MINNESOTA FEED SERVICE

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A NEW LOOK IN SHEEP AND CATTLE FEEDING?

Complete Pelleted Rations

R. J. WEBB*

The pelleted, complete ration—fed automatically—is the new look in beef cattle and sheep feeding. Self-unloading wagons and trucks, front end loaders, self-feeders, feed bunk augers and belts, and automatic grinding and mixing equipment have put most beef cattle and sheep feding operations in some stage of mechanization and automation.

The complete ration is a natural for these mechanized set-ups, and pelleting this complete ration has in most cases increased the meat-producing ability and efficiency of the operation.

A first cutting timothy-alfalfa hay mixture was self-fed as hay pellets, baled hay, and chopped hay to three lots of 15 steer calves each at the University of Illinois Dixon Springs Station for 119 days in the winter of 1955-56.

Calves fed hay pellets gained an average of 1.73 pounds per day, compared to 0.63 pounds and 0.62 pounds per day for calves fed baled hay and chopped hay, respectively. The calves consumed 15.7 pounds of hay-pellets per day, while 11 pounds baled hay hay and 10.7 pounds chopped hay were eaten. Thus, much of the difference in performance can be attributed to the 43 percent increase in consumption of the hay pellets.

Each year, a group of nationally known agricultural scientists presents a roundup of information on feeds and feeding practices at the Animal Nutrition and Health Short Course, held in September on the University's St. Paul Campus. As in the past, much of this fall issue is devoted to reports from the 1958 event. Some new feeding ideas are presented which could find good use in Minnesota's livestock industry.

Cost of Pelleting

Only 906 pounds of hay in the pelleted form were required to produce 100 pounds of gain, but 1,732 pounds of baled hay and 1,722 pounds of chopped hay were required per 100 pounds of steer gain. With baled and chopped hay at $20.00 per ton, the cost per hundredweight of gain was $17.32 and $17.22, respectively. Figuring $10.00 per ton for grinding and pelleting the hay, or a total cost of $30.00 per ton, the feed cost per hundredweight was $13.95 when hay pellets were fed.

Similar results were obtained the following winter when a ton of alfalfa hay-pellets produced 253 pounds of steer calf, timothy-alfalfa pellets 206 pounds, and baled hay less than 100 pounds.

In a 1956-57 test at the Imperial Valley Field Station, El Centro, California, alfalfa hay was fed to yearling steers as pellets and baled hay free choice, along with 2 pounds of barley and 2 pounds of oat hay. Gains were 2.17 pounds per day in the hay-pellet lot and 1.80 pounds in the baled hay lot. Little difference was noted in efficiency of feed utilization.

In 1958 tests are Purdue, similar gains were obtained in the pelleted vs. meal rations, but 13.7 percent less feed was required in the pelleted rations. The steers consumed 11 percent less daily feed on the pelleted rations.

Results of tests with hay pellets suggest taking another look at potentials of hay as a beef-producing feed. Pelleting hay increases the density 3 to 5 times, compared to baled, chopped, or long hay. The advantages in storing, shipping, handling, and feeding are obvious.

Feeding one complete ration to beef cattle and sheep has been gaining popularity rapidly in recent years. Some increase in feed utilization has been noted, but most advantage has been in increased efficiency in handling and feeding.

Pelleting the complete ration has shown some further advantages. In a 1954-55 test at the Dixon Springs Station, Robbs, Illinois, steers on a complete ration gained 2.75 pounds per day compared to 2.58 pounds on the same ration in meal form. The pellet-fed steers required 14 percent less feed per hundredweight gain than those getting the meal. The pelleted ration was worth $6.39 more per ton than the meal ration.

Kansas workers report that feed efficiency was significantly improved by pelleting a complete ration for beef heifers. Stanford Research Institute, California, reports a 15.4 percent improvement in feed efficiency on a pelleted, high-roughage (64 percent) ration and 13 percent improvement in efficiency on a high-concentrate (60 percent) ration in fattening steers. There was no significant differences in average daily gains. Workers at Washington report a 20 percent increase in feed efficiency for a pelleted ration compared to non-pelleted ration for beef heifers.

Pellets for Lambs

Pelleted complete rations fit well into lamb feeding programs. Reports from Kansas and New Mexico indicate faster daily gains and less feed per 100 pounds of gain when pelleted rations are compared with the same ration in other forms. Purdue has developed a complete pelleted ration for lambs which they described as a "real 'breakthrough' in lamb feeding."

In a lamb feeding trial in 1953 at the Dixon Springs Station, no significant advantage was found by pelleting an

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Some Considerations in Producing Meat-type Hogs

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The future welfare of the swine industry appears to be dependent upon the production of meat-type hogs. Unfortunately, the term "meat-type" is misleading to a fair number of persons concerned with the hog business. As a result some producers are marketing what the trade calls "slim jims," "scalywags," and "meatless wonders."

Actually, we use the term "meat-type" hog only to imply that we want a well-muscled, meaty pig that will yield a high percentage of its live weight in the four lean cuts (ham, loin, picnic, and boston butt).

Since the swine producer is dependent upon consumer demand, one of his goals must be the development or production of hogs that yield a high percentage of lean cuts of the right size, correct weight, proper eye-appeal, and desirable lean-to-fat-ratio.

The three major considerations of the swine producer are: (1) Breeding, (2) Feeding, and (3) Marketing.

Breeding

Breeding is set up as the first consideration because this seems to be the only approach that is feasible over the long run. Partial summarizing of the results of the 1958 spring and summer testing program at the Minnesota Swine Evaluation Stations show these results:

Barrows, all of which were thought good by their owners, had from as little as 1.16 to as much as 2.13 inches of backfat. This same group of barrows showed a range of from 2.60 to 4.80 square inches of loin eye as measured by a cross section of the loin at the tenth rib.

The range in percentage of 4 primal cuts of "off-test" weight for this same group of barrows was from a low of 28.7 to a high of 38.7. The poorest pig at 200 pounds yielded 57.4 pounds of the 4 lean cuts while the best pig yielded 77.4 pounds of these same cuts—a difference of just 20 pounds.

It might also be pointed out that there was a difference of more than 3 inches in the length of the shortest and of the longest pig of the more than 100 barrows slaughtered.

The most efficient pen of pigs required 253 pounds of feed per hundred pounds gain, while other pens required as much as 350 pounds of feed for the sameamount of gain. With the average cost of feed at $60 per ton, this difference in efficiency represents a difference of $3 per hundredweight in cost of gain.

Although a few boars probed less than 1 inch of backfat at 200 pounds live weight, it was also found that a large number of boars probed more than 1.4 inches of backfat, and some boars probed over 1.6 inches of backfat.

All of these pigs were fed the same rations throughout the test period and had maximum opportunity to express their inherited capacity to become fat or remain lean and meaty, to gain efficiently, and to gain rapidly. The wide variation in performance indicates that a proper breeding program is the most feasible approach to producing the meat-type hog.

It seems reasonable that the commercial producer should concentrate on purchasing the right kind of boar year after year and depend upon these boars to improve the meatiness of his hogs, rate of gain, and efficiency of feed utilization.

Although some breeds of hogs have the "reputation" of being fat and others have the reputation of being lean, some of the very best gaining and cutting barrows came from the so called "fat breeds" in tests. On the other hand, some of the poorest cutting barrows came from the breeds which are supposed to be lean.

Most commercial producers will get the best performing and the best carcass hogs through some type of cross-breeding program. It has been demonstrated at the Southern Experiment Station, Waseca, that level of performance of pigs produced by a three-way rotational crossbreeding system was above that of pigs produced by a two-way rotational crossbreeding system.

At present, the most reasonable approach for rotational crossbreeding systems is to recommend use of breeds that can complement one another in such traits as rate of gain, prolificacy, mothering ability, and carcass quality.

The producer should have boars from large litters and the boars should not have more than 1.0 to 1.2 inches of backfat at 200 pounds. They should weigh 200 pounds at 150 days of age, or less, and should be from litters, or sire groups, requiring as much less than 300 pounds of feed per hundredweight of gain during the 60- to 200-pound period as possible.

Feeding

As swine production becomes more and more specialized, the swine producer must think in terms of full-feeding his hogs a well-balanced ration until they are marketed—if he is to make maximum use of his facilities and keep his program properly sequenced. Meat-type hogs must have the inherited capacity to be self-fed a typical corn-belt growing-finishing ration and still go to market as well-muscled, meaty animals.

There are alternatives to the full-feeding program. It has been shown that by feeding high-fiber rations, limited feeding or hand-feeding, the rate of gain can be reduced, giving the pig more time during which to grow and resulting in less fat and more lean.

One major drawback is that pigs fed bulky rations sometimes require more feed per hundredweight of gain. For example, including 8 percent alfalfa meal in rations fed to growing-finishing pigs at the University of Minnesota retarded gains by as much as 10 percent, but those pigs also required from 10 to 14 percent more feed per hundredweight of gain. The same pigs required 10 additional days to reach market weight—a hazard in event of disease outbreaks.

If rations which were even more bulky were used, rate of gain would be decreased to a greater extent, the pig's time on the farm increased, and the feed per hundredweight of gain probably increased.

It has recently been reported that the addition of 3-Nitro-4-hydroxy phenylarsonic acid increased carcass leanness about 12 percent based on live probe of backfat. This has been construed by some to mean that the use of this feed additive will accomplish as much as 2 to 3 years of constructive breeding.

That might be true, but it would still be unfortunate if the swine producer were to rely upon this as a means of producing meat-type hogs. Such a reduction of backfat thickness on market

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Developments in Feed Additives for Beef Cattle

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Tapazole

This is probably the most recent feed additive used in experimental rations for beef cattle. To date, it has not been approved by the Food and Drug Administration as a feed additive for beef cattle rations.

In view of the preliminary reports which appeared to have great possibilities, even greater benefits than stilbestrol, and also because of the publicity which aroused the feed industry this last spring, we might look at the data reported thus far.

Iowa State College made the first report with Tapazole. In a 79-day feeding trial with 0, 200, 400, 600 and 800 mg. of Tapazole in the daily ration of 980-pound steers, the average daily gains were 2.95, 3.39, 3.12, 3.58 and 3.01 pounds, respectively. The steers fed the 600 mg. level of Tapazole made the most efficient gains. The poorest feed utilization was made by the control group. Carcass grades were not improved by Tapazole.

The Arizona Experiment Station fed seventy-two yearling steers for 93 days. Two levels of Tapazole were fed to steers that had been implanted with 6, 18 or 30 mg. of stilbestrol. The daily gains for the groups fed 0, 148 mg., and 284 mg. of Tapazole were 2.72, 2.82 and 2.66 pounds respectively. The investigators reported an improvement in carcass grade from 0.4 to 1.75 of the Federal grade over those which did not receive Tapazole. Differences in feed efficiency and dressing percentage were very small.

The Missouri Experiment Station fed Tapazole to 800-pound steers during the last 42 days of the 142-day feeding trial. The gains were not increased, 1.95 pound (control) vs. 1.76 pound (Tapazole) daily gain, during the last 42 days. There was no appreciable difference in feed efficiency or dressing percentage. Carcass grades were slightly higher in the group that was fed Tapazole.

Dynafac

Dynafac is considered to be a growth promotant for livestock. The compound is described as a "chembiotic" in which the chemical material possesses antibiotic-like activity but is not obtained from fungal or microbial fermentation processes.

Two experiment stations have reported some benefit in increasing gains by the addition of Dynafac.

Tranquilizers

The use of tranquilizers as a feed additive in beef cattle rations has not been approved by the Food and Drug Administration. Published reports of tests where tranquilizers were fed to beef cattle indicate variable responses in gains, feed efficiency, and animal behavior.

Feeding tests with beef cattle on wintering and fattening rations at four experiment stations (Nebraska, Purdue, Oklahoma, and Kansas) do not show any consistency in the performance of cattle by the addition of tranquilizers. Different factors—such as size of animals, type of compound, and level of tranquilizer fed—may account for these variable responses.

Stilbestrol

The use of stilbestrol, as implants or in the daily ration, is an accepted practice today by the majority of cattle feeders. Experimental results which have been accumulated in the past 3 or 4 years reveal the following:

1. Feeding of 10 mg. stilbestrol in the daily ration increases steer gains 15 to 20 percent above those not receiving it.

2. Although there have been some exceptions, the stilbestrol implants at 24 or 36 mg. levels have given comparable results to those with oral administration of stilbestrol.

3. Stilbestrol increases feed efficiency about 15 to 20 percent.

4. Stilbestrol produces greater response in weight gains when it is implanted or fed to cattle on high energy rations as compared to low energy or non-fattening type rations.

5. Stilbestrol is more effective for steers than for heifers when weight gains ande feed efficiency are compared.

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hogs which would normally have 2.0 inches of backfat at 200 pounds would still fail to make No. 1 butcher hogs.

With a higher percentage of strictly "meat-type" hogs, it may be necessary to revise our recommendations on protein content, especially if results of future research indicates a higher protein requirement for these pigs.

Four experiments at the Universtiy of Minnesota's St. Paul Campus fail to show any improvement in carcass quality of growing-finishing swine which were fed rations containing more than the generally recommended levels of protein.

However, a more recent large-scale experiment at the North Central Experiment Station, Grand Rapids, shows that pigs fed rations containing more protein than generally recommended had significantly higher percentages of the four lean cuts of carcass than did pigs fed a low level of protein.

The levels of protein were 18, 16, and 14 percent when pigs were placed on test. These levels were reduced to 15, 13, and 10 percent, respectively, when the average weight of pigs within a lot reached 100 pounds. This may indicate that the pigs used at Grand Rapids actually had a higher protein requirement than those used in earlier experiments on the St. Paul Campus.

It still appears questionable to feed substantially more protein to pigs with the idea that such a practice would result in a "meat type" hog.

Marketing

The producer can, through a proper breeding and feeding program, produce very desirable hogs weighing 190 to 210 pounds. If he markets such hogs at weights over 210 pounds—at least until he has developed strictly meat-type hogs—some of his hogs may not sell as No. 1 butchers. In addition, he only aggrevates the situation of the processor when he markets hogs which yield too much fat and may also yield cuts that are undesirable because too large or too heavy.

Timely marketing often will do a great deal to aid the breeding program, particularly until the quality of the hogs is well fixed. One producer, for example, marketed 380 hogs at an average weight of 199 pounds. A large number of these hogs were marketed at 190 pounds because it was obvious that if they were held until they reached 205 to 210 pounds they would grade as No. 2 butchers. Of the 380 hogs, 26 graded No. 2, two graded No. 3, and the remainder graded No. 1.

This producer realized an average premium of $1 per hundredweight on this entire group of hogs, or approximately $726 by marketing the right kind of hogs. Part of this success was due to breeding, but part was also due to timely marketing.

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IMPORTANCE AND USE

Mechanical Cro

Drying equipment can be used on hay, small grains, and corn. However, it is necessary to do some planning ahead before actual purchase and installation to be sure this drying equipment will be an asset to the farm business, and not a liability.

Because of unfavorable drying conditions, mechanical drying equipment is helpful in getting hay and corn dry enough to store safely. This is especially important with corn, where high humidity and cool fall temperatures often combine to make safe storage difficult. In addition, Minnesota farmers select their corn varieties in such a way that mechanical removal of moisture is necessary in most years.

A recent Minnesota survey by the State Federal Crop and Livestock Reporting Service shows that 45 percent of the corn acreage is planted to medium-maturing varieties, 41 percent to late-maturing varieties.*

In the important corn producing southwest and south central regions, 70 percent of the acreage was planted to late maturing varieties. This selection of late-maturing varieties introduces additional risks, especially where the corn crop is marketed directly as grain rather than through livestock.

How Does Corn Dry in the Field?

Corn changes in moisture content more rapidly in the earlier stages of ear development. As the corn matures and dries in the field, the rate of moisture reduction consistently decreases. Table 1 shows the trend for moisture reduction at various stages of growth over several years.

The table is based on data collected at the Iowa Experiment Station at Ames, Iowa. The kernel moisture reduction figures, therefore, are likely to be higher than is actually experienced under Minnesota conditions.

Knowing the stage of growth and the approximate rate of kernel moisture reduction per day will enable you to make reasonably accurate estimates of (1) the present moisture content of the corn, and (2) the approximate harvest date for a particular moisture content. These estimates may help in determining whether mechanical drying will be advantageous.

Corn not cribbed at safe storage levels results in two major problems: heating, and mold development. Both of these factors reduce the market and feeding value of the grain. Corn that had been properly dried mechanically in 1957 was generally of a higher grade than corn which heated and molded in storage.

Drying of Corn for Industrial Use

Industrial use of corn is a relatively small part of the total corn crop produced in Minnesota. However, this outlet is important to many country elevators. Certain precautions need to be taken to assure that dried corn will be acceptable for industrial use. Much of the commercial and farm drying of corn is done at too high temperatures for it to be acceptable for industrial use.

Recent work at the Northern Utilization Research Laboratory at Peoria, Illinois, shows that high temperature drying reduces the recovery of starch. When the temperature of corn was 200° F., only 73 percent of the starch was recovered. This compares with 83 percent starch recovery when the air and kernel temperatures were 120° F. Starch recovery from material dried at higher temperatures was also more difficult.

Based on these research findings, the Corn Industry Research Foundation recommends 140° F. as an absolute maximum air temperature for drying corn that may move into industrial use. To avoid market discrimination, dryer operators should avoid high temperature drying.

Corn and Hay Drying with the Same Equipment

When considering the purchase of corn drying equipment for the farm, it may be wise to consider using the same equipment for hay drying. It is usually necessary in our humid climate to use heated air for drying corn in the fall. However, some equipment that is now on the market can be so modified for hay drying that heat is not necessary.

Actual farm experience and research results have shown definite benefits in mow curing of hay. By using mechanical drying, the benefits of early cut hay can be fully realized. Dry matter losses usually do not exceed 20 percent and can be as low as 10 percent, depending upon efficiency of equipment. Compare this to the average dry matter loss of 20 percent through field curing when the hay is not damaged by rain and 40 to 50 percent when hay is rain-damaged.

Cost per ton of dry hay will range from $1.85 to $2.30 for power costs and equipment depreciation. The extra quality of the hay, however, is equal to this cost and in most cases is even greater.

Mow curing makes it possible to save more of the leaves and therefore feed a higher protein hay. This is possible because hay can be placed on the drier at 35 to 40 percent moisture. Leaf losses generally occur in the field when hay is raked and baled or chopped at the lower moisture levels which are considered safe for storage when mow drying is not used.

An extremely important factor when setting up any type of drying equipment, whether it be for commercial or farm use, is to get competent assistance from engineers. There is no one best system for all operations and in most cases of mow drying equipment, a certain amount of special planning is necessary to be sure that the equipment will work efficiently.

—William F. Hueg, Jr., Extension Agronomist

* Early maturing varieties 95 days or less; medium maturing varieties 95 to 109 days; late maturing varieties 110 days or more.

Table 1. Rate of moisture reduction for corn in the field in relation to stage of growth

Stage of growth	Approximate kernel moisture (percent)	Approximate rate of kernel moisture reduction per day (percent)	Approximate number of days required
At pollination	90*		
Water blister	88-85	2.00	6
Beginning roasting ear	85-75		
"Milky" roasting ear	75-70	1.30	19
"Doughy" roasting ear	70-60		
Denting	60-50		
Final development and drying	50-25	0.75	33†

* Includes cob and undeveloped kernels.

† Additional 7-28 days are required for moisture reduction from 25 to 20 percent.

Drying

DRYING EQUIPMENT

Minnesota farmers regularly lose a good deal of the feed value in their hay and grain through poor drying. Mechanical drying equipment can help solve the problem, but installation and use require careful planning according to the individual farm operation. Now, while problems from this harvest are fresh in mind, is a good time for each farmer to consider the possibilities of dryers and plan toward next year.

The basic principle involved in artificial drying of hay, small grains, and corn is to force air through the high-moisture crop, thus reducing the moisture content to a safe storage level. To do so, a fan, electric motor to drive it, and an air distribution system are necessary.

Drying can be done with unheated air or with heated air. The limitations or unheated air-drying are much greater than those of heated air-drying.

Hay Drying Equipment

There are two types of fans in general use—the propeller and the centrifugal. Either is satisfactory. Most common sizes of electric motors used are 5 horsepower and 7½ horsepower. The latter is the largest single-phase motor most power suppliers will allow connected to their line.

Loose, chopped, or baled hay can be dried. A number of different systems can be used, depending upon the amount of hay to be dried and the type of structure in which it is to be dried. The amount of hay which can be dried at one time is limited by the capacity of the fan.

For drying in structures up to 30 feet in width, only a central duct is necessary. This can be an A-frame or a rectangular duct. Such an air distribution system is least expensive.

In wider mows, a central rectangular duct with a slanted floor is generally used. Such a system is more flexible but is also more expensive. If air-cooled doors are provided in the duct, any portion or all of the system can be used at one time as may be necessary.

A low-cost drying structure for chopped hay can be made from poles 25 or 30 feet long set to form a circle about 22 feet in diameter. Snow fence or welded mesh can be used as walls. A vertical duct constructed in the center with a lead to the side of the structure allows air to be blown uniformly through chopped hay placed in it.

A structure of the same general type but somewhat more elaborate, and thus more expensive, can be used as a self-feeder for livestock. With this the chopped hay is blown in and needs no further handling.

It is important that the fan used for hay drying have a capacity of 500 c.f.m. (cubic feet per minute) per ton at 1 inch static pressure. Generally a 5 h.p. fan will deliver about 15,000 c.f.m. at 1 inch static pressure. That means that 30 tons of wet hay is the maximum that can be done on the system at any one time. With a 7½ horsepower fan, the maximum would be about 40 tons.

Drying should be completed in 7-10 days to avoid mold damage. The fan should run continuously from the time the hay is put on the dryer until drying is completed regardless of weather conditions. After the first batch is dry, some additional hay may be placed on the system.

The cost of a new fan and motor in the 5-7½ horsepower class will range between $800 and $1,200. Used fans can often be purchased at a much lower price.

In an experiment conducted at the University of Minnesota, cost of electric power for drying hay with natural air ranged between $.96 and $1.85 per ton.

When heated air is used, hay can be dried much more rapidly. The amount of hay that can be dried at one time is determined by the moisture content of the green material and the amount of heat supplied. No more hay should be put on the system than can be dried in about 3 days, in order to avoid mold growth.

Because of possible fire hazards involved, it is best to dry hay with heated air outside the barn. Cost of heat and power in University experiments ranged between $1.85 and $2.30 per ton. If hay over 40 percent moisture is dried, the cost will be somewhat greater.

Corn Drying Equipment

In drying corn, the same principle of design applies as that mentioned for hay. That is, regardless of the type of structure used, have the air distribution system designed so that the drying air will have to travel the same direction through the material being dried. The same fan and motor used for hay drying can be used for corn drying, depending on the amount of corn to be dried. It may be necessary, however, to reduce the speed of the fan, especially if supplemental heat is used.

Little drying takes place with natural air when the temperature is below 50° F. and the relative humidity is above 70 percent. Since these conditions do not generally prevail in Minnesota during the time corn is harvested, natural air should not be relied upon for drying ear corn with a moisture content of over 30 percent.

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ECONOMIC ASPECTS

"Will drying equipment pay for itself on my farm?" To answer this question, Minnesota farmers must compare the annual costs and expected returns for each particular situation.

Hay-Drying Installation

Added income can be realized from the effects of three different factors when a hay-drying installation is put into use on a dairy farm. The three results normally observed are: (1) less need for grain and protein concentrates, (2) an increase in hay yield, and (3) increased milk production per cow.

Feed Savings — Farmers with barn-cured hay have found that requirements for concentrates are considerably lower than they were in an average year before the hay dryer was installed. Normally, this savings in feed would amount to between 6 and 10 bushels of corn-equivalent per cow and about 200 pounds of protein concentrates during the winter feeding period.

Such a savings in feed costs, brought about by feeding higher quality hay, was shown in a study of 34 dairy farms in Michigan.* This particular study, done in cooperation with the U.S. Department of Agriculture, showed a saving of over $20 per cow in feed costs when excellent hay was fed as compared to feeding poor quality hay. Mow drying, properly done, assures high quality hay.

Yield Increase — Reduction of field losses obtained with artificial drying of hay means higher harvested yields and, consequently, lower acreage re-

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* Special Bulletin 390, *High Quality Roughage Reduces Dairy Costs*, C. R. Hoglund, Department of Agricultural Economics, Michigan State University.

ECONOMIC ASPECTS OF CROP DRYING

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quirements. Consider the impact of this on 30-cow dairy farm.

If a potential yield of 3 tons per acre is assumed, and the normal hay requirement is 100 tons per year, it would take 47.6 acres of hay with normal harvesting methods. This is based on an average 30 percent loss in dry matter each year if every other cutting is rained on. Mow curing would cut the loss to 20 percent or less and thereby reduce acreage requirements to 41.6 acres. Thus a saving of 6 acres is realized with the barn-cured method.

Depending on the particular farm situation, this 6 acres could be used in a variety of ways. It could provide hay for 4 or 5 more cows, or it could provide corn for an additional 20 to 25 hogs. Even considering corn alone as a cash crop, 360 bushels of corn could be harvested from these "extra" acres in most of the corn-producing area of the state. Since production costs for corn are about equal to those for alfalfa hay, this would mean an additional net income of about $400.

Production Increase — Most farmers find that it is impossible to compensate completely for poor quality hay by increasing grain and protein rations when they are caught with poor quality roughage. Consequently, when poor quality roughage is fed, milk production is lower despite heavier grain feeding.

A group of 15 farmers in Northern Minnesota increased their average BF production by more than 80 pounds per cow in the past 4 years. A large proportion of this increase was due to improving the quality of hay, silage, and pasture. At the same time they have been decreasing grain and concentrate feeding.

Total Increase in Returns—However, even if we were to ignore the possible increase in production per cow, the increased returns from a hay dryer installation for this 30-cow herd would be as follows:

6 bushels less corn-equivalent per cow equals 180 bushels × $1.10 = $198.00.

200 pounds less protein concentrates per cow equal 6,000 pounds × .045 = $270.00.

6 acres of corn at 60 bushels per acre equals 360 bushels × $1.10 = $396.00.

Total added returns $884.00

Costs — How about the extra costs? For purposes of our example, let's assume that the cost of electricity in drying this quantity of hay would be about $1.00 per ton. To this variable cost, we should add the ownership costs encountered any time an investment is made in farm machinery. These are depreciation, interest, and repair costs. These costs are enumerated in table 1.

Table 1. Annual operating costs of Mow Dryer (43-inch fan and 7.5 horsepower motor, and cost of ducts)

Total investment	$1,500.00
Depreciation (5%)	75.00
Interest (5%)	38.00
Insurance (0.2%)	3.00
Repair (1%)	15.00
Electricity at $1 per ton	100.00
Total Annual Cost	$ 231.00

Thus, comparing the annual cost with the annual return, we find a net advantage of 563 per year. This would be even greater if the motor and fan were used in grain-drying operations, too. A portion of the ownership costs could then be charged against the grain drying.

Any dairy farmer can make a similar budget analysis for a proposed drying installation on his farm. It appears, though, that this would be a sound investment for anyone intending to remain in the dairy business. (Similar benefits would show up in beef feeding.)

Corn-Drying Installation

Added Costs—Since heated air is generally required for satisfactory results in drying corn, the original investment in equipment is usually greater than for a hay-drying installation. But to determine the profitability of the corn dryer, the same budgeting procedure can be used.

Annual ownership costs as well as variable costs of fuel should be considered. Assume that a direct-heat portable dryer or a small batch dryer can be purchased for $2,600. The annual costs of drying 5,000 or 7,000 bushels would be as shown in table 2.

Table 2. Annual operating costs for a corn dryer

	5,000 bu.	7,000 bu.
Depreciation (10%)	$260.00	$260.00
Interest (5%)	65.00	65.00
Insurance (0.2%)	5.00	5.00
Repair (4%)	104.00	104.00
Fuel (5c/bu.)	250.00	350.00
Labor ($1.25/hr.)	76.00	88.00
Total Annual Cost	$760.00	$872.00

Fuel and labor costs are calculated on the basis of a moisture reduction from 25 to 13 percent. The capacity of this dryer would be about 20 bushels per hour for this amount of drying. It is assumed that one fourth of a man's time is needed to operate the dryer.

If this dryer is also to be used for other crops, the total fixed cost—depreciation, interest, insurance, and repair—should be apportioned between the various crops. For example, if only half of the fixed costs were charged against the corn crop, total annual costs of corn drying would be reduced by $217.

Added Returns—The main things to consider on the return side of the ledger are:

1. Greater yields due to lower field losses—average savings in field losses will amount to about 5 percent.

2. Greater yields due to the larger yield potential of later maturing varieties—up to the limit recommended for the area. (Beyond this limit, average yields over a period of years will probably be reduced due to losses in years when corn does not mature.) Within this limit, a 5-day later corn than otherwise would increase average yields 5 percent or more.

3. The price differential in wet corn years or the cost of commercial drying—the price discount is about 2 cents per percentage point above 14 percent—the commercial drying charges vary somewhat by areas.

4. Affords more opportunity for fall plowing—early spring seeding usually means larger yields for grain crops.

Using these criteria, annual return from a corn dryer can be calculated as shown in table 3.

Table 3. Annual expected returns from a Crop Dryer

	5,000 bu.	7,000 bu.
Field losses saved	$250	$350
Later maturity	250	350
Commercial drying cost (1 yr. in 4)	188	263
Expected Annual Returns	$688	$963

No credit is given for point 4 above, since the use of later varieties might largely offset this. If the latest recommended varieties are already being grown, credit could be given for point 4 but not for point 2.

It will be noted that the value of extra corn harvested amounts to 10 cents for each bushel of normal production. (Corn is valued at a dollar per bushel since extra costs of drying, handling and storage would cost about 10 cents per bushel). Returns over this will vary greatly depending on the frequency of "wet corn" years.

In the above example, it is assumed that a drying cost of 15 cents per bushel is incurred once every four years. If these losses occur 2 years out of 5, this particular drying installation would pay off the farmer producing more than 5,000 bushels of corn as a cash crop.

However, if drying charges or wet corn discounts are never incurred, annual costs of drying must be kept under 10 cents per bushel before a drying installation becomes profitable. This would necessitate a lower cost installa-

Importance of Texture in Dairy Feed Formulation

W. E. PETERSEN*

The texture of the feed fed dairy cattle has, within recent years, been shown to have important effects in results obtained. With a number of different methods now used in processing both concentrate and forage, texture effects are of significant importance.

Fineness of grinding of concentrate has been a question for many years, the majority favoring moderate or medium fine to very fine. Reasons given against fine grinding are lower palatability and digestibility.

More recent work at New Hampshire, in which a commercial mixture was reground by hammermill with a 3/32-inch screen, showed fine feed to excel coarser feed in digestible protein and TDN. The coarse, the very coarse, and the pelleted feeds were equal in nutritive value. Ground corn was superior to flaked corn, but crimped oats were superior to ground oats. The New Hampshire workers suggest adding crimped oats to otherwise finely ground mixtures.

The most dramatic effect of texture upon performance of a feed comes from grinding forage. Finely-ground forage reduces fat percentage of the milk, with some evidence of a reduction of the solids-not-fat as well.

High concentrate with low-roughage rations have been reported in some cases as lowering fat percentage. The makeup of the concentrate is important as to the depressing effect. Flaked corn is more depressing than crushed oats or barley. Wisconsin workers have reported that about 4 pounds of hay is enough to overcome the depressing effect upon fat percentage from an all-concentrate ration. Grazing young pastures, especially green oats, lowers fat percentage as much as 50 percent. Adding as little as 4 pounds dry hay per day will largely overcome the depressing effect.

There is now evidence that the depressing effect upon the fat percentage is due to a change in volatile fatty acid production in the rumen. Workers found that 1 pound sodium acetate per day overcame the depressing effects of an all-grain ration. Maryland and Australian workers have reported a marked decrease in acetate production in the rumen by all-concentrate or young-grazed herbage.

With increasing use of milking parlors, the rate of grain consumption becomes a practical problem. Some reports indicate that very finely ground grain slows down the eating rate and has a tendency to reduce palatability. Studies by Minnesota and Michigan workers have shown that adding water to the concentrate will speed up eating rates.

The water is added at 1.5 pounds per pound of feed after the grain has been placed in the receptacle. No mixing of the water and grain is needed, since the cow apparently enjoys doing this herself.

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DRYING EQUIPMENT

(Continued from page 5)

tion or a larger volume of production. Lower cost installations utilizing natural air with supplemental heat might prove profitable for many smaller cash corn producers.

For the livestock feeder—one who feeds most of his corn crop—there are other alternatives that are more economical than farm drying of corn. He should consider the use of ear corn or shelled corn silage. Iowa studies show that overall harvesting and storage costs are less with ear corn or shelled corn silage than with any other harvesting method.

In conclusion, each farmer should look at the costs and returns of a drying installation for his particular farm situation. It seems quite clear that any dairy farmer with 20 or more cows could profitably install a drying system on his farm. The producer of cash corn, however, should have a quite extensive volume of business before considering going to shelling and drying operations. The corn drying installation for the average Minnesota livestock producer would normally be uneconomical. He should first consider putting up ear corn or shelled corn silage.

New innovations in crop drying are appearing every year. Each farmer should study the many different techniques to determine which one will most profitably fit into his particular farm program.

—Paul R. Hasbargen, Extension Economist

A minimum air flow of 5 c.f.m. per bushel at 30 percent moisture ear corn is recommended. The maximum that can be dried per fan horsepower is about 800 bushels. For 25 percent moisture corn, a minimum air flow of 3 c.f.m. is recommended with a capacity of about 1,300 bushels per fan horsepower.

Most single or double corn cribs can be prepared for drying quite easily. The average cost of drying ear corn with natural air will be about 8 cents per bushel.

The use of heated air should generally be considered for drying corn. If a field sheller is used, heated air is essential. For any moisture range, the number of bushels that can be dried per hour depends largely on the fuel consumption and efficiency of the heating unit.

Heated air dryers generally burn fuel or gas. There are two types of burners, direct-heat and indirect heat. With the former the products of combustion are discharged into the drying air. The latter have a heat exchanger, similar to a hot air furnace, and the projects of combustion are discharged through a smokestack. Total fuel consumption averages approximately 40 percent more for an indirect-heat dryer than for a direct-heat dryer; however, there is less of a fire hazard.

There are three types of drying units: the batch dryer, and the continuous dryer for shelled corn, and the portable dryer whcih can be used for either shelled or ear corn. There are also available supplemental heating units which will step up the drying rate of a fan using natural air.

Shelled corn can be dried in bins having some type of false bottom or duct system which will allow the drying air to move up through the corn. A practical depth to dry is from 4 to 6 feet.

Heated air does not dry the grain uniformly. That which the incoming air strikes first dries faster than that on the exhaust side of the bin. When the average moisture content is 13 percent, the moisture content of the driest will be much less, and that of the wettest grain will be considerably higher. For this reason it is necessary to mix the batch after drying is completed so the moisture content will be more uniform throughout the grain. Sufficient mixing is usually accomplished while the grain is moved from the drying bin to the storage bin.

After drying is completed unheated air should be blown through the grain for ½ to 1 hour to cool it within a few degrees of atmospheric temperature.

The cost of drying corn with heated air will range between 12 and 15 cents per bushel under average conditions.

—D. W. Bates, Extension Agricultural Engineer

MEAT-TYPE HOGS

(Continued from page 8)

Summing Up

In summary, it appears that a sound breeding program is the first prerequisite if the producer is to supply the kind of pork desired by Mrs. Housewife. This must be accompanied by a sound feeding and management program. Timely marketing can also help the producer realize the greatest return for his hogs.

Space and time have not permitted a discussion of such factors as type of operation, specialization, and disease. However, it is obvious that in any system of swine production, the factors we've discussed must also fit the system of production and that disease must be controlled.

PELLETED RATIONS

(Continued from page 1)

alfalfa-corn ration, although average daily gains and feed conversion were slightly improved. In a fortified timothy-corn ration, daily gains were increased 32 percent and feed conversion improved 16 percent by pelleting. Pelleting improved daily gains in a non-fortified timothy-corn ration 55 percent and feed conversion 25.5 percent.

Advantages of Pelleting

Advantages for pelleting roughages and complete rations for beef cattle and sheep feeding may be summarized as follows:

1. Improved feed utilization. This will average around 10 percent in high concentrate rations and as high as 50 percent in high roughage rations. An average of 15-20 percent can be expected for many fattening rations.

2. Increased rate of gain. Increases from 10 percent to 200 percent have been noted, again related to ratio of concentrate to roughage with the greatest increase observed on all-roughage rations.

3. Increased feed intake. Acceptability of rations with poor physical qualities is greatly improved by pelleting, especially with lower quality roughages. Little increase in feed intake is observed in highly palatable grains and supplements.

4. Complete control of ration. Exact ratios of various ingredients can be maintained. Cattle and sheep can be started on self-feeders at once since concentrate-roughage proportions can be controlled.

5. Easier handling. Pelleting reduces bulk of roughages, decreases dusting and makes complete mechanized movement of most feed possible.

Here are some points to keep in mind with pelleted rations:

1. Lower grade roughages have found a friend in pellets and their potential should not be overlooked.

2. Pelleting is not expensive, since it is a completely mechanized operation.

3. Preparing the complete ration in the meal form can be expensive and along this line is where changes to greater efficiency must be made.

4. Changes in hay-making methods seem important. From the handling standpoint, pelleting should be done as early as possible in the haying operation.

5. Pelleted complete rations for beef cattle and sheep must be bulk-handled from the raw ingredients to the steer or lamb.

Protein-Energy Levels for Laying Hens

H. R. BIRD*

Most of the money spent for feed for laying hens is spent for energy and protein, so herein lie the best opportunities for future improvements in feeding economy.

Until a few years ago, energy and protein levels for layers showed little variation. The level of energy was fixed by custom and by the available feedstuffs at about 800 Calories per pound and a protein requirement of 15 percent was generally accepted.

In the last few years, the availability of animal fats has made it possible to raise energy levels materially. In one study, layers made good use of as much as 8 percent of added fat. The fat improved efficiency of feed conversion but did not affect egg production. In other tests, good production has been obtained with as much as 10 percent of added fat, giving an energy level of 1,050 Calories per pound of diet.

Hill and others found that high energy diets suported the highest rate of egg production during cold weather, whereas all energy levels were equally effective in supporting rate of production during the rest of the year.

There are some reports of unfavorable effects of high-energy diets. Weiss and Fisher found that 5 or 10 percent of added tallow caused excessive fatness of White Leghorn layers. Turk and others found that 10 and 15 percent of added animal fat caused feather picking in incrossbred layers. Picking was not prevented by an increased portein level. However, it seems likely that unfavorable effects of added fat are the results of dietary imbalance and can be corrected once the nature of the imbalance is discovered.

There are reports that the protein requirement of layers may be only 13 percent, rather than the accepted 15 percent. The apparent decrease in protein may reflect better quality protein in modern feeds or better vitamin supplementation, resulting in less dependence on portein supplements to supply vitamins.

It is impossible to predict what protein levels will be recommended in the next few years. The trend to lower levels might be counteracted by the need for more protein to go with higher energy levels, although the ratio of energy to protein is less critical for the hen than for the chick.

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