COMPLETE ENERGY CORN SILAGE CONCEPTS DEVELOPED FOR EXTENSION PRESENTATION TO CATTLE FEEDERS

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ABSTRACT

COMPLETE ENERGY CORN SILAGE CONCEPTS DEVELOPED FOR EXTENSION PRESENTATION TO CATTLE FEEDERS

by Carl G. Silvernail

Purpose

The purpose of this presentation has been three-fold: (1) to summarize reasons why corn silage usage in the beef feedlot is increasing, (2) to present information available on complete energy silage and how it can be produced, and (3) to develop an extension presentation to acquaint cattle feeders with this information on corn silage feeding.

Problem

Many cattle feeders unnecessarily limit the amount of corn silage they feed to their cattle and in so doing often reduce their profits.

On the other hand, it has been observed that many cattle feeders are feeding more and more corn silage. Some cattle feeders have increased the amount of corn

silage they include in the ration to the maximum possible considering the nutritional properties of the regular corn silage. However, the amount of silage that can be fed in the feedlot may soon be increased because of research efforts to raise the energy level of this feedstuff.

Furthermore, the research workers who have developed complete energy corn silage and continue to perfect means of producing it need to know and are interested in the farmer's reaction to this new practice.

An extension education program should help to inform farmers of these recent developments and to indicate what farmer opinion is on this matter.

Procedure

Through a review of literature and interviews with authorities on the subject a summary was made of reasons for increased use of corn silage in the beef feedlot. The literature review was also important in developing the subject of complete energy silage, but much information has been gained through participation in and observation of research projects conducted by Dr. H. W. Newland.

The script and slide ideas for a slide-tape presentation were developed by the author; reviewed by specialists in the fields of Animal Husbandry, Extension Education,

Communications, and Audio-visual Aids; and then modified and improved with the suggestions and help given.

Summary

There are numerous, interrelated reasons for the increased use of corn silage in the beef feedlot. For instance, corn harvested as silage produces more TDN per acre than any other feed commonly available to the Mid-western cattle feeder. Also, feeding experiments have consistently shown that profits realized from the feeding operation increase as more corn silage is fed, up to the maximum amounts permitted.

By using the recently developed concepts of hay and grain equivalents in corn silage it is possible to more correctly estimate and appreciate the true feeding value of corn silage. The work with all-in-one silage has shown that it is economically feasible to add shelled corn to silage when the silo is filled. This has led to numerous experiments seeking ways to balance the energy level of corn silage for finishing feeder calves.

By analyzing the nutrient level of various parts of the corn plant it has been possible to estimate what portions of the corn plant are needed to provide a complete energy

corn silage. While butt silage experiments raised the energy level of the resulting silage only slightly, they did indicate that the nutrient value of corn silage can be modified at harvest time. Center-cut silage as proposed is a means of harvesting complete energy silage in one operation.

The extension presentation on this subject matter is developed within the frame of reference of Axinn's analysis of the communications process. This analysis considers four phases: audience, message, communications channels, and treatment. The slide-tape channel of communication chosen for this extension presentation should prove to be an effective means of carrying this information to cattle feeders--being particularly helpful for the slower adopters.

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By

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PREFACE

For three and a half years I have been employed as an agricultural missionary in the southern part of the state of Goiaz, in Brazil, working in the area of rural community development. Upon completion of my present studies I plan to return to Brazil and to continue this type of program.

During the next several years it appears that the areas in which I work will have only a slight chance of any significantly increased industrialization other than in agriculturally related industries. Increased family incomes will be quite dependent upon increased agricultural production. The economic backbone of these areas has been animal industries, especially beef production. For these and other reasons I believe that improvement in rural living will come about as the result of increased efficiency in beef production as well as in other animal industries such as dairy and swine production.

A good share of the beef herds are managed for the dual purpose of beef and dairy production. In Goaiz one cannot now think of either beef or dairy separately. Since, however, the emphasis has been on beef products, it is wise and necessary to approach any educational or improvement

program from the beef farmer's viewpoint.

From my experience I believe that improvement in community life is dependent upon meeting a number of needs. Two of these important needs which can more easily be met are the needs for improved technological methods and improved adult education. It must be emphasized that these are "easier to meet" from my viewpoint and position. To a modest extent some success has already been realized in these two areas.

On returning to the United States I was convinced that I needed further formal education to both broaden my areas of competency and to deepen my understanding in the specific areas of animal husbandry and extension education methods--thus the combined major degree in Animal Husbandry and Extension Personnel Development.

Two specific problems confronting me in Brazil involve finding methods of providing rations for cattle during the rather extended dry season and of passing information on to farmers who are highly intelligent but unable to read or write much more than their own names. Tentatively I had concluded that rations would need to be provided in the form of silages and that extension education would for some time be strongly dependent upon demonstration and other audio-visual methods of teaching.

The extension educator in Goiaz and other similar

situations will need to evaluate and interpret information before he passes it on to the farmer. This is true for almost any extension educator in any country, but in some situations such as in Goiaz the evaluation and interpretation of information become more important and demanding. Evaluation is needed because experiment stations are not present in these areas. Research results obtained at experiment stations in Sao Paulo, Rio, Trinidade, Australia, or any other place may or may not be applicable to situations in Goiaz and other south central areas of Brazil. This explains the need for evaluation of information coming from outside sources. Such evaluation may often take the form of attempting to repeat original experiments carried out in other situations, or to perform similar experiments. Upon having the specific information to be passed on to the farmer, the educator must interpret and present this information in such a way that it will be both intelligible and interesting.

This master's thesis study has provided the opportunity to investigate and evaluate corn silage as a possible means of providing feed for cattle. Part of this investigation and evaluation process included original research projects designed to evaluate and develop new ways of harvesting

and feeding the corn crop. Furthermore, audio-visual methods were surveyed and evaluated as potential extension education methods. Valuable information and practices were gained in producing for extension education purposes, a slide-tape presentation on the subject of complete energy silage.

There are two men in particular whom I want to thank for their continued help and assistance--Dr. Jack C. Ferver for continued encouragement and timely suggestions and Dr. H. W. Newland for the invaluable experience gained in experimental procedures and evaluations. I would also like to thank Mr. Mason E. Miller, Dr. Howard L. Miller, and Dr. Robert J. Deans--the other members of my advisory committee--for their helpful suggestions and interest in this project.

To Dr. Wilfred Veenendaal of the Audio-visual Center I express my appreciation for the help he has given in developing the slide portion of the extension presentation included as part of this project.

To my wife, Phyllis, I express particular appreciation for moral support and help in the preparation and editing of this thesis.

Finally, thanks go to the leaders of the Division of World Mission of the Evangelical United Brethren Church for their positive support during this period of helpful and useful education. Because of their support this experience has been most enjoyable and rewarding.

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INTRODUCTION

Corn silage as a beef finishing feed has increased in popularity until now it is one of the more important feed sources for cattle feeders in the Midwest. Yet the pros and cons of corn silage feeding are discussed quite heatedly by cattle feeders in Michigan. Such disagreement indicates that even today the reasons for feeding corn silage are not clear, and in some instances in Michigan corn silage may not be the "best" feed available to the cattle feeder. Many arguments set forth by both sides are based on insufficient knowledge or incorrect information.

Corn silage feeding recommends itself in areas where corn can be successfully grown. The purpose of this paper is to summarize reasons for increased corn silage usage in Midwestern feedlots. This will be followed by a presentation of experimental evidence which indicates that the nutrient value of corn silage may be modified so that even more of this feed may be used in the finishing ration.

The problems of getting farmers to accept new but sound ideas and methods will be briefly confronted and

discussed. Finally, the script of a slide-tape presentation on the subject of corn silage usage for the modern cattle feeder will be included. The basic purpose of all this is to summarize corn silage usage as it relates to feeder cattle operations and to provide a means of passing this information on to cattle feeders in a meaningful and effective manner.

CHAPTER I

REASONS FOR INCREASED POPULARITY OF CORN SILAGE IN THE BEEF RATION

Corn silage usage in beef feeding rations has greatly increased in recent years. In the state of Michigan during the period from 1954 to 1961 corn silage production has increased 41%.[1] The large number of silos being constructed on farms throughout the countryside also indicates that corn silage usage is on the increase. According to Maddex this rapid increase of corn silage usage is taking place on both beef and dairy farms throughout Michigan.[2]

The cause of this increase is both interesting and important. It is interesting because of the many interrelated factors that have a bearing upon this development. The question is important because an understanding of why

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[1] Michigan Department of Agriculture, Michigan Agricultural Statistics, A Report Prepared by the Michigan Cooperative Crop Reporting Service (Michigan Department of Agriculture, July, 1962), p. 22.

[2] R. L. Maddex and others, "Engineering Silage Equipment and Operations for Dairy and Beef Cattle Feeding," MSU Silage Conference (Michigan State University, 1959), p. 49.

this increase is taking place will help indicate possible future developments in beef rations as well as indicate under what conditions corn silage feeding may be practical and economical.

Not only has corn silage become a commonly used ration in the feedlot, but it has also become a "standard" ration in feeding trials run at many experiment stations located in the Corn Belt and other corn growing areas. Corn silage has proven in many such situations to be the most economical ration and has become the yardstick by which the economics of other rations are compared.[1]

For years corn silage has been recognized as a palatable feed having a good physiological effect upon large ruminants such as beef and dairy cattle. The red barns with one or two silos standing beside them have been a most common scene throughout Michigan for several decades. Why, however, has there been this recent large increase in silage fed to beef cattle? A number of factors have to be considered in attempting to give any kind of an adequate answer to this question. Such factors include the following:

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[1]Roscoe R. Snapp and A. L. Neumann, Beef Cattle (5th ed.; New York: John Wiley and Sons, Inc., 1960), p. 435.

1. Increased profits from the feeding operation.
2. The shift to higher energy rations.
3. Increased corn yields.
4. Minimum tillage.
5. Mechanization of the corn silage harvesting operation.
6. Continuous corn farming.
7. Mechanization and automation of the feedlot operation.
8. Increased size of feedlot operations.
9. Increased moisture problems in harvesting and storing larger amounts of dry feed.
10. Increased land prices.

1. Increased Profits from the Feeding Operation

The most commonly stated opinion as to why the beef feeder is increasing corn silage usage is that its use increases his net profits. That this statement is true is generally supported by feeding trials conducted in the Midwest.[1] It is true that no one ration is the best or most profitable feed for all situations, but--where corn can be successfully grown--it is difficult to improve upon it as an economical feed.

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[1] Ibid., p. 437.

There are some who would say that establishing the fact that corn silage is an economical feed is sufficient to explain the increased use. It is true that if a method of feeding is economical, it will often be used. There are, however, questions of feasibility and practicability. There are situations in which feeds other than corn silage are more economical and practical. If the reasons for increased corn silage usage are to be understood at all adequately, it is necessary to look and see the "why" of increased profits when corn silage is fed.

2. The Shift to Higher Energy Rations

Since the end of World War II (1946) rations fed to farm animals have steadily increased in concentration of energy.[1] This has happened particularly in poultry and swine but also is taking place in the cattle feeding industry. Younger feeder stock are being finished thus requiring a higher energy ration. Also, cattle feeders are learning that by increasing the rate at which cattle are finished, each feedlot will produce more beef gains per year. This

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[1]The significance of this increased concentration of energy in the beef finishing ration was presented in a personal interview by Robert G. White, Extension Agricultural Engineer, Michigan State University.

permits a quicker return on investments. Whatever the reasons, higher energy feeds are being used to finish beef cattle. Generally corn silage has fit into this trend toward higher energy rations better than most other roughage feeds.

3. Increased Corn Yields

In the period from 1954 to 1961 yields of corn silage have increased 31%.[1] Yield increases have also been realized in the amount of grain produced per acre. Technological changes and refinements have made this increase possible. No one change, even one as important as the development of adapted hybrid varieties, could explain these tremendous increases. Increased use of fertilizers and the advantageous placement of fertilizers have been important in this progress. Better weed control through improved cultivating practices and increased herbicide usage has also helped to make possible the increase of corn plant population which in turn has increased corn yield.[2] Insecticides have also added

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[1] Michigan Department of Agriculture, Michigan Agricultural Statistics, p. 22.

[2] White reports that in one minimum tillage experiment using different cultural practices, corn yield was more greatly affected by plant population than by any other factor such as difference in fertilizer application, herbicide usage, etc.

their bit to increased yields. Corn yields have progressed to the point that for the Midwest it is difficult to find other crops that come close to producing as many tons of total digestible nutrients per acre as does corn when harvested as silage. Table 1 compares corn harvested as silage with other crops in nutrient producing ability. This TDN per acre advantage is a strong factor encouraging the increased use of corn silage.

4. Minimum Tillage

Minimum tillage has made it possible to reduce the horsepower hours required to prepare an acre of land to be planted to corn without reducing the corn yield. This alone results in a saving of $5.00 to $7.00 per acre.[1] It is also thought that for a few years minimum tillage has an accumulative effect. Thus soil that has been prepared by minimum tillage for two or three years becomes looser and more mellow reducing further the horsepower hours required for seedbed preparation. While principles of minimum tillage are applicable to other crops, they have been more widely

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[1]Robert G. White, "Minimum Tillage Field Day Results," (Agricultural Engineering Department, Michigan State University), p. 2. (Mimeographed.)

Table 1. Comparable nutrient yields per acre of common feed crops at different levels of production.[a]

	Very Productive Soil		Moderately Productive Soil		Low Productive Soil	
	Yield	T.D.N.	Yield	T.D.N.	Yield	T.D.N.
	Ton or bu.	lbs.	Ton or bu.	lbs.	Ton or bu.	lbs.
Alfalfa hay	3.7	3700	2.8	2800	2.0	2000
Other hay	3.0	3000	1.9	1900	1.0	1000
Corn silage	20.0	8000	13.0	5200	7.0	2800[b]
Shelled corn	100.0	4480	65.0	2950	35.0	1570
Ear corn	200.0	5100	130.0	3370	70.0	1800
Oats	90.0	2000	55.0	1232	40.0	900
Oat silage	15.0	5000	10.0	3360	5.2	1800
Oats + pea silage	15.0	5000	9.0	3000	6.8	2300
Oats + vetch	14.0	4900	9.5	3420	6.2	2170
Barley	55.0	2060	35.0	1310	20.0	750
Wheat	55.0	2640	35.0	1680	20.0	960
Sorghum silage	20.0	6960	13.0	4524	7.0	2440

[a]D. Hillman, G. L. Blank, and L. H. Brown, "Changing Styles of Forage Feeding and Nutrition of Animals," MSU Forage Symposium (Michigan State University, 1962), p. 86.

[b]Underlining is mine.

applied to corn.[1] This results in corn having further economic advantages over other crops as a feed source.

5. Mechanization of the Corn Silage Harvesting Operation

At the close of World War II the field forage chopper and self-unloading wagons became available to the farmer. This development was a major step in making it possible to harvest as a palatable feed the total tonnage of nutrients produced in one acre of corn. Before this, hours of hard labor were required to produce and feed one ton of corn silage. This high labor requirement increased the cost of corn silage and caused it to be a less convenient feed to use. Partly for these reasons corn silage was used primarily as a succulent supplement to a ration consisting mainly of dry feeds. Because of the large amount of hand labor required to harvest corn silage, which was about 70% water, it seemed more logical and economical to handle for feed, dry materials that were 15% water or less. Until the

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[1] White commented that minimum tillage methods have been used most extensively on spring row crops, particularly corn. Teaming herbicide usage with minimum tillage makes it possible in many situations to perform all operations required in raising corn in one operation. The corn needs only to be harvested after it is plow-planted with the necessary fertilizers, herbicides, and insecticides. Minimum tillage operations can be and are used with other crops, but for various reasons the practice has caught on more quickly with corn.

corn silage harvesting operation was mechanized, corn silage was not nearly the economical or convenient feed that it now is.

6. Continuous Corn Farming

With the development and acceptance of mechanized corn silage harvesting, the amount of corn silage that could be produced on a given farm was often limited only by the amount of cropland available for growing corn. Many farms, especially those located outside of the Corn Belt proper (which includes most of Michigan), have only a certain percentage of land that can be used to raise row crops. Common rotations often permit this cropland to be in row crops for only one or two years in every four or five years. It has been shown in recent years, however, that corn can be grown year after year on some good cropland with no apparent harm to the soil. In fact, the Morrow corn plots at the University of Illinois demonstrate that such soil characteristics as tilth and fertility can be improved under good continuous corn cropping practices.[1] Continuous corn farming has in many situations increased the number of acres

[1]Some of the plots in this experiment have been in continuous corn since 1888; yet, soil fertility and tilth as measured by corn yields continue to improve.

that can be planted to corn on a given farm. The availability of corn silage as a feed has thus been increased.[1]

7. Mechanization and Automation of the Feedlot Operation

Mechanization and size of the feedlot operation are so closely related that it is difficult to speak about either one by itself. Yet, it seems advisable to do so. Mechanization of the feeding operation made it possible for cattle feeders to expand the size of their feedlots without expanding their labor force. Until recently there were very few mechanized systems available for handling dry feeds. Mechanized and automated systems of handling silage (particularly corn silage) were developed and perfected at an earlier date resulting in silage becoming a convenient feed to handle and, as will be pointed out in the next section, a cheaper feed. Mechanized feeding of corn silage has overcome one of the serious drawbacks of feeding silage--that of handling a feed that is more water than feed.

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[1] Even on farms where actual continuous corn farming is not practiced, farmers using rotation permitting two or more years of row crops will often plant all the row crop allotment to corn year after year. Several of the cultural practices mentioned elsewhere in this section (i.e., minimum tillage, insecticides, mechanization, etc.) have made this more intensified use of corn in the rotation practical and acceptable.

8. Increased Size of Feedlot Operations

With small feedlots (less than 100 head) the economics of feeding corn silage are questionable. Smaller amounts of corn silage are expensive to store and inconvenient or expensive to harvest. Larger feedlots require more total feed; thus, harvesting and storage costs per ton of silage can be reduced. As the size of tower silos increases from 40 feet by 12 feet to 60 feet by 30 feet, the initial cost per ton of storage capacity is reduced from $25 to $6.25.[1] Increased tonnages of silage permit more efficient use of harvesting equipment reducing the feed costs even more.[2] Furthermore, as feedlot size increases, there is an opportunity to mechanize and automate the feed handling operations further reducing feed costs.[3] In small operations mechanization and automation may increase the convenience of feeding corn silage, but the cost of

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[1] M. L. Esmay, J. S. Boyd, and C. R. Hoglund, "Equipment, Practices, Investments and Annual Costs Associated with Tower and Bunker Silo Systems," MSU Silage Conference (Michigan State University, 1959), pp. 60-68.

[2] Robert G. White and Howard F. McColly, "Methods, Equipment, Power and Investments for Harvesting and Storing Hay and Silage," MSU Silage Conference (Michigan State University, 1959), pp. 22-30.

[3] Maddex and others, MSU Silage Conference, pp. 54-56.

feeding may remain the same or be even higher. When larger numbers of cattle are fed, however, this machinery does reduce costs of feeding cattle. If properly planned, enlarging the feedlot does reduce finishing costs.

9. Increased Moisture Problems in Harvesting and Storing Larger Amounts of Dry Feed

When comparatively small acreages of crops are harvested as dry feeds, the harvest season is often long enough to permit waiting for the drying process to take place in the field. With increased size of operation more acres and thus more tons of material must be harvested as feed. Cattle feeders are no longer able to depend upon unpredictable field drying. Increased production usually requires increased investments. Time lost waiting for drying becomes increasingly costly. Often material being harvested for feed is heavily damaged or completely lost so it is therefore more difficult to accurately predict the feed supply that will be available for the following feeding period. This situation has caused cattle feeders to seek means of harvesting feed supplies that are not so sensitive to adverse weather conditions. One such means of overcoming the moisture problem has been to store feed as silage.

Silage usage permits the harvesting of high moisture crops for feed.

The moisture problem is of particular concern to cattle feeders in Michigan because of a shorter growing season than is optimum for growing corn.[1] In order to raise the highest yielding corn possible later maturing corn varieties are used. As harvest dates are postponed, the harvest season is shortened, and rain and other adverse weather conditions cause the harvest situation to become even more critical. Therefore, the storage of feeds as silage in Michigan is not only a matter of economics, but often one of necessity or insurance.

10. Increased Land Prices

In the ten year period from 1946 to 1956 average land prices increased 70% to 80%.[2] It is known that as investment costs increase, gross incomes must likewise increase if a net profit is to be realized. It has already been shown that corn harvested as silage yields more total

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[1] According to White the harvesting of large acreages of dry shelled corn is particularly problematic in much of Michigan. More and more farmers are turning to silage as a means of overcoming this problem.

[2] Raleigh Barlowe, Land Resource Economics (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1958), p. 205.

digestible nutrients than any other crop commonly available to the Midwestern farmer for feeding purposes.[1] This increased TDN harvested per acre increases the beef gains produced per acre of cropland. Harvesting more corn as silage then is one means a cattle feeder has of intensifying his farm program to cover ever-increasing land investments.

Conclusions

In conclusion it can be said that corn silage fed in the beef feedlot has increased because its competitive position with other crops has improved during the last few years. Even though corn silage has for decades been considered a nutritious and palatable ration, it has not always made up the basic portion of the finishing ration as it does today in so many situations. Recent technological advances have seemed to strengthen the position of corn silage as a feed. Future developments in these and other areas may improve the relative value of some other crop as a feed for finishing cattle. Today, however, in the Midwest corn silage is tough to beat as a convenient and profitable feed that is readily available to the cattle feeder.

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[1] See Table 1.

CHAPTER II

EXPERIMENTAL RESEARCH INFORMATION PERMITTING NEW EVALUATIONS OF AND MEANS OF PRODUCING CORN SILAGE

Because corn silage is an advantageous feed in so many situations, many cattle feeders have increased its use to the maximum. If possible they would feed even more, but corn silage is not a balanced feed and must be supplemented with energy, proteins, minerals, and sometimes vitamins. Most of this supplement is required to balance the energy level of the corn silage. It is this need for comparatively large amounts of high energy feed such as shelled corn or other grains which limits to the greatest extent the amount of corn silage that can be fed to cattle.

Recent experimental work has permitted researchers to re-evaluate the potential of corn silage as a feed. Until recently the true feeding value of corn silage has not been appreciated. Learning to more adequately evaluate this feeding value has permitted researchers to develop means of improving it. The more pertinent experiments and concepts growing out of these experiments are now summarized.

1. The Feeding Value of Corn Silage

Corn silage for years has been mistakingly thought of as roughage. On the dry matter basis corn silage was treated as though it were about equal with grass silage or hay. This was true even though there were some who wondered about the value of the grain in the corn silage.[1]

Now it is possible to evaluate with some degree of accuracy the feeding value of corn silage. This is done by using the concepts of grain and hay equivalents. In this way corn silage is thought of as part hay (forage) and part grain which in essence it is.[2] By sampling fields of corn for a twelve year period Huffman determined that on the average one acre of corn produced 53.9 bushels of grain and 1.9 tons of hay equivalent.[3] When corn is harvested as shelled corn, this 1.9 tons of "hay" is lost. This is a significant economic loss because it has been shown

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[1]According to Carl F. Huffman, professor Emeritus in Dairy and Animal Husbandry, as presented in a personal interview.

[2]C. F. Huffman, C. W. Duncan, and S. T. Dexter, "Corn Grain and Stalks (Hay-Equivalent) in Corn Silages Obtained from Random Samples," Michigan Agricultural Experiment Station Quarterly Bulletin, Vol. XLII (Michigan State University, May, 1960), pp. 801-806.

[3]Ibid., p. 803.

that hay equivalents in corn silage are about equal to good mixed hay in milk producing ability.[1] Likewise the grain in the corn silage compares in feeding value with corn grain that was separated from the corn stover and later added to the ration.[2] While in Huffman's work the feeding value of corn silage was measured in its milk producing ability, there is very little reason to question the validity of applying these results in evaluating its beef producing abilities.

It has further been established that corn silage when harvested with the same moisture content will have a similar grain to stalk ratio.[3] On the average a ton of corn silage will contain between 4.5 and 5.0 bushels of grain. This information makes it possible to place a monetary value on silage as well as to estimate its feeding value. According to both Huffman and Nevens corn silage can no longer be considered merely a roughage. It is a roughage with grain in it.

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[1] Ibid., p.803.

[2] Ibid., p.801.

[3] W. B. Nevens and others, "The Ear and Leaf-stalk Contents of Corn Forage as Factors in Silage Evaluation," Journal of Dairy Science, Vol. XXXVII (1934), pp. 1088-1093.

2. Effects of Feeding Large Amounts of Corn Silage in the Finishing Ration

Continually questions are raised concerning the effect of high corn silage rations on the quality of finish in fattening cattle. This is important because quality of finish should influence the price received by the feeder for his cattle. Many cattle feeders are concerned that cattle which are fed heavily on corn silage will have a higher water content, will have a finish that is less firm, and will shrink more in shipping. Some are concerned that the carcass will carry less marbling as well. Snapp and Neumann point out that many of these and other suspicions of corn silage fed cattle are a carry-over from the time that dry roughage was the common feed and cattle buyers were worried that silage fed cattle would resemble cattle finished on grass.[1]

In an experiment conducted by Neumann, cattle fed high amounts of corn silage graded lower than high grain fed cattle when live grading standards were used. On carcass evaluations, however, the high silage fed cattle graded higher than the high grain fed group. In this

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[1] Snapp and Neumann, p. 434.

experiment cattle fed more heavily on corn silage had a trimmer fatback, a higher degree of marbling, and a higher yield of trimmed lean cuts.[1] It should be pointed out that experiment cattle fed higher amounts of corn silage had a lower rate of gain, thus requiring more time to reach market weight. Under many feeding situations this would be a distinct disadvantage. However, if carcass evaluation becomes more important in determining the price paid for cattle, these apparent advantages of trimmer carcasses and more marbling will become increasingly important.

This information indicates that cattle fed a high amount of corn silage can produce the type of carcass in high demand.

3. The Development and Evaluation of All-in-one Silage

A. L. Neumann of the University of Illinois has for a number of years experimented with developing and evaluating all-in-one silages. One method he first used to produce the "complete" silage was to add varying amounts of ground

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[1] A. L. Neumann and others, "Effect of Length of Heavy Corn Silage Feeding Period on Total Feed Requirements and Carcass Yield and Grade in Fattening Steers," Illinois Cattle Feeders' Day (University of Illinois, 1962), p. 3.

shelled corn and other supplements to grass silage and oat silage at silo filling time.[1] Later he experimented with raising the energy level of regular corn silage in this way.

Much time and effort have been spent on this approach to balancing rations because a considerable amount of costly labor and machinery are required to feed both corn silage and grain in the traditional manner. It was theorized that if these silages could be balanced at silo filling time, then a truly all-in-one silage would result. This, then, could be fed directly from the silo requiring very little time and machinery. If such a system were practical, it would be simpler and cheaper than various methods now used to feed silages and concentrates, including push-button feeding systems designed to process, meter, mix, and convey various feedstuffs in the correct proportions.[2] Four of the questions raised concerning the development and use of these all-in-one silages shall now be considered briefly.

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[1] A. L. Neumann and others, "Comparison of Alfalfa and Oat Silages Containing High-corn Additions with Corn Silage for Fattening Beef Calves," Illinois Cattle Feeders' Day (University of Illinois, 1957), pp. 4-6.

[2] Ibid., p. 4.

Will the loss of nutrients in the silo be prohibitive?

Feed losses occurring in the silo are always of concern to cattle feeders. This becomes even more important when one considers storing a higher energy feed in the silo because each percent dry matter loss then represents more actual energy loss. Williamson analyzed the fermentation action of this all-in-one silage. He concluded that while there was from 3.6% to 10.7% loss of dry matter during the fermentation process, this loss was not excessive. In fact, this loss is not as high as for grain or forage stored as dry feed "under certain conditions."[1]

Will shelled corn added to the silage at silo filling time be as efficient in producing beef gains as corn added when the silage is fed?

This and the preceding question are crucial in determining whether this approach to modifying the nutrient value of corn has any chance at all of being feasible. Experimental evidence to date indicates that when ground shelled corn is added to silage at silo filling time, it is

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[1] J. L. Williamson and others, "Chemical and Nutritive-value Changes in Alfalfa Silage Made with High Levels of Added Corn," Illinois Cattle Feeders' Day (University of Illinois, 1957), p. 2.

as effective in producing beef gains as the traditional means of feeding corn grain and silage.[1] If high moisture shelled corn (30% moisture) is used to balance the energy level, the all-in-one method may even produce more beef gains per acre than the traditional method. This increase is realized because field losses are reduced when corn is harvested as high moisture shelled corn compared to harvesting corn as dry ear or shelled corn.[2] Also, it has been shown that nutrient losses of high moisture corn stored in silos are lower than that of "dry" corn stored in cribs or bins.[3] By comparing rate of gain produced by corn grain added to silage at the feed bunk and at the silo, it appears that one method is about as efficient as the other. From these considerations it appears that high energy silage may be feasible.

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[1] A. L. Neumann, W. W. Albert, and G. E. Mitchell, Jr., "Alfalfa, Oat, and Corn Silages Containing 40 Percent Corn for Fattening Beef Calves," Illinois Cattle Feeders' Day (University of Illinois, 1958), pp. 1-6.

[2] A. L. Neumann and others, "Effect of Moisture Level in Field-shelled Corn on Harvesting and Storage Losses and on Feeding Value for Beef Cattle," Illinois Cattle Feeders' Day (University of Illinois, 1959), p. 2.

[3] Ibid., pp. 2-3.

Will it be possible to balance all nutrient requirements in this manner?

In the earlier literature written on this method of supplementing silage as a feed, reference was made to all-in-one silage. At first it appeared that silage could be made into a completely balanced feed in this manner. The possibility of producing an all-in-one silage looked particularly good when corn grain and various minerals were added to grass silage (alfalfa or mixed silage). Initial feeding trials indicated that nutrient requirements of cattle were adequately met, making it appear that this was a completely balanced all-in-one silage.[1] However, subsequent experiments have shown that in spite of having a theoretically balanced diet, resulting gains were not equal to those produced by traditionally balanced rations.[2] It should be realized that this all-in-one silage resulted in economical gains, but that they were not optimum. This silage is now often referred to as the "so-called" all-in-one

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[1] Neumann, Albert, and Mitchell Jr., Illinois Cattle Feeders' Day, p. 4.

[2] W. W. Albert and others, "Effect of Adding Soybean Meal to a High-energy Silage Made of High-moisture Corn and Alfalfa for Fattening Steers," Illinois Cattle Feeders' Day (University of Illinois, 1960), pp. 21-22.

silage.

These and similar feeding trials indicate that it is not now feasible to develop a completely balanced ration as all-in-one silage from oats or corn. It is possible, however, to balance the energy level of these silages. However, urea or other protein supplements added to the silage at silo filling time do not sufficiently raise the protein level. Either protein is lost through chemical changes taking place in the silo, or its availability is interferred with.[1] Thus we see that complete energy silage appears to be feasible but the completely balanced silage is not. It should be remembered, however, that alfalfa or mixed grass silage do approach the complete feed category when shelled corn is added.

Will the all-in-one method result in significant economic advantages for the cattle feeder?

It is too soon to give a categorical answer to this question because there has not yet been time to adequately evaluate this harvesting and feeding method. Since this paper is concerned with corn silage usage, the all-in-one

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[1] Neumann, Albert, and Mitchell Jr., Illinois Cattle Feeders' Day, p. 6.

silage approach as related to grass and oat silage will not be dealt with further. The question is, what advantages can be realized by storing the corn crop as so-called all-in-one silage?

Since it has not been possible to develop all-in-one silage from corn, this approach is just a qualified success. It was seen that complete energy silage can be produced. This is an important development. However, in answer to the stated question, it appears that in handling the corn crop the addition of corn grain to silage at the silo has only limited economic advantages.

On the positive side some steps of processing and handling are saved at feeding time when the all-in-one method is used. If high moisture shelled corn is added to the corn silage, then all corn can be stored in the silo if careful consideration is given to planting and maturing dates. A certain saving in storage facilities may result.

On the other hand, there are numerous reasons to question if the adjustment of energy level at silo filling time is a really practical approach to harvesting the total corn crop. Corn has to be harvested both as silage and grain, requiring two basic harvesting machines. This is costly. If this year's high moisture corn is to supplement

this year's silage, two harvesting processes have to go on simultaneously. Both shelled corn and silage must be harvested and hauled to the silo for mixing. This demands a great deal of equipment and personnel. If, however, the previous year's corn is to be added to this year's silage, this increases storage and interest costs, and involves a number of other problems. As a means of utilizing alfalfa and oats the all-in-one approach may prove to be useful and economical for the beef feeder. However, for handling the corn crop there are serious drawbacks.

Conclusion

Even though the all-in-one method of producing complete energy silage will probably not prove to be too practical or advantageous for handling the corn crop, some results of this research have a very significant bearing upon corn harvesting possibilities. As already shown, this research work indicates that the nutrient level of corn silage can be significantly raised at silo filling time. In particular the research shows that <u>complete energy corn silage can be economically stored and fed</u>. This knowledge opens the door to all sorts of possibilities. Knowing that it is possible to store complete energy corn silage, we now have the problem of finding the most economical and practical

means of producing it. Some of the possible means will be presented and discussed later.

4. Loss of Energy in Undigested Whole Kernels

As more corn silage is fed, as more value is placed upon the corn kernel in the silage, and as more corn grain is put into the silage--the possible nutrient loss due to whole, undigested kernels becomes more of a concern. When shelled corn is added to silage at feeding time, it is usually ground. If not ground the loss in undigested whole kernels is so great that hogs are allowed to run in the feedlot as scavengers. Corn kernels in silage are not now ground or cracked to any great extent, nor is high moisture corn usually rolled or otherwise treated to break the outside covering. Just how great then is this loss due to undigested kernels?

Whole kernels of corn in the feces contain almost all of their original nutrients. Therefore, the percentage of whole kernels in the feces is a good indication of feed losses due to this cause.[1] Huffman discovered that in most

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[1] C. F. Huffman and C. W. Duncan, "Corn Kernels in Feces of Dairy Cattle Fed Corn Silage," Michigan Agricultural Experiment Station Quarterly Bulletin, Vol. XLI (Michigan State University, February, 1959), pp. 542-543.

instances fewer whole kernels were in the feces than casual observation would indicate. This is because corn bran that is in the feces carries much of its yellow color and looks like yellow kernels. However, most of the nutrients in this bran have been removed by the cattle in the digestion process. By actual count from 0.2% to 8.3% of the original whole kernels were recovered in the feces. The average was 2.7%.[1]

The above information was gained from feeding corn silage to dairy cows. Similar experiments have been conducted with beef cattle. The percent energy loss was estimated by weight gains produced by hogs running with the cattle. Evidence supports the view that there is some nutrient loss through whole, undigested corn kernels, but in most instances it is not excessive.[2]

5. The Corn Plant Parts Analyzed

Traditional methods of harvesting and feeding the corn crop have been to harvest the whole corn plant as a comparatively low energy feed and to harvest the shelled grain as a high energy feed. The two feeds are then mixed

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[1] Ibid., p. 543.

[2] Snapp and Neumann, p. 434.

and fed by one of several alternative methods in such proportions as to meet the energy requirements of the cattle being fed. The all-in-one approach attempted to balance the energy level of the feed between harvest and storage. Some researchers asked why it would not be logical to balance the energy level one step sooner--at harvest time. This, they reasoned, would result in numerous advantages.

In an effort to determine if this would be possible Plog and Newland determined the "relative" energy level of TDN values of corn silage made from different sections of the corn plant.[1] This was done by hand harvesting various parts of the corn plant and storing them separately as silage in silos of equal size and type. Digestibility determinations were made by feeding the silage to lambs. Table 2 shows the TDN level of silages made from various parts of the corn plant.

The results of this experiment indicate the large variation between parts of the corn plant in respect to energy levels. By harvesting only the corn tops the silage

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[1] John Plog, H. W. Newland, and Hugh Henderson, "Nutritive Value of Silage Made from Various Parts of the Corn Plant," Michigan Cattle Feeders' Day (Michigan State University, 1960), pp. 5-7.

Table 2. Percent TDN of corn silage made from various parts of the corn plant.[a]

	% TDN	
	As Harvested Basis	Dry Matter Basis
1. Regular silage (whole plant silage)	16.22	63.0
2. Ears only	40.26	83.7
3. Butts only (leaves and stalks below the ear)	6.37	41.8
4. Tops only (leaves and stalks above the ear)	5.95	32.8
5. Butts and ears	23.90	73.3

[a]John Plog, H. W. Newland, and Hugh Henderson, "Nutritive Value of Silage Made from Various Parts of the Corn Plant," Michigan Cattle Feeders' Day (Michigan State University, 1960), p. 6. The "as harvested" values are as reported. Dry matter values are calculated from the "as harvested" values.

would have a TDN level of 32.8%. On the other hand, by harvesting only the high moisture shelled corn, a silage of 94% TDN would be produced.[1] It appears logical to conclude that the energy level of corn silage can be raised or lowered between these two extremes by harvesting selected

[1]These TDN percentages are on the dry matter basis which will be used throughout the paper unless otherwise indicated.

portions of the corn plant. Because even ear corn silage is higher in TDN than rations presently fed to feeder cattle, it appears that the "balanced" energy silage will contain the corn ear plus a certain percent of the forage portion of the corn plant.

6. Dwarf Corn Silage

Dwarf corn silage was tried as a possible means of increasing the energy of corn silage. It seemed logical to think that dwarf corn had a higher grain to forage ratio. Experimental evidence comparing dwarf silage with regular silage indicates that the yield per acre of the two was about equal on the dry matter basis. When compared to regular corn, dwarf corn had a smaller percentage of stalks but a larger percentage of leaves so that the ratio of grain to forage was about equal for the two types of corn. When evaluated in a feeding trial dwarf and regular corn silage resulted in similar responses further indicating that the energy level of the two silages was about equal.[1]

It is apparent that with present dwarf corn varieties

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[1] J. E. Zimmerman and others, "Dwarf Versus Regular Corn Silage for Beef Cattle," Illinois Cattle Feeders' Day (University of Illinois, 1960), p. 19.

the corn plant is shorter and leafier than regular corn so the resulting silages are about equal energy wise. Possibly future dwarf corn varieties may be developed that will have a higher grain to forage ratio or perhaps a two or three ear variety of regular corn may also increase the amount of grain in silage. For the present, however, there appears to be very little possibility for significantly increasing the energy level of corn by selecting varieties with higher grain ratios since the variation is so small.

7. Butt Silage

With the analysis of the corn plant parts in support of their position, Henderson and Newland attempted to produce a higher energy silage by using butt silage. In making this silage the corn top was cut off just above the ear and discarded.[1] Figure 1 shows the remaining ear and butt portion of the corn plant which made up the silage. For a two year period butt silage was compared with regular silage by chemical analyses and feeding trials.

One feeding trial was run with the objective of

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[1]Hugh E. Henderson and others, "High Energy Corn Silage for Fattening Beef Heifer Calves," Michigan Cattle Feeders' Day (Michigan State University, 1961), p. 1.

feeding groups of cattle on regular silage and butt silage ration in such a way as to result in the two groups gaining at the same rate. Theoretically the same rate of gain would require the same amount of TDN so that in measuring the amount of ground shelled corn required to give equal gains the energy level of the two silages could be compared. The butt silage group required more silage per hundred weight gain, but considerably less corn (9% more silage and 48% less shelled corn).[1] By analysis regular corn silage was 20% TDN and butt silage was 24% TDN as fed.[2]

A follow-up feeding trial was run in which more care was taken to produce both the regular silage and butt silage from comparable corn. This was done to make certain that differences between the two silages were due to different harvesting methods rather than to differences in the corn crops.[3] The main objective of this trial was to determine how much ground shelled corn has to be added to butt silage so that the ration is equal to the energy level in a

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[1] Ibid., pp. 1-3.

[2] Ibid., p. 3.

[3] H. W. Newland, C. G. Silvernail, and C. M. Hansen, "Effects of Adding Various Levels of Shelled Corn to Topped (Butts and Ears) Corn Silage for Fattening Heifers," Michigan Cattle Feeders' Day (Michigan State University, 1962), AH 76.

ration consisting of regular corn silage and shelled corn. The major conclusion resulting from this experiment was that discarding the cornstalk top slightly raises the energy level of the resulting butt silage.[1] However, before this level can be significantly raised, a more positive means of reducing the amount of forage harvested must be developed.

Summary

From this information it seems logical to conclude that the energy level of corn silage can be modified. Complete energy corn silage has been produced at silo filling time and successfully fed. Feed conversion rates and silo losses of the complete energy corn silage are such that higher energy silages appear to be of practical consideration. From analyses of the parts of the corn plant it appears likely that the energy level of corn silage can be modified at harvest time by selective harvesting methods. In fact, the energy level of corn silage was slightly raised by harvesting corn as "butt silage." If complete energy corn silage is to be produced at corn harvest time, a more effective means of reducing the amount of forage harvested with the ear will be needed.

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[1] Ibid., pp. 2-3.

CHAPTER III

CENTER-CUT SILAGE--A PROPOSED MEANS OF HARVESTING CORN AS COMPLETE ENERGY SILAGE

Newland and Huffman have presented center-cut silage as a means of harvesting corn as complete energy silage.[1] They propose that the grain to forage ratio of corn silage will be increased by discarding the top and bottom portions of the corn plant. Only the ear and center section are harvested as silage. This method is similar to that of producing butt silage except that more of the leaves and stalks are discarded, thus further increasing the energy level. By adequately reducing the leaves and stalks that are harvested with the ears, a complete energy silage should result.

1. How Center-cut Silage is Produced

In producing center-cut silage only the middle section of the corn plant, as shown in Figure 2, is harvested. The top of the corn plant is cut off and discarded by attaching

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[1] H. W. Newland and C. F. Huffman, "'High Energy' Corn Silage--A New Approach for the Cattle Feeder," MSU Forage Symposium (Michigan State University, 1962), pp. 70-71.

a sickle bar mower to the front of a tractor and adjusting it to the desired height. The butt portion of the corn plant is discarded by adjusting the forage harvester to cut higher than usual. The tractor with the mower bar is used to power the forage harvester so the center-cut silage is harvested in a one step operation (Figure 3).

The size of the center portion that needs to be harvested is determined by the energy level desired in the ration. If center-cut silage is to be 79% TDN, only 40% of the stalks and leaves need to be harvested with the ear.[1] It would be better if the leaves and stalks could come entirely from below the ear.[2] However, because of practical problems of harvesting the center-cut silage, 8% is harvested above and 32% below the ear. In practice it was observed that these percentages were obtained by setting the topper to cut as close to the top of the ear as possible under field conditions, and by setting the forage harvester to cut off the center portion midway between the ear and ground. The locations of these cuts are shown in Figure 4.

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[1] Ibid., p. 70.

[2] As shown above in Table 2, p. 32, the portion of stalks and leaves below the ear is higher in TDN. Using the highest TDN portions of the corn plant will produce the largest quantity of high energy silage.

Silage with 79% TDN would be comparable in energy to other currently used finishing rations. If a lower energy silage is desired, it can be obtained just by lowering the height at which the forage harvester cuts. In this way more leaves and stalks are harvested thus lowering the TDN in the silage. The center-cut method, therefore, is flexible in that silages may be produced that meet varying energy levels required by different feeding situations.

2. Advantages of the Center-cut Method

Properly harvested center-cut silage is a complete energy feed for finishing cattle. Only protein and minerals need to be added to produce a completely balanced ration.

Machinery costs are reduced.

When corn is harvested as both grain and silage, two different harvesting operations are involved requiring two different harvesting machines. Both a forage harvester and a corn picker (or picker-sheller) are necessary and costly. If large acreages of shelled corn are harvested, a grain dryer is often required. Using complete energy center-cut silage will end the need for shelled corn, thus making it unnecessary to have the grain harvesting and drying machinery.

Further savings in machinery costs are realized because the corn crop is fed as stored. Shelled corn need not be ground, added, or mixed with center-cut silage so metering devices, grinders, and mixers are no longer needed.

Feed storage costs are reduced.

The traditional method of harvesting corn necessitates the use of at least two types of storage. Silage is stored in silos and grain in cribs or bins. It has been shown earlier that as the capacity of silos increases, the initial cost of storage decreases. By using the center-cut method all the harvested corn is stored in silos. The size of silos that can be used is thus increased and there is no need for a second type of storage for corn grain. Figures 5 and 6 summarize these machinery and storage facility savings.

Labor costs of feeding cattle are reduced.

Harvesting corn as complete energy silage not only reduces machinery costs, but also reduces labor costs. In feeding the corn crop as silage and shelled corn the energy level in the feed is balanced at feeding time. The various methods used to balance the energy level require considerable amounts of labor as well as machinery and, therefore, are

costly. The previously presented all-in-one method of producing complete energy silage balanced the energy level at silo filling time. This reduced labor requirements at feeding time but mainly transferred the need for labor to the time when the silo was filled. Some labor savings were realized in this way, but labor was still required for handling and mixing shelled corn and silage. The center-cut method completely eliminates the energy balancing operation as a separate and specific operation. The energy level is balanced in the harvesting operation without significantly increasing labor costs over that of harvesting regular corn silage. In this way the center-cut method results in a sizeable reduction in labor requirements.

Beef gains per acre of corn harvested are not decreased.

Harvesting the total corn crop as regular corn silage produces the maximum amount of energy per acre of corn grown. This silage is, however, too low in energy to be the only source of energy in the beef finishing ration for most of today's feedlot operations. Corn grain is, therefore, harvested to fortify the silage. Thus the total stalk, representing considerable energy, is left in the field from which the corn is picked. In using the center-cut

method of producing complete energy corn silage only certain portions of the stalk are left in the field. This still results in some energy loss, but no more than with the traditional method of harvesting corn. In fact, there is evidence which indicates that there will be as much as a 7% increase in the amount of TDN harvested per acre of corn.[1]

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[1] Newland and Huffman, MSU Forage Symposium, pp. 68, 70.

CHAPTER IV

OTHER POSSIBLE MEANS OF PRODUCING COMPLETE ENERGY SILAGE

A number of other means of producing complete energy corn silage have been suggested. Two of these will be mentioned here.

1. Corn Top Silage

Harvesting the corn plant from the ear up has been suggested as a possible way of producing complete energy silage.[1] This at first appears to be an economical and feasible method. Just a regular forage harvester adjusted to cut at ear level would be required as machinery and no topping device would be necessary.

The first drawback is that the top of the cornstalk is harvested which is the part of the corn plant highest in moisture and lowest in TDN. Thus more TDN would be left in the field in the form of corn butts. Also, as will be pointed out in more detail later, some corn ears break over at such angles as to prohibit the cutting of the cornstalk

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[1] Ibid., p. 69.

at the necessary height. Thus this method does not appear to be practical at the present time.

2. One-and-one Silage (one row ears and butts, and one row ears)

This method is suggested as a means of producing high energy silage. One-and-one silage would have about 72% TDN which is a complete energy feed for yearling finishing cattle but would be too low in energy for finishing calves to choice grade at 1,000 pounds.[1] A few farmers have tried this method, or a modified form of it, in which one row of whole corn is harvested with one row of ears. This one-and-one method may prove useful to some farmers under some conditions. However, there are reasons to believe this method will never be widely accepted.

The energy level of silage harvested with this method is fixed. There is no way of easily increasing or decreasing the amount of forage harvested with the ears. Also the machinery needed for this operation is rather complicated. Farmers have modified forage harvesters to perform the necessary operation, but such machines are not likely to be available commercially. The greatest disadvantage to this

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[1] Ibid., p. 69.

method is that the resulting silage is not a truly complete energy feed and would require energy supplementation for many feeding situations.

CHAPTER V

SIGNIFICANT CONCLUSIONS RESULTING FROM HIGH ENERGY CORN SILAGE EXPERIMENTS CARRIED OUT BY M.S.U.

As experience with producing and feeding high energy silages increases, information is gained that permits certain conclusions to be made. Some of these conclusions are more definite while others are rather tentative requiring more research for further substantiation.

1. Lodging Reduces the Efficiency of the Topping Operation

Lodged corn is difficult to top. Often some cornstalks are standing straight while others are leaning over at various angles. The topping machine cannot be lowered any further than the highest ears will permit. Therefore, some tops are missed because they are leaning over too far. On badly lodged corn the topping operation may be of very little value while with straight standing corn the forage portion of the resulting silage may be reduced 17% by topping the corn plant.[1]

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[1] Ibid., p. 65.

2. Variation in Height and Attitude of the Corn Ears Interferes with the Harvesting of Center-cut Silage

As can be observed in almost any corn field, the height of the corn ear on the cornstalks varies to a considerable extent. Also some ears stand almost straight up, some hang almost straight down, and others are at various angles in between. The topping unit must be adjusted to cut above the highest upstanding ears while the forage chopper must cut below the lowest hanging ears. This often means that more than the desired amount of stalks and leaves are unavoidably harvested with the ears. The seriousness of this problem varies from field to field. In some, the ear and 40% of the stalks and leaves can be harvested, but in others twice as much forage may be harvested when adjusting to cut above the highest ears and below the lowest.

3. High Energy Corn Silage Requires Finer Chopping

Cattle fed higher energy silage were seen to pick over their feed more than cattle fed regular corn silage.[1]

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[1] Newland, Silvernail, and Hansen, Michigan Cattle Feeders' Day, pp. 1, 3.

The larger pieces of cobs and stalks were left in the bottom of the feed bunk. This would indicate that high energy silage is less palatable than regular corn silage. It has been observed that high energy silage is drier than other silages, and these larger pieces of dry cob and stalks are not readily eaten by the cattle. Finer chopping of the high energy silage would increase the palatability of both cobs and stalks.

4. Finer Chopping of Silage Appears to Reduce Nutrient Loss Due to Whole Undigested Kernels

In making high energy silage efforts have been made to chop the corn plant as fine as possible. In doing this it was observed that more of the kernels appeared to be cracked than usual. If this proves to be true, then one of the possible energy losses in harvesting and feeding complete energy silage is reduced.

5. Length of Corn Silage Harvest Period May Be Critical

If all corn is harvested as silage and this silage is to provide all the energy in the finishing ration, large tonnages of material must be harvested and stored. The corn silage harvesting season has already been seen as a peak

load period for labor and machinery. In some areas the possibility of early frosts may reduce the reliability of corn silage as a source of high quality feed.

CHAPTER VI

IMPLICATIONS FOR FUTURE RESEARCH WITH COMPLETE ENERGY SILAGE

Complete energy silage is an important and creative concept. Because the advantages of such a feed are numerous, the production and evaluation of these silages warrant further research. Presently the most promising method of producing complete energy silage is the center-cut method. Following are some areas of research which may prove to be useful and fruitful.

(1) A reliable means of harvesting the desired length of center portion of the corn plant must be developed. As already mentioned the ear height and attitude interferes with this. Perhaps a header for the forage harvester can be developed that will lift the low-hanging ears so they will not interfere with the cutting operation. If the center-cut method catches on, it may be profitable for plant breeders to develop corn varieties having more uniformity in height and attitude of ears.

(2) More work needs to be done in harvesting and evaluating center-cut silage with varying lengths of the

center portion of the plant. In this way guideposts could be established for harvesting center-cut silage to meet different energy requirements.

(3) Corn varieties and cultural practices should be investigated in an effort to lengthen the period during which corn silage can be harvested.

(4) It appears that finer chopping of corn silage would increase palatability and decrease nutrient losses as indicated earlier. Means of finely chopping or otherwise breaking the corn plant into smaller particles need to be developed.

(5) It has been suggested that most of the corn-stalk tops and butts left in the field by the center-cut operation could be harvested as a low energy silage by use of a flail type harvester. While this silage is very low in energy, it would provide most of the energy required by beef cow herds during the winter. After observing the condition of the corn stubble following the center-cut harvest, it is quite obvious that a goodly share of the tops and butts are so trampled into the ground that much of it could not be salvaged.

Newland suggests an approach that would harvest the total nutrients produced in a field of corn. The total

corn plant would be cut off by the harvester. Portions of the plant could then be separated, chopped, and loaded into two different wagons. One wagon would consist of complete energy silage. The second would have the low energy silage for feeding the cow herd. In this manner the total corn crop could be harvested in one operation in forms that can be easily utilized.

The significance of this suggestion is likely to increase because beef cow herds are on the increase in Michigan. These herds are capable of utilizing large amounts of low energy roughages. A fair sized beef cow herd could be maintained on the amount of roughage that is lost on many farms in the form of corn stubble. In close cooperation with the Agricultural Engineering Department a machine capable of simultaneously performing these operations could probably be developed without serious difficulty.

Research in the area of producing and feeding complete energy corn silages is yet in the infant stage. The advantages and possibilities of harvesting the total corn crop are great enough to make new corn feeding and harvesting methods a potentially rich area of investigation.

CHAPTER VII

SLIDE-TAPE PRESENTATION

1. Extension Communications

The writer believes that the foregoing review and summary of research concerning complete energy corn silage represents knowledge of practical and economic value to cattle feeders. The university's research function of seeking new knowledge in this area continues. But as new knowledge is obtained through research, a second function of the university must come into play--that of extending this new knowledge to those who can use it. The task of extending useful knowledge from the university to the farm has long fallen within the particular providence of the Cooperative Extension Service. It is to this task that this paper is now directed.

As has been pointed out in the introduction, the "end product" of this paper is a slide-tape presentation which may be used by extension workers to communicate a message about corn silage usage to beef feeders. This is essentially a communications problem, and here it shall be analyzed briefly in terms of the communications process

as this process has been conceptualized by George H. Axinn in his manuscript, The Strategy of Communications.[1] Axinn breaks the communications process into four phases:

The Audience

The Message

Communications Channels

The Treatment.

The Audience.

The audience envisioned for this presentation is the beef cattle feeder. Axinn states that "The more specific your definition of the audience, the greater the chance that you will be able to communicate with that audience."[2] Herein lies a possible limitation in the effectiveness of the presentation developed in this paper, for the audience to which the message is addressed is a rather diverse one--cattle feeders. Many different types of people are cattle feeders. Some have much more education than others. Some feeders have large, specialized operations while some operate small feedlots that are just supplemental to other sources

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[1] George H. Axinn, The Strategy of Communication (unpublished manuscript, Michigan State University, 1959).

[2] Ibid., Chapter IV, p. 3.

of income. Some feeders are already feeding the maximum amount of corn silage possible while others feed very little if any. Some are early adopters while others are late adopters.

If the audience could be more definitely defined so as to include particular types of cattle feeders such as large commercial operators, then a more specialized presentation could be developed which might be more effective for that particular group. However, in the extension situation, tours and meetings are attended by cattle feeders in general, not by cattle feeders of a specific category. This presentation has information that should be useful for various classes of cattle feeders.

The Message.

As defined by Axinn the message "is the intent of the communicator with respect to the audience."[1] What the communicator intends to happen to his audience can be called his message. The acceptance of a message by an audience may be measured in terms of behavioral change of the audience. In measuring the effectiveness of the communication process it should be useful to break behavior down "into thinking

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[1] Ibid., Chapter IV, p. 7.

behavior, feeling behavior, and acting behavior."[1] In this slide-tape presentation there are three main messages for cattle feeders. In sequential order as presented in the slide-tape program they are the following:

1. If you farm good corn land, feed as much corn silage as is possible and still balance the energy level of the ration.
2. Corn silage produces good quality beef gains.
3. It may soon be possible for you to harvest all your corn crop as complete energy silage.

This slide-tape presentation will need to be evaluated by its influence upon all three phases of behavior because each of the main messages is dealing with a different phase. These phases or levels of behavior form a continuum from the thinking phase through the feeling phase to the acting phase. For any behavioral change to take place in the feeling or acting levels, a certain amount of change must already have taken place in the preceding phase.

The three messages listed above fit into this behavior continuum in reverse order from which they are listed. The third message will influence thinking behavior,

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[1] Ibid., Chapter III, p. 3.

the second will influence feeling behavior, and the first message will influence acting behavior. This is to say that it is hoped this presentation will influence some cattle feeders to begin to develop new concepts of corn harvesting, storing, and feeding; to believe or feel that corn silage produces high quality beef gains; and to feed as much corn silage as possible.

Which of these messages will be most important or most clear should depend upon the individual farmer. If he is a late adopter, the first message on advantages of feeding more corn silage may be most important. For the early adopter the concept of complete energy corn silage may be most important. For the innovator--if there is one present--all of this may be old hat and somewhat a waste of his time.[1]

Communication Channels.

The slide-tape presentation was chosen as the channel of communication for this message for a number of reasons. First, slide presentations are effective teaching methods.

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[1]The adopter groups mentioned are according to adopter categories as presented by Agricultural Extension Service of Michigan and other states, Adopters of New Farm Ideas, North Central Regional Extension Publication No. 13 (October, 1961), pp. 4-5.

"Evidence clearly supports the conclusion that films can teach factual information effectively over a wide range of subject matter content, age, ranges, abilities, and conditions and use."[1] They are effective in teaching perceptual-motor skills;[2] in modifying motivation, interest, attitudes and opinions;[3] and in teaching various concepts.[4] Contrary to often stated opinions films are at least as effective as conventional teaching methods in helping students learn how to think and to develop concepts and inferences.[5] Research also shows that, as teaching devices, filmstrips and slides are as effective as films.[6] Lillian Schwartz has also shown that as an extension education method slide-tape presentations are as effective as the more conventional lecture type of teaching method.[7]

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[1]William H. Allen, Audio-visual Communication Research, Prepared for the Third Edition, Encyclopedia of Educational Research (Santa Monica, California: System Development Corporation, 1958), p. 9.

[2]Ibid., p. 11.

[3]Ibid., p. 14.

[4]Ibid., p. 13.

[5]Ibid.

[6]Ibid., pp. 16-17.

[7]Lillian M. Schwartz, "A Comparison of Traditional and Mechanical Aid Training Methods in an Extension Home Economics Situation" (unpublished Master's thesis, Institute for Extension Personnel Development, Michigan State University, 1961), p. 35.

The slide-tape presentation is also a means of reinforcing other learning processes. It is an additional or alternate means of presenting information to farmers. Emery and Oeser have concluded that

> The degree of exposure [to a new idea or practice] is the main determinant of adoption; and the decisive extension service operations must be designed to make use of these pathways along which degree of exposure can be improved.[1]

Information about high energy corn silage is gradually appearing in research summaries and farm periodicals. Cattle feeders are beginning to ask more questions about this subject. Extension workers will need to present answers to these questions in a correct, understandable manner. This slide presentation will provide variety of treatment as well as increase the farmer's exposure to the subject. This should help to speed up the adoption process because "The greater the number of channels in parallel between the communicator and his audience, the greater the chance that message will get through."[2]

Another reason for choosing the slide-tape channel of communication is that it is a totally recorded program that

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[1]F. E. Emery and O. A. Oeser, Information, Decision and Action (New York: Melbourne University Press, 1958), p. 76.

[2]Axinn, Chapter VIII, p. 31.

can be reproduced by anyone having the necessary projector and tape recorder. By using such presentations the extension specialist can, in effect, send himself around the state without ever leaving his office. In many situations good slide presentation should be about as effective as having the specialist appear in person. This then is a means of increasing the influence and effectiveness of specialists.

Lastly, the slide-tape presentation was chosen because this channel may more effectively reach some farmers than might be the case if lectures and printed materials were used. Emery and Oeser indicate that less urbanized farmers are slower adopters.[1] They use the concept of urbanization as a measure of the "experiences in the farmer's life history which predisposes him to an unemotional intellectual or instrumental attitude to knowledge as contrasted with a personal or traditional 'craft' view."[2] Farmers at the bottom of the urbanization scale have less conceptual ability and rely more heavily upon first-hand experiences as learning experiences.[3] Visualization in the slide-tape presentation

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[1] Emery and Oeser, pp. 14-16.

[2] Ibid., p. 44.

[3] Ibid., pp. 9-10.

should help the later adopters to better understand ideas and concepts which are presented.

According to Lionberger,[1] the earlier adopters provide themselves with much of their exposure to new ideas, or at least search for information that provides them with this exposure. This information eventually filters down to farmers who are later adopters. It has been shown that early adopters are better readers and more skillful in conceptualizing new ideas than later adopters. The later adopters rely more heavily on other people to perform these functions for them. The visualization of the message in this slide-tape presentation should help later adopters to better see and understand concepts which before may not have been too well understood. To the extent that this is accomplished, the adoption process will be speeded up.

The Treatment.

"Treatment," according to Axinn, "is not a statement about how a message might be treated. <u>It is the actual content which the audience will perceive.</u>"[2] The development

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[1]Herbert F. Lionberger, <u>Adoption of New Ideas and Practices</u> (Ames, Iowa: The Iowa State University Press, 1960), pp. 36-41.

[2]Axinn, Chapter IX, p. 2.

of this treatment has been influenced by a basic assumption that if cattle feeders, like farmers in general, are presented with the relevant facts and understand these facts and their implications--they will modify their operations in such a manner as to give them the most personal satisfaction.[1] It is hoped that the audience will perceive this presentation as largely a summary of research information on corn silage usage for feeding beef cattle. An effort has been made to indicate what some of the implications are if the basic information presented in the research summaries is accepted. As the result of this treatment it is hoped that these cattle feeders who unnecessarily limit the amount of corn silage fed will increase corn silage usage to a maximum because experience shows that increased feeding of corn silage usually increases profits. It is likewise hoped that cattle feeders will feel or believe that corn silage produces good quality carcasses because research shows this is true. Finally, it is hoped that cattle feeders will begin to develop concepts of complete energy corn silage

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[1]This basic assumption that farmers are willing to learn and accept new ideas is commonly accepted by extension workers as indicated by Christopher Sower, "External Development Organizations and the Locality," Paper Prepared for presentation to the Joint Meetings of the American Sociology Society and the Rural Sociological Society in Chicago (September, 1959), p. 8.

usage because research indicates that such silage has certain economic advantages.

To be understood by the designated audience has been a major goal in developing this slide-tape presentation. Axinn states that

> The extent to which an audience will perceive a treatment as meaning what the communicator intended it to mean depends upon the extent to which the symbols used carry the same meaning for audience and communicator.[1]

It is thought that both the pictures and words chosen will be understood by the audience. For this audience the necessity of interest for holding attention was also considered to be important. To develop a presentation that was both intelligible and interesting, the writer turned for help and guidance to individuals who were knowledgeable in the fields of program content and presentation of program content. The development of this presentation involved numerous steps and processes as summarized below:

1. Summary of information that is to be passed on to the cattle feeder.
2. Checking and correcting by specialists of information for accuracy and adequacy.

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[1] Axinn, Chapter IX, p. 9.

3. Development of the script for the presentation.
4. Checking and modification of script by communication authorities for clarity and meaning.
5. Development of visual presentation.
6. Checking and redevelopment of visual presentation by visual-aids specialists.
7. Reworking of script and slides for compatability.

It is hoped that through this developmental process the goal of intelligibility and interest has been approached. It is realized that further improvements could be made through pretesting the presentation with farmer audiences, but the practical limitation of time does not permit this.

2. Script: "Center-cut Silage For Beef"

(In the following script the included numbers indicate the slide illustrating the point being discussed. Included as illustrations are photos of slides used to explain the more important points of the presentation.)

(1) Center-cut silage as a source of complete energy feed for beef cattle offers new and exciting opportunities for cattle feeders in corn producing areas. Silage feeding is well accepted, but much of the information you are going to see about center-cut silage is still in the developmental

stage. It is offered to you at this time to inform you of recent research developments which may soon become important to you--the cattle feeder.

(2) This program has been produced by Carl Silvernail in cooperation with the Animal Husbandry Department at Michigan State University and the Michigan Cooperative Extension Service. We welcome your opinions about the possibilities of using complete energy corn silage on your farm.

(3) Recent beef cattle research projects carried out by Michigan State University indicate that it may soon be possible to harvest corn in the form of complete energy silage. Such silage will not require energy supplementation with ground shelled corn or other high energy feed.

(4) Harvesting the total corn crop as complete energy silage has at least three advantages. First, corn is harvested in a one-step harvesting operation requiring only one harvesting machine. Second, the cattle feeder needs only a single type of storage facility. And third, the corn crop can be fed in the form in which it is harvested and stored. It needs no further grinding or mixing. All this would be possible with no decrease in pounds of beef gains produced per acre of corn harvested.

(5) The cattle feeding industry has undergone many changes in the last few years as have many industries in the United States. Only a few years ago most finished cattle came from comparatively small feedlots where feeding was done by hand. Today these small lots are being replaced by larger feedlots which are often highly mechanized and automated. Fewer man hours are being required to finish more cattle.

(6) Changes have taken place not only in size and mechanization of operation, but also in what the cattle are being fed. Many cattle feeders in good corn growing areas have made important changes from the conventional hay and shelled corn finishing ration. Increasingly corn silage is being used in the feedlot for finishing cattle. There are a number of reasons for this.

(7) Corn is a good yield crop. A field of corn harvested as corn silage yields far more energy than most other crops. This advantage in yield continues to increase.

(8) Great strides have been made in providing mechanical means of harvesting and handling large tonnages of heavy, bulky materials such as corn silage. Harvesting corn silage is now comparatively economical, practical, and convenient.

(9) Feeding trials and carcass evaluation show that high corn silage rations produce beef carcasses of desirable quality.

(10) Feeding trials have repeatedly shown that feeding corn silage to feeder cattle increases profits. In fact, as the amount of corn silage fed to cattle increases, profits also increase.

(11) For these and other reasons many cattle feeders have increased corn silage usage to the maximum. However, corn silage--even when full-fed--does not provide sufficient energy for maximum gains and finish on choice calves. For this reason supplementation with a high energy feed such as shelled corn is necessary. (12) If corn silage were higher in energy, less shelled corn would be needed and more silage could be fed. In fact, if corn silage had sufficient energy to meet the total energy requirements of feeder calves, no shelled corn would need to be added. (13) Michigan State University beef specialists have had this possibility in the back of their minds in some of their recent research projects. The results of these trials and experiments indicate that it may soon be possible to harvest corn as a

complete energy feed for use in the feedlot. (14) Harvesting corn as complete energy silage will have a number of advantages over harvesting corn both as silage and grain. Let us look at the methods and processes necessary to harvest corn for use in the finishing ration.

(15) First, part of the corn crop is harvested as silage using a forage harvester. After being chopped and blown into a wagon or truck, the corn is hauled to the silo for storage.

(16) Next, when the remainder of the corn crop is adequately matured, it may be harvested by a combination picker and sheller as shelled corn and stored in appropriate bins. There are a number of alternate methods of harvesting corn as silage and grain, but they are all alike in that two or more harvesting machines are required as are two or more types of storage facilities.

(17) Finally, before the silage and grain can be fed, the grain must be further processed. If stored as shelled corn--it must be ground, metered, and mixed with the silage in proper proportions so that a feed containing the needed level of energy is produced. Even with mechanization

and automation this processing and mixing is costly and time consuming.

(18) To summarize, here is what is needed to handle the corn crop as silage and shelled corn. To harvest the silage a forage chopper, wagons, and silo filler are needed. The grain harvesting requires in addition a picker-sheller and often a grain dryer. To store the two products silos for silage and bins for the shelled corn are necessary. Before the shelled corn can be fed, it must be run through a grinder. Finally, a metering and mixing device is needed for combining the grain and silage in the desired amounts.

(19) Contrast this with harvesting all corn as complete energy silage. Over one-half of the equipment we just listed is no longer needed. Because all the corn is harvested as silage, the picker-sheller, dryer, bins, grinder, and metering devices are not needed. This looks simple and easy in theory. But is this approach likely to be practical as well as profitable?

(20) Experiments being conducted at M.S.U. give us reason to believe this approach will be both practical and profitable. Complete energy silages have already been produced and fed. At one research center ground shelled corn was added to regular corn silage at silo filling time.

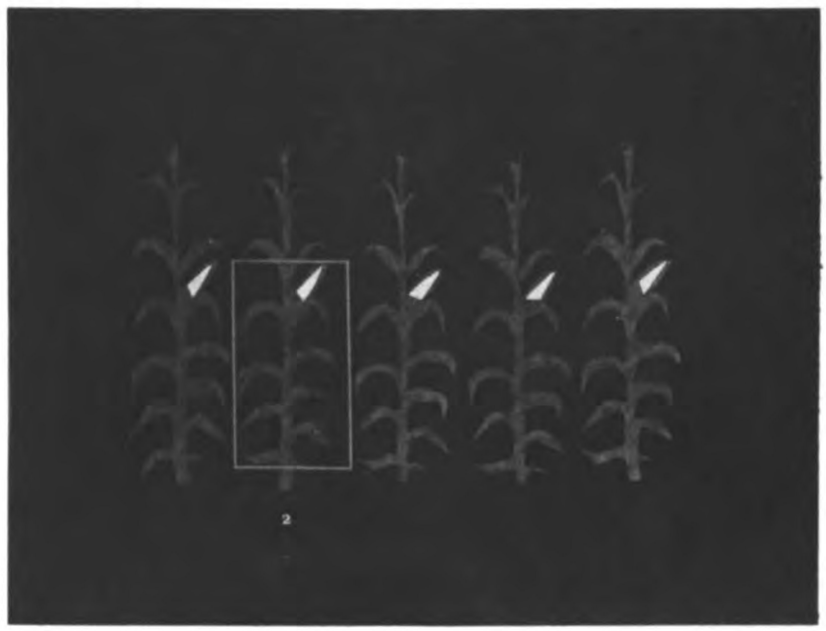

Figure 1. Portion of the corn plant harvested as butt silage.

Figure 2. Portion of the corn plant harvested as center-cut silage.

Sufficient corn was added to provide the energy level necessary for finishing feeder calves. (21) Feeding trials were conducted to evaluate this feed, and the resulting evidence is that ground shelled corn added to silage at silo filling time is as effective in producing beef gains as is ground shelled corn added to the silage when fed. This indicates that it is possible and economically feasible to produce and feed a complete energy corn silage. The method used, however, is not exactly convenient nor does it reduce machinery or storage facility costs.

(22) Other research workers made silage from dwarf corn in an effort to raise the energy level of silage. Feeding trials indicated that while this silage was slightly higher in energy, shelled corn was still required to meet the energy requirements of feeder calves.

(23) How much energy is needed to finish feeder cattle? Various factors such as age of cattle being fed and rate of gain and quality of finish desired influence the energy requirements. However, for weaning calves to finish as choice 1,000 pound steers, a ration containing 77% total digestible nutrients on the dry matter basis is generally considered sufficient. Yearling feeder stock will finish nicely on a ration with 72% total digestible nutrients.

(24) In utilizing the corn crop for finishing cattle,

the problem is to harvest and feed it in such a way as to end up with a ration containing the level of energy required by the feeding program. (25) What are the energy levels in corn as we now harvest it? Remember we said that finishing calves require a ration with 77% TDN and yearlings require 72% TDN. On the dry matter basis shelled corn is 94% TDN, ear corn is 83.7% TDN, and regular corn silage is 69.4% TDN. Not one of these forms of the corn plant meets the energy requirements of calves or yearlings. (26) For years the energy level has been adjusted to meet our feeding needs by mixing low energy feed (corn silage) with high energy feed (shelled corn) in such proportions as required. This, we have seen, results in added expenses and inconveniences.

(27) Perhaps by selecting only certain parts of the corn plant to be harvested as silage, the energy level could then be raised. We have seen that regular corn silage is too low in energy, and ear corn and corn grain are too high for our purposes. Why not harvest something <u>more than the corn ear</u>, but <u>less than the whole plant</u>? Wouldn't this change the energy level of the silage?

(28) Research conducted at M.S.U. under the direction of Dr. H. W. Newland established the following TDN levels for the various parts of the corn plant:

Whole cornstalk (no leaves and no ears)	58.8%
Corn leaves	60.1%
Cornstalk butts (stalks and leaves)	64.4%
Whole plant silage	69.5%
Ear corn silage	83.7%

You see that the cornstalk tops are lowest in TDN and the corn grain is highest.

(29) What possible ways are there to harvest the corn ear plus some remaining portion of the corn plant? Among other combinations the researchers could choose to harvest--

1. The ear plus the top of the cornstalk,
2. The ear plus the bottom portion of the cornstalk,
3. The ear only from one row of corn plus the ear and the butt portion of the corn plant from the next row, or
4. The ear plus a middle section of the cornstalk.

(30) Since the top of the cornstalk has the lowest energy level, it seems reasonable that this should be the first part of the corn plant to be discarded. By cutting off and discarding the cornstalk tops, a lower moisture and higher energy butt silage should result. (31) Researchers at M.S.U. harvested butt silage by mounting a mower on the front of a tractor. This provided a means of getting rid of the tops. The forage harvester following behind chopped only the corn

ear and bottom portion of the corn plant. (32) Chemical analyses and feeding trials indicated that this butt silage was slightly higher in energy than regular silage, so this silage required less supplementation with shelled corn and permitted more silage to be fed. However, no great advantages were realized, since corn still had to be harvested as both silage and grain.

(33) Other researchers harvested corn by taking just the ear from one row and mixing it with ear and butt silage from the next row. The resulting silage was sufficiently high for finishing yearling feeder cattle but would not do for calves. This method also required a rather complicated and thus expensive machine for harvesting the corn.

(34) M.S.U. researchers have proposed center-cut silage as a means of harvesting corn as a complete energy silage. Further research is needed before it is known just how successful the center-cut method will prove to be. However, early experiments have been promising and research on this method continues. In making center-cut silage only the ear and a center portion of the corn plant is harvested. (35) The machinery required to harvest center-cut silage is quite simple. The corn is topped at the desired level by a mower blade mounted on the front of the tractor. The ear and center portion of the corn plant are then harvested with

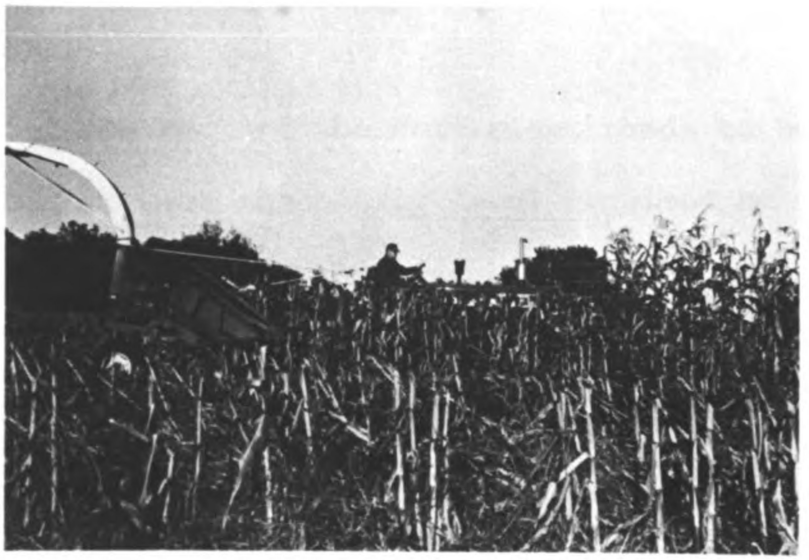

Figure 3. The harvesting of center-cut silage.

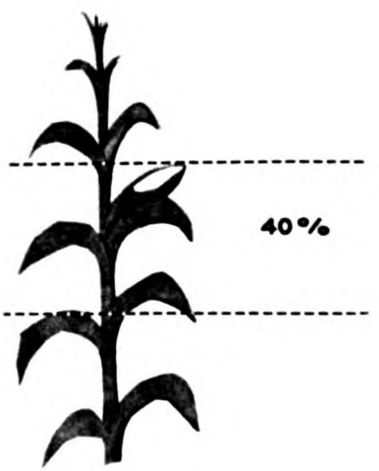

Figure 4. Portion of stalks and leaves needed with the ear to produce complete energy corn silage for beef calves (showing location of top and bottom cuts).

a regular forage harvester adjusted to cut at the height required.

(36) How much of the corn plant needs to be harvested with the ear to meet the energy level required by feeder calves? By referring to the energy levels of the various parts of the corn plant, researchers have calculated that the ear plus 8% of the plant above the ear and 32% of the plant below the ear will result in silage having the necessary energy level. These percentages of the stalks and leaves are harvested by adjusting the topper to cut as close to the ear as possible, and by adjusting the forage harvester to cut halfway between the ear and the ground. (37) A further advantage of center-cut silage is that the energy level of the harvested silage may be raised or lowered by harvesting more or less of the corn plant along with the ear. (38) We have seen that this center-cut silage will permit the beef feeder to harvest all his corn as silage. This permits single step harvesting, requires only one type of storage facility, and the corn crop can be fed as it is harvested and stored.

(39) The center-cut method of harvesting complete energy corn silage will reduce investment and operating costs of harvesting, storing, and feeding the corn crop.

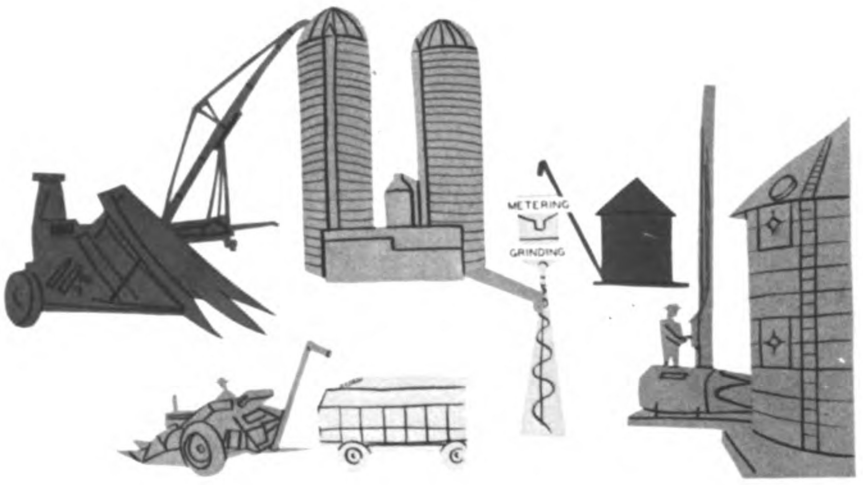

Figure 5. Machinery and facilities required to handle corn as both shelled corn and silage.

Figure 6. Reduction of machinery and facilities realized with the center-cut method.

But, what effect will this harvesting method have on beef production per farm? Will center-cut silage reduce the total beef gains produced per acre of corn harvested?

(40) Let us compare the beef gains produced by corn harvested by the conventional silage and shelled corn method with beef gains produced by corn harvested as center-cut silage. How many acres of corn are required by each of these methods to feed 100 head of 400 pound calves to finish at choice grade when they weigh 1,000 pounds? (41) In figuring this acre requirement let us assume that each acre of corn will produce 80 bushels of shelled corn or, if harvested as silage, will produce 16 tons of silage.

(42) If corn is harvested as silage and shelled corn, 64 acres will be required to finish these 100 calves. Twenty-five acres can be harvested as silage and 39 acres as shelled corn. Corn harvested as silage and grain in these proportions will provide the necessary level of energy required by these calves.

(43) By harvesting corn as center-cut silage these 100 calves will be finished on 59.5 acres which is 4.5 acres less than required by the silage and shelled corn method. This is a 7% reduction in land requirement. (44) It should be pointed out, however, that the beef gains produced per acre of corn harvested as center-cut silage are based on

the ideal situation in which just the ear and the desired 40% of stalks and leaves are harvested. Until these figures are supported by experimental evidence, it does not appear wise to plan on this reduced acreage requirement. It seems clear, however, that center-cut silage will not reduce beef gains produced per acre of corn harvested.

(45) As proposed, center-cut silage is a complete energy feed which will permit the cattle feeder to harvest all of his corn as silage. This single step harvesting method will reduce labor, machinery, and storage costs. These advantages will be realized with no reduction of beef gains produced per farm.

(46) One of the results of research efforts with center-cut silage is the development of new ideas on how to harvest in one operation the total corn plant as two different types of silage. The ear plus the desired portion of stalks and leaves could be loaded into one wagon to form complete energy silage for feeder cattle. The remaining portion of stalks and leaves could be loaded into a second wagon to form a low energy silage for feeding the beef cow herd. (47) The number of beef breeding herds being raised on high value land in the Midwest is rapidly increasing. The cornstalks and leaves that were once discarded are now recognized as being a good source of lower energy feed.

As the importance and significance of cornstalks and leaves as a feed are increasingly appreciated, more efforts will be made to harvest them.

(48) The center-cut method of corn harvesting and feeding appears to be a strong possibility in the near future. Single step harvesting of the total corn plant as two different silages shows some promise for future cattle feeders. What do you think?

BIBLIOGRAPHY

Agricultural Extension Service of Michigan and other states. Adopters of New Farm Ideas, North Central Regional Extension Publication No. 13. October, 1961.

Albert, W. W. and others. "Effect of Adding Soybean Meal to a High-energy Silage Made of High-moisture Corn and Alfalfa for Fattening Steers," Illinois Cattle Feeders' Day. University of Illinois, 1960, pp. 21-22.

Allen, William H. Audio-visual Communication Research, Prepared for the Third Edition, Encyclopedia of Educational Research. Santa Monica, California: System Development Corporation, 1958.

Axinn, George H. The Strategy of Communication. Unpublished manuscript. Michigan State University, 1959.

Barlowe, Raleigh. Land Resource Economics. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1958.

Emery, F. E. and Oeser, O. A. Information, Decision and Action. New York: Melbourne University Press, 1958.

Esmay, M. L., Boyd, J. S., and Hoglund, C. R. "Equipment, Practices, Investments and Annual Costs Associated with Tower and Bunker Silo Systems," MSU Silage Conference. Michigan State University, 1959.

Henderson, Hugh E. and others. "High Energy Corn Silage for Fattening Beef Heifer Calves," Michigan Cattle Feeders' Day. Michigan State University, 1961.

Hillman, D., Blank, G. L., and Brown, L. H. "Changing Styles of Forage Feeding and Nutrition of Animals," MSU Forage Symposium. Michigan State University, 1962.

Huffman, C. F., and Duncan, C. W. "Corn Kernels in Feces of Dairy Cattle Fed Corn Silage," Michigan Agricultural Experiment Station Quarterly Bulletin, Vol. XLI. Michigan State University, February, 1959.

Huffman, C. F., Duncan, C. W., and Dexter, S. T. "Corn Grain and Stalks (Hay-Equivalent) in Corn Silages Obtained from Random Samples," Michigan Agricultural Experiment Station Quarterly Bulletin, Vol. XLII. Michigan State University, May, 1960.

Huffman, C. F. Interviews. Professor Emeritus in Dairy and Animal Husbandry, Michigan State University, 1962.

Lionberger, Herbert F. Adoption of New Ideas and Practices. Ames, Iowa: The Iowa State University Press, 1960.

Maddex, R. L., and others. "Engineering Silage Equipment and Operations for Dairy and Beef Cattle Feeding," MSU Silage Conference. Michigan State University, 1959.

Michigan Department of Agriculture. Michigan Agricultural Statistics, A Report Prepared by the Michigan Cooperative Crop Reporting Service. Michigan Department of Agriculture, July, 1962.

Neumann, A. L., Albert, W. W., and Mitchell, G. E., Jr. "Alfalfa, Oat, and Corn Silages Containing 40 Percent Corn for Fattening Beef Calves," Illinois Cattle Feeders' Day. University of Illinois, 1958.

Neumann, A. L., and others. "Comparison of Alfalfa and Oat Silages Containing High-corn Addition with Corn Silage for Fattening Beef Calves," Illinois Cattle Feeders' Day. University of Illinois, 1957.

Neumann, A. L., and others. "Effect of Length of Heavy Corn Silage Feeding Period on Total Feed Requirements and Carcass Yield and Grade in Fattening Steers," Illinois Cattle Feeders' Day. University of Illinois, 1962.

Neumann, A. L., and others. "Effect of Moisture Level in Field-shelled Corn on Harvesting and Storage Losses and on Feeding Value for Beef Cattle," Illinois Cattle Feeders' Day. University of Illinois, 1959.

Nevens, W. B., and others. "The Ear and Leaf-stalk Contents of Corn Forage as Factors in Silage Evaluation," Journal of Dairy Science, Vol. XXXVII (1954), pp. 1088-1093.

Newland, H. W., and Huffman, C. F. "'High Energy' Corn Silage--A New Approach for the Cattle Feeder," MSU Forage Symposium. Michigan State University, 1962.

Newland, H. W., Silvernail, C. G., and Hansen, C. M. "Effects of Adding Various Levels of Shelled Corn to Topped (Butts and Ears) Corn Silage for Fattening Heifers," Michigan Cattle Feeders' Day. Michigan State University, 1962.

Plog, John, Newland, H. W., and Henderson, Hugh. "Nutritive Value of Silage Made from Various Parts of the Corn Plant," Cattle Feeders' Day. Michigan State University, 1960.

Schwartz, Lillian M. "A Comparison of Traditional and Mechanical Aid Training Methods in an Extension Home Economics Situation." Unpublished Master's thesis, Institute for Extension Personnel Development, Michigan State University, 1961.

Snapp, Roscoe R., and Neumann, A. L. Beef Cattle. 5th ed.; New York: John Wiley and Sons, Inc., 1960.

Sower, Christopher. "External Development Organizations and the Locality," Paper Prepared for presentation at the Joint Meetings of the American Sociology Society and the Rural Sociological Society in Chicago. September, 1959.

White, Robert G. "Minimum Tillage Field Day Results." Agricultural Engineering Department, Michigan State University. (Mimeographed.)

White, Robert G. Interview. Extension Agricultural Engineer, Michigan State University, 1962.

White, Robert G., and McColly, Howard F. "Methods, Equipment, Power and Investments for Harvesting and Storing Hay and Silage," MSU Silage Conference. Michigan State University, 1959.

Williamson, J. L., and others. "Chemical and Nutritive-value Changes in Alfalfa Silage Made with High Levels of Added Corn," Illinois Cattle Feeders' Day. University of Illinois, 1957.

Zimmerman, J. E., and others. "Dwarf Versus Regular Corn Silage for Beef Cattle," Illinois Cattle Feeders' Day. University of Illinois, 1960.