the author to insure the subjects privacy. After the data was collected an analysis of variance of the mean test scores was made by using the t-test.

The Pearson Correlation of Coefficients statistical test was used to determine significant relationships of predictor variables. The level of significance for this research was set at the .05 level. After all data had been collected and coded, it was placed on a fortran sheet. The data collected from the study was analyzed by using the computor at Kansas State University.

CHAPTER IV

Information in Chapter 4 contained an analysis of the test scores for the lecture and independent study methods of instruction. Also included is an analysis of the factors of age, acres, bushels, education, farm experience and storage experience. The relationship of the factors to each other are also included.

Data in Table I indicated that the mean score on the grain storage test for the lecture group was 79.5 and the mean score for the independent study group was 72.5. The t-value of 1.41 was not significant and the null hypothesis number 1. "There is no significant difference in the test score for the lecture and independent study methods of teaching grain storage to farmers," was retained.

TABLE I

t-TEST ANALYSIS OF SCORES
FOR THE
LECTURE AND INDEPENDENT STUDY METHODS
OF TEACHING

Group	Mean	Standard Deviation	Standard Error	t Value	Degree of Freedom	t Probability*
Lecture	79.5	10.99	3.89	1.41	13.28	0.181
Independent Study	72.5	8.67	3.07			

* t-value = 2.145 P .05 (Tuckman, 1978)

Information in Table 2 analyzed the effect of age, acres, bushels, education, farm experience and storage experience with the test scores for the lecture and independent study methods of instruction. Although the mean age for the lecture group was 45.0 and the mean age of the independent study group was 35.9 the t-value for age was 1.14. This t-value was less than the significant t-value of 2.145 at the .05 level and therefore age was not a significant factor. The mean acres for the lecture group was 902.5 and the mean acres for the independent study group was 737.3 with a t-value of 0.49 and was not significant. Farmers in the lecture group stored 7,437.5 bushels of grain and the farmers in the independent study group stored 3,919.1 bushels. The t-value for bushels stored was 1.48 and was not significant. The mean years of educational attainment for the lecture group was 13.3 and for the independent study group 12.8 years of education. The t-value of 0.67 for age was not significant. Farm experience indicated that the lecture group had produced grain for 27.1 years and the independent study group were producers for 19.1 years. No significant difference occurred between the farm experience and farm storage test scores. For farm storage experience the lecture group indicated 15 years of experience and the independent study group 9.8 years with no significant difference found for storage experience.

Since none of the factors age, acres, bushels, education, farm experience and storage experience significantly affected the test scores hypothesis number 2, "There is no significant difference in the farm storage test scores of farmers when compared by age, acres, bushels, education, farm experience and storage experience," was retained.

TABLE 2

t-TEST ANALYSIS COMPARING

VARIABLES BETWEEN GROUP

Variable	Group	Mean	Standard Deviation	Standard Error	T Value	Degree of Freedom	T Probability
Age	Lecture	45.0	19.39	6.86	1.14	11.38	0.28
	Ind. St.	35.9	11.49	4.06			
Acres	Lecture	902.5	648.99	229.45	0.49	13.96	0.63
	Ind. St.	737.2	686.61	242.95			
Bushels Stored	Lecture	7437.5	4593.96	1624.14	1.48	13.93	0.16
	Ind. St.	3919.1	4930.46	1743.18			
Education	Lecture	13.3	1.48	.053	0.67	14.00	0.51
	Ind. St.	12.8	1.49	.053			
Farm Experience	Lecture	27.1	14.18	5.00	1.29	12.86	0.22
	Ind. St.	19.1	10.43	3.69			
Storage Experience	Lecture	15.0	12.20	4.31	1.05	10.56	0.32
	Ind. St.	9.9	6.38	2.26			

T-Value = 2.145 $P < .05$ (Tuchman, 1978)

The Pearson correlation of coefficients was used to test hypothesis number 3. "There is no significant relationship between the predictor variables of age, acres, bushels, education, farm experience, storage experience and test scores." Correlation matrixes were developed to display the data for the comparing predictor variables for all students (Table 3), lecture group (Table 4), and independent study group (Table 5).

Information in Table 3 listed the data for the predictor variables of age, acres, bushels stored, years of education, years of farm experience, years of storage experience and test scores for all subjects. The probability score of (.4973) (Tuckman, 1978) was significant at the .05 level using the Pearson correlation of coefficient statistical test. It was found that eight of the 21 comparisons had significant relationships at the .05 level. A significant relationship was found between test scores and acres farmed (.5058), and between test scores and bushels stored (.5426). There was a significant relationship between age and education (-.5073), age and farm experience (.9713) and between age and storage experience (.7444). A significant relationship existed between acres and bushels stored (.8527). There was also a significant relationship between education and farm experience (-5101), and a significant relationship existed between farm experience and storage experience (.7207).

TABLE 3

CORRELATION MATRIX FOR ALL SUBJECTS

Scores	1.000						
Age	-.2818	1.000					
Acres	.5058*	-.0696	1.000				
Bushels	.5426*	-.0053	.8527*	1.000			
Education	.0714	-.5073*	.2105	.3427	1.000		
Farm Experience	-.1663	.9713*	-.0480	.0084	-.5101	1.000	
Storage Experience	-.2669	.7444*	.1595	.1667	-.3410	.7202*	1.000

	Scores	Age	Acres	Bushels	Education	Farm Experience	Storage Experience

*Significant at $P < .05$ Level (.4973) (Tuckman, 1978)

Information in Table 4 reports the Pearson Correlation Coefficient scores for the lecture group. A probability score of .7067 (Tuckman, 1978) was significant at the .05 level. Four of the 21 comparisons indicated significant relationship. A significant relationship was found between age and farm experience (.9395). There was a significant relationship between acres and bushels stored (.8949). A significant relationship existed between years of education and bushels stored (.7496), and between education and years of farm experience (.7252).

TABLE 4

CORRELATION MATRIX FOR LECTURE GROUP

	Score	Age	Acres	Bushels	Education	Farm Experience	Storage Experience
Score	1.000						
Age	-0.4351	1.0000					
Acres	0.5709	-0.0767	1.000				
Bushels	0.3795	-0.2287	0.8949*	1.000			
Education	0.1440	-0.6118	0.5448	0.7496*	1.000		
Farm Experience	-0.2094	0.9395*	-0.0488	-0.2577	-0.7252*	1.000	
Storage Experience	-0.1950	0.6056	0.1237	-0.1715	-0.3499	0.5995	1.000

* Significant at the $P < .05$ level (.7067) (Tuckman, 1978)

Data in Table 5 indicated four of the 21 comparisons had significant relationships for the independent study group. Significant relationships had a probability score of .7067 (Tuckman, 1978) or greater. Significant correlations were found between age and years of farm experience (.9886), and between age and years of storage experience (.7602). A significant relationship existed between acres and bushels stored (.8472), and between years of farm experience and years of storage experience (.7430).

TABLE 5

CORRELATION MATRIX FOR

INDEPENDENT STUDY GROUP

	Score	Age	Acres	Bushels	Education	Farm Experience	Storage Experience
Score	1.000						
Age	-0.4343	1.000					
Acres	0.4423	-0.1446	1.000				
Bushels	0.5650	-0.0706	0.8472*	1.000			
Education	-0.0961	-0.6139	-0.1812	-0.1750	1.000		
Farm Experience	-0.3811	0.9886*	-0.1368	-0.0262	-0.5370	1.000	
Storage Experience	-0.4985	0.7602*	0.1451	0.2205	-0.4721	0.7430*	1.000

*Significant at the $P < .05$ level (.7067) (Tuckman, 1978)

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

On-the-farm grain storage by farmers reached a level of 10 billion bushels in 1979, as reported by Secretary of Agriculture Bergland. (Farm Journal, 1979) Improper storage for this amount of grain would be a serious loss to the farming community through the world.

This research was conducted to determine which of two methods of instruction for teaching on-farm grain storage to adult farmers was the most effective. The two methods of instruction utilized were the classroom lecture and independent study in the home. The amount of learning was determined by analyzing the test scores for a multiple choice test.

The subjects for this research were randomly selected from the adult farm population of School District 463, Udall, Kansas. The random selection of subjects were drawn from the farmers who tilled 160 acres or more. The ages of the adult farmers ranged from 20 to 67 years.

The lesson plan material and the test were developed by the author with the assistance and advice of grain storage manufacturers and grain storage specialists at Kansas State University. The lesson plans were proof read

by Agriculture Education Staff members at Kansas State University. The author was the instructor of Vocational Agriculture at Udall High for the previous fourteen years. Each subject was given lesson plan material plus necessary Kansas State University Cooperative Extension bulletins on grain storage. The lecture and independent study groups of farmers met together in an orientation session in December, 1979. The materials for the assignments were handed out and the length of time for study and testing was given. The independent study group worked at home while the lecture group met with the author, as their instructor, in two, three hour class meetings. Both the lecture and independent study groups met together to take the test, following the completion of the instructions.

The hypothesis number 1 "There is no significant difference in the test scores for the lecture and independent study methods of teaching grain storage to farmers" was retained. Although the test scores for the lecture method were higher 79.5 to 72.5 there were no significant difference in the test scores.

The hypothesis number 2 "There is no significant difference in the farm storage test scores of farmers when compared by age, acres, bushels, education, farm experience, and storage experience" was retained. Hypothesis number 3 stated "There is no significant relationship between the predictor variables of age, acres, bushels, education, farm experience, storage experience and test scores." Twenty-one

comparisons were made for the combined lecture and independent study groups, and for the lecture and independent groups separately.

There were eight of twenty-one comparisons for the combined groups where significant relationships existed using the Pearson Correlation Coefficients statistical test. Significant relationships occurred. Significant relationships were found as follows: test scores and acres formed (.5058), test scores and bushels stored (.5426), age and education (-.5073), age and farm experience (.9713), age and storage experience (.7444), acres and bushels stored (.8527), education and farm experience (-.5101), and farm experience and storage experience (.7207).

There were four of twenty-one comparisons with significant relationships for the lecture group. Significant relationships were found between age and farm experience (.9395), acres and bushels stored (.8949), education and bushels stored (.7496), and education and years of farm experience (.7252).

Four of twenty-one significant relationships were indicated for the independent study group. The significant relationships were between age and years of farm experience (.9886), age and years of storage experience (.7602), acres and bushels stored (.8472), and between years of farm experience and years of storage experience (.7430).

Conclusions

This research was conducted with subjects from one unified school district. The author concluded that the farmers were highly motivated and performed well for both the lecture and independent study methods of instruction. All subjects of this research were involved with grain storage and were very interested in the subject matter. Farm prices for grain commodities were depressed and farmers were looking at farm grain storage for increased farm profits.

Recommendations

As a result of this study the author recommends:

1. That the study be replicated at a time when the farm prices were not depressed.
2. That a similar study be conducted using the same variables, but with a larger population.
3. That further studies include additional methods of instruction.

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APPENDICES

APPENDIX A

TEACHING UNIT

FARM GRAIN DRYING AND HANDLING

TERMINAL OBJECTIVES

Upon completion of this unit student will be able to sell grain at its highest quality without weed infestation and without heating. This objective will be considered completed upon achieving a satisfactory test score on this unit.

SPECIFIC OBJECTIVES

After completion of eight hours of instruction the student should be able to:

1. Know terms used in grain drying.
2. Determine the economic significance of maintaining grain quality.
3. Accurate check of grain moisture.
4. Use a thermometer for checking heating in grain.
5. Describe moisture migration in grain.
6. Control grain heating.
7. Describe a procedure for maintaining stored grain.
8. Discuss the methods of drying grain.

FARM GRAIN DRYING AND HANDLING

INFORMATION SHEET

I. Terms and Definitions

A. Aeration -- Movement of air through grain to keep down heating.

B. Axial Fan -- Fan blade mounted to motor shaft; fan has large center hub (Transparency No. I)

C. Centrifugal Fan -- Fan wheel of a typical backwand curved blade. (Transparency No. I)

D. C.F.M. -- Cubic feet per minute.

E. Equilibrium of moisture -- A condition where moisture in the grain is equal to moisture in the air surrounding the grain.

F. Grain moisture -- Amount of water in grain to the amount of grain dry matter; given in percent.

G. High temperature drying -- drying of grain with temperatures of 100 to 140 degrees.

H. Low temperature drying -- drying of grain with temperatures of 20 to 40 degrees.

I. Moisture migration -- The movement of moistures from grain heating in one location to cool grain in another location of bin.

J. Natural air dry -- Drying of grain with air from outside; no added heat.

K. Plenum -- A duct which connects the fan or heating unit to drying floor.

L. Relative Humidity -- Amount of water in the air at a specific temperature.

M. Solar drying -- Collecting the sun's energy and using it to heat air for drying.

N. Static pressure -- Pressure required to force air through grain; this pressure expressed in inches of water.

O. Vapor pressure -- A condition when moisture will move from one item to another.

P. Very low temperature drying -- Drying of grain with temperature of air between 5 to 8 degrees.

Q. Vane Axial Fan -- Has guide vane fan blades that act to straighten air leaving fan which reduces energy loss. (Transparency No. I)

II. Methods of maintaining quality of stored grain

A. Aeration

B. Natural air drying

C. Low temperature drying

D. High speed drying

III. Problems with stored grain

A. Molds, bacteria, insects and mite infestation. Insect prevention.

1. Store only dry grain using weather-tight rodent-proof bins, preferable of steel.

2. Clean out all bins, spray walls and floor before filling bins with grain.

3. Clean up and dispose of litter and waste grain around granaries

4. Treat grain for insects while filling granary.

5. Inspect stored grain on regular schedule for new infestation of insects.

6. Molds and bacteria are controlled in grain storage by keeping

   a. Moisture of the grain below 13.50

   b. The relative humidity of the air around grain below 60%

   c. The temperature of grain below 70°

B. Control temperature of grain.

C. Control of moisture migration in dry grain (Transparency No. 2).

IV. Aeration

A. To keep grain temperature uniform in bin with the outside temperature.

B. To keep grain temperature at safe level. (NOTE: Usually 1/10 C.P.M. of air per bushel needed.)

C. To control moisture migration in stored grain. (Even grain stored at 12% will need aeration.)

D. Basic rules for aeration are:

1. Aerate heating grain to cool regardless of weather conditions.

2. Grain above 1% moisture will need continuous aeration.

3. In cold periods keep grain below 40 degrees F but do not freeze.

4. Aerating dry grain for long periods at a low humidity and temperature could overdry grain resulting in test weight loss.

V. Natural air drying

A. Management knowledge needed

1. Understanding of relationship between temperature and humidity of the air as related to grain moisture content.

2. Rate of mold growth at certain temperature and humidity.

3. Grain depth and fan characteristics on rate of air flow.

4. Speed of drying and power requirements.

5. Difference between grain species.

B. Grain equilibrium (Transparency No. 3)

1. The relative humidity of the air surrounding the grain.

2. Drying accomplished when humidity of outside air is below the humidity of the grain.

3. Drying zone (Transparency No. 3).

a. Drying zone -- the area where evaporation of grain moisture is taking place.

b. Movement of drying zone through the grain is critical; it must move at such a speed to avoid mold growth. (NOTE: Speed of drying zone depends mostly on size of fan, but humidity and temperature have some effect.)

VI. Low temperature drying

A. Low temperature drying is drying with air eight degrees above the natural air.

B. Electric heat for five to eight degree temperature raise over natural air.

C. Use of propane or other fuels for twenty to forty degree temperature rise.

D. Advantages and disadvantages of low temperature drying are:

1. Advantages

a. Low cost drying

b. Save crops from bad weather

2. Disadvantages

a. More time in management

b. Equipment cost

VII. High temperature drying

A. Temperature range one hundred to one hundred forty degrees. (NOTE: Soybeans no more than one hundred degrees drying temperature.)

B. Can dry grain in hundreds of bushels an hour.

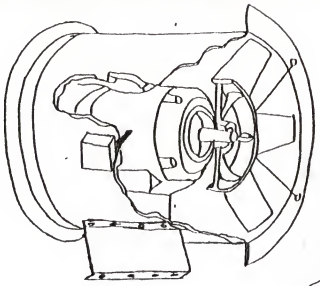
C. Types of high speed driers (Transparency No. 6).

1. Layer-in-bin drier

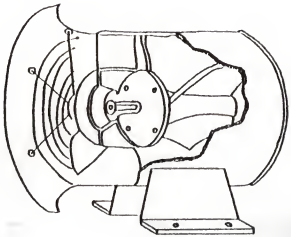
2. Batch-in-bin drier

3. Column batch drier

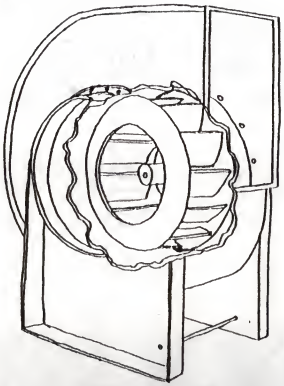
4. Continuous Column drier



AXIAL FAN

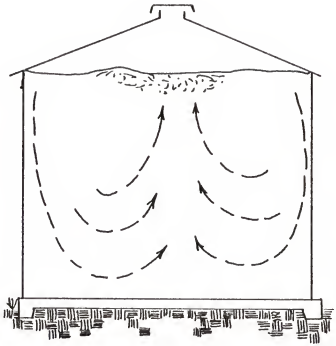


VANE AXIAL FAN

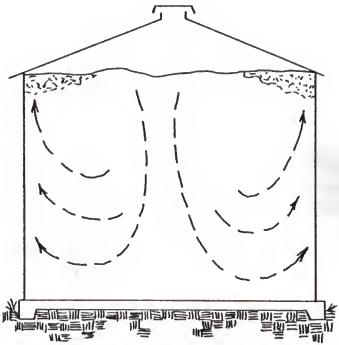


CENTRIFUGAL FAN

MOISTURE MIGRATION



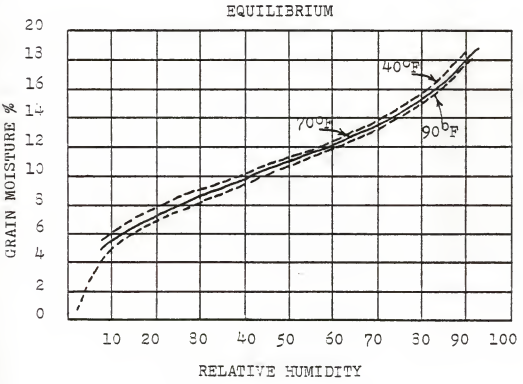
Inside grain cold
Outside bin warm

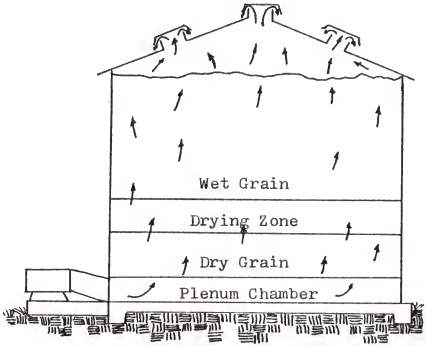


Outside bin cold
Inside grain warm

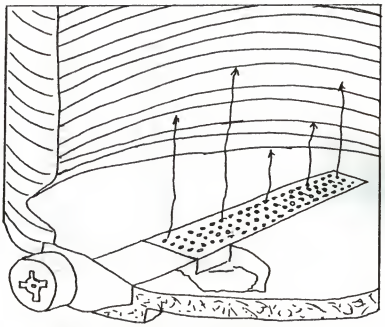
Relative Humidity	Barley	Shelled Corn	Oats	Grain Sorghums	Soybeans	Wheat
90%	19.5	19.0	18.5	18.5	18.5	20.0
75%	14.5	14.5	13.5	15.0	13.0	14.5
60%	12.0	13.0	11.5	12.0	9.5	12.5
45%	10.0	10.5	9.5	10.0	7.5	10.5
30%	8.5	8.5	8.0	8.5	6.5	8.5
15%	6.0	6.5	5.5	6.5	5.0	6.5

Moisture content of grain in equilibrium with humidities of air-air temperature 77°F.





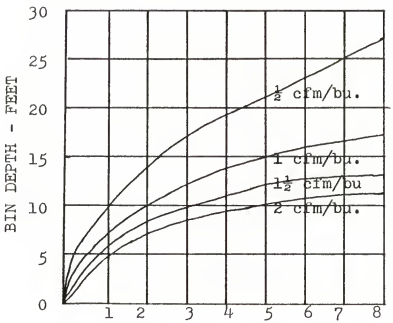
Drying Bin Cross Section



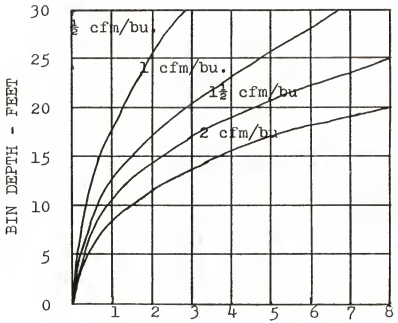
Aeration System - Recessed Floor

Perforated section of floor 18" wide permits air tube pushed through the grain and exhausted through roof outlets.

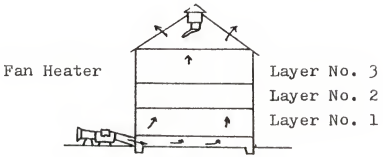
STATIC PRESSURE-INCHES-GRAIN SORGHUM



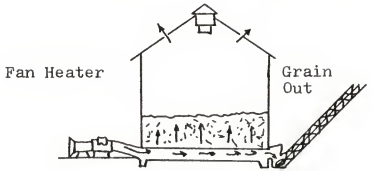
STATIC PRESSURE-INCHES-SOYBEANS



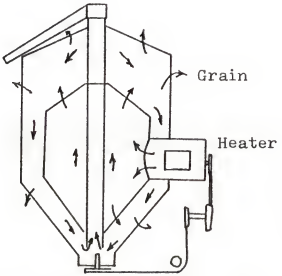
Static pressure of grain
in a bin per foot of depth



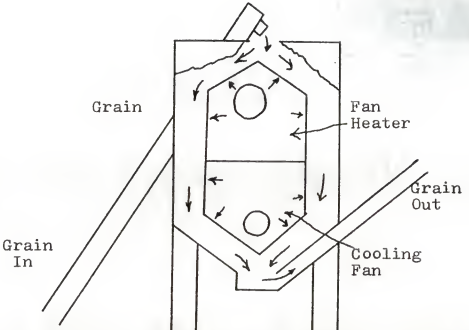
Layer-In-Bin Drying



Batch-In-Bin Drying



Column Type Drier



Continuous Column Drier

APPENDIX B

TEST AND ANSWERS

_____ 1. Aeration is the movement of air through grain to (1) Keep down heating of grain (2) Dry grain (3) Control insects.

_____ 2. A condition where moisture in grain is equal to moisture in air surrounding the grain is called (1) Grain moisture content (2) Equilibrium of moisture (3) Vapor Pressure.

_____ 3. The movement of moisture from grain heating in one location to cool grain in another location of bin is called (1) Moisture migration (2) High relative humidity (3) Too much grain moisture.

_____ 4. Drying of grain at 100 degree temperature is known as (1) Natural air drying (2) Low temperature drying (3) High temperature drying.

_____ 5. The amount of water in the air at a specific temperature is known as (1) Vapor pressure (2) Equilibrium of moisture (3) Relative humidity.

_____ 6. Very low temperature drying of grain is using a temperature range of (1) 20 to 40 degrees (2) 100 to 140 degrees (3) 3 to 8 degrees.

_____ 7. To aeration grain in the bin, a fan should move (1) 1 cubic foot of air per bushel (2) 1/10 the cubic foot of air per bushel (3) 3 cubic feet of air per bushel per minute.

_____ 8. When storing grain for the best control of molds and bacteria, the temperature should be below (1) 100 degrees (2) 80 degrees (3) 70 degrees.

_____ 9. Grain stored above 18 per cent moisture must be aerated (1) once a week (2) Continuously (3) Every other day.

_____10. Aerating dry grain for long periods at a low humidity and temperature could (1) Over dry grain (2) Add moisture to grain (3) Cause moisture migration.

_____11. Normal air and moisture movement through grain in a storage bin is (1) Up (2) Down (3) Static.

_____12. After grain has been in storage long enough for the grain temperature to reach 55 degrees, insects will be found (1) Along the edge of grain bin (2) At the center of grain bin (3) At the bottom of grain bin.

_____13. The migration of moisture in grain can be expected when one of the following sets of conditions exists. (1) When one of the grain and outside temperature are the same (2) When the temperature of the grain is different from the outside temperature (3) When the grain temperature and relative humidity are the same.

_____14. The dew line is located (1) At the top of the drying zone and wet grain (2) At the top of grain

in grainary (3) Between the drying zone and dry grain.

_____15. Fans used to aerate or dry grain should be purchased by (1) The cubic feet moved per minute and the static pressure developed (2) The horsepower of the fan (3) The size of the fan blade.

_____16. The most frequent type fan used for the on-the-farm grain storage is the (1) vane axial fan (2) Centrifugal fan (3) Axial fan.

_____17. Which one of the following insects spins a web on top of the stored grain? (1) Granary weevil (2) Lesser grain borer (3) Indian-Mealmoth.

_____18. Before putting grain in a granary for storage the granary should be sprayed with. (1) Carbon tetrachloride (2) Methylbromide (3) Malathion

_____19. When the Indian-Mealmoth larvae are found in stored grain the insecticide to use is (1) malathion (2) tear gas (3) dichlorvos resin strip.

_____20. The Indian-Mealmoth can be controlled by the use of (1) tear gas (2) dichlorvos resin strip (3) malathion.

_____21. When treating stored grain for insects, it should be treated when grain temperature is above (1) 40 degrees (2) 55 degrees (3) 70 degrees.

_____22. The recommended fumigant for farm stored grain is (1) Methyl-bromide plus ethylene diromide (2) Calcium ajanide (3) carbon bisulfide.

_____23. The movement of the drying zone through the grain mass is critical because of (1) the development of mold growth (2) over drying of grain (3) The increase in expense of running the fan.

_____24. The speed of the drying zone movement depends mostly on? (1) Humidity (2) Temperature (3) size of fan.

_____25. In the management of stored grain the most important item to keep check on is (1) the grain temperature (2) grain moisture (3) air movement thru grain.

TEST ANSWERS

1. 1
2. 2
3. 1
4. 3
5. 3
6. 3
7. 2
8. 3
9. 2
10. 1
11. 1
12. 2
13. 2
14. 1
15. 1
16. 3
17. 3
18. 3
19. 2
20. 2
21. 3
22. 1
23. 1
24. 3
25. 1

APPENDIX C

QUESTIONNAIRE

UNIFIED SCHOOL DISTRICT 463
Udall, Kansas 67146

My name is John E. Tibbs, my present position is the Vocational Agriculture instructor at the Udall High School. At this time I am working on a Master's Degree at Kansas State University. My Master's work is being monitored by Dr. James Albracht of Adult Education, Kansas State University.

I will be conducting classes in the problem of on-the farm grain storage. Your cooperation will be deeply appreciated. These classes will require approximately six hours of time. If you would like to attend please sign below and you will be notified of time and place.

You will be asked to answer some questions, the answers you give will be used in a roster of mixed numbers. All the information that you give will be strictly confidential and only seen by me and after recording is done will be destroyed.

Please answer the following questions.

1. Your age is _____
2. Educational level, circle the highest grade attended 8, 12, 16.
3. Size of farm owned and rented _____
4. The average number of bushels of grain stored each year _____
5. Number of years in farming _____
6. Number of years of experience in storage of grain _____

I would like permission to use the above statistics and test over the class material you have been given in my study.

Your signature _____

Thank you for your time and assistance.

John E. Tibbs

A COMPARISON OF THE LECTURE AND INDEPENDENT STUDY METHODS OF TEACHING GRAIN STORAGE TO FARMERS

by

John E. Tibbs

B.S., Kansas State University, 1965

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the
requirements for the degree
MASTER OF SCIENCE
Agriculture Education

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1979

ABSTRACT

This research studied two methods of teaching to determine which method was the most effective for adult farmers in obtaining information for efficient grain storage. The classroom lecture and the home independent study methods of instruction were used in the study. The lesson plan material and test for grain storage utilized in this research was developed by the author. Data was collected from 16 adult farmers from Unified School District 463, Udall, Kansas.

The predictor variables that were used in the study included: age of subject, educational level, grain storage experience, years of farming experience, number of acres farmed and number of bushels stored. Two statistical treatments were applied to the data collected. The test scores and the significance of predictor variables between groups were analyzed by the use of the T-Test. The relationship between predictor variables was tested by the use of the Pearson Correlation of Coefficients.

The hypotheses of this research were:

1. There is no significant difference in the test scores for the lecture and independent study methods of teaching grain storage to farmers.

2. There is no significant difference in the farm storage test scores of farmers when compared by age, acres, bushels, education, farm experience and storage experience.
3. There is no significant relationship between the predictor variables of age, acres, bushels, education, farm experience, storage experience and test scores.

The T-Test was used to determine the statistical significance of hypotheses one and two. The Pearson Correlation of Coefficients was used to test the statistical significance of hypothesis three.

Although the mean test scores for the lecture method (79.5) was higher than for the independent study method (72.5) no significant difference occurred and hypothesis number 1 "There is no significant difference in the test scores for the lecture and independent study methods of teaching grain storage to farmers" was retained.

There were no significant differences for the factors of age, acres, bushels, education, farm experience and storage experience and test scores so hypothesis number 2 "There is no significant difference in the farm storage test scores of farmers when compared by age, acres, bushels, education, farm experience and storage experience" was retained.

Hypothesis number 3 stated "There is no significant relationship between the predictor variables of age, acres, bushels, education, farm experience and storage experience. The hypothesis was rejected for 16 of the 63 comparisons.

The hypothesis was rejected for eight of 21 comparisons for the combined lecture and independent study groups. Factors where significant relationships existed included: test scores with acres and bushels stored; age with education, farm experience, and storage experience; acres with bushels stored; education with farm experience; and farm experience with storage experience.

Four of 21 comparisons for the lecture group had significant relationship. Significant relationship occurred between: age and farm experience; acres and bushels stored; and education with bushels stored and years of farm experience.

The independent study group had four of 21 comparisons where significant relationship existed. The significant relationships were: age and farm experience and storage experience; acres and bushels stored, and farm experience and storage experience.

As a result of the study the author recommended that the research be replicated with larger population, at a time when farm prices were not depressed, and that additional instructional methods be included.