MINNESOTA FEED SERVICE

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Feeding Swine for Greater Reproduction Performance

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JUST HOW WELL SWINE can reproduce or how big healthy litters they can have is probably not known, but the average performance of the nation's sow herd leaves much to be desired.

The reproductive capacity of the sow for one litter is determined by the number of eggs produced, the percent of eggs fertilized, the survival of embryos to birth and of pigs to weaning. Residual influences undoubtedly extend beyond weaning.

The effects of environmental variation during lactation on performance after birth have been studied widely. Observations have been made of the effect of plane of nutrition, during and prior to gestation, on size and vigor of litters at birth. Relatively little research, however, has investigated the point or place in the reproductive process where failure or variation in performance is most likely to occur.

Environmental Influences

Inheritance, on the average, has a relatively mild effect on litter size, accounting for only about 15 percent of the variation in number of pigs farrowed, whereas environment is responsible for the remaining 85 percent. However, in a single herd an inherited abnormality may be responsible for reproductive failure.

Swine men who know that the sow's environment is largely responsible for litter size are inclined to blame the feed when reproduction is substandard, and in the majority of cases they are perhaps correct. However, there are other environmental factors that play important roles in successful reproduction.

For example, the season in which a gilt is farrowed will partly determine the age at which she reaches sexual maturity, and the age of sexual maturity influences the ovulation rate at a given calendar age.

THIS ISSUE OF Minnesota Feed Service presents some of the reports given during the annual Animal Nutrition Short Course, held recently on the St. Paul Campus, University of Minnesota.

Gilts increase their average egg production rather rapidly during the first few heat periods after puberty. Disease is another example of a non-hereditary factor which may cut down reproductive performance.

Although the female reproductive tract is sensitive to many influences—the one most likely to affect the majority of gilts and sows is feeding.

Recent investigations have shown that the gilt's ovulation rate and the survival of embryos during early pregnancy is largely responsible for determining the number of pigs farrowed. Yet little is known about specific nutrients and their association with egg production and/or embryo survival.

Nutritional Factors

Single nutritional factors can markedly influence reproductive performance during the early stages of the reproductive cycle. This has been demonstrated by J. Moustgaard of Denmark using vitamin B_{12} and by D. E. Ullrey, and his co-workers of the University of Illinois working with pantothenic acid.

Purebred swine breeders have observed that highly fitted show animals frequently experience reproductive failures even though they were fed good rations and were forced to take considerable exercise.

University of Wisconsin research in 1951 showed that limiting the intake of feed to 70 percent of a full feed for gilts from 70 days of age to 25 days of gestation cut down ovulation rate and stimulated embryo survival.

Continued research at the University of Wisconsin has supported this earlier observation. The opposite effects of full and limited feeding on ovulation rate and early embryo survival are shown in Table 1. A ration of corn, oats, tankage or meat scraps, soybean oil meal, ground limestone, iodized salt, and antibiotic supplement was used.

Table 1. Effect of level of feeding on reproductive performance

Item compared	Full feed	(70%) Limited feed
Average number of eggs	14.0	11.1
Average number of pigs (25 days pregnancy)	7.5	8.8
Percentage of eggs surviving	53%	80%

Work by R. E. Christian and J. C. Nofziger of Washington State College support these observations. They found that self-fed gilts ovulated an average of 15.1 eggs and farrowed 4.7 live pigs, whereas limited-fed gilts ovulated 13.4 eggs and farrowed 7.4 pigs on the average.

H. L. Self and others at the University of Wisconsin showed that the influence of short-time feeding levels is as pronounced as that of longer feeding in respect to ovulation rate (Table 2).

Table 2. Variations in level of feeding as influencing egg production at second heat period

Feed level		
70 days to puberty	First Estrual Cycle—3 weeks	Ovulation Rate
Full	Full	13.9
Limited	Full	13.6
Limited	Limited	11.1
Full	Limited	11.1

Another experiment demonstrates a similar effect on ovulation rate and also shows that changing feeding levels influences embryo survival.

These data show that gilts fed the same level of feed three weeks prior to breeding ovulate before that time, at about the same rate even though they were fed differently.

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* University of Wisconsin.

Silage Grades Needed

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Standards have been developed for most feedstuffs in order to associate physical characteristics of the feedstuff with feed value and chemical composition.

Standards have been developed for hay based on the important physical characteristics that can readily be evaluated. They are:

(1) Stage of maturity at cutting.
(2) Percentage of leaves.
(3) Percentage of natural green color.
(4) Percentage of foreign material.
(5) Aroma.
(6) Size and pliability of stems.

Similar forage material harvested part as hay and part as silage might result in feedstuffs with large differences in actual feed value. The evaluation of silages must then be based on a somewhat different system.

Silage is a feedstuff which results when green forages are chopped and stored—and then undergo a natural fermentation or a preservation by the addition of fermentation - inhibiting chemicals.

Silage then may be evaluated on the same general basis as hay with the addition of an evaluation of the preservation process.

Scoring Systems

Scorecards have been developed which in most instances give an "organoliptic" evaluation of the preservation only and do not reflect many of the most important aspects of quality, namely species and time of cutting.

Michigan State University has developed a scorecard for silage which specifically singles out stage of cutting as one of the major factors in silage quality. The University of Wisconsin has developed a scoring system based on both preservation and feed value of the ensiled material.

Any scoring system has drawbacks but an acceptable scorecard can be developed. Concerted efforts should be made to do so.

To be workable an evaluation system must meet the following conditions:

1. Reflection to a degree of the true worth of the silage as a feed.
2. Usefulness to professional agriculturists and farmers in evaluating silage.
3. Educational value to show how to make better silage.

Research at the present time on the relationships of various silages to their actual feeding value is extremely limited.

Some investigations of this type have been conducted, however, with graded hay. Feeding trials have proved to be expensive, time-consuming, and often inconclusive, the test applying only to a few types of hay. This is true with silages as well. Physical evaluation of hay in most instances reflects its chemical composition. This would also be true of silage.

At the present time to evaluate silages, a general assumption must be made. We must assume that a desirable fermentation or a desirable preservation by addition of a chemical does preserve maximum amount of feed value of the original crop in a given silage.

A Minnesota Scorecard

In most instances this evaluation of preservation is based on (1) odor, (2) color, and (3) condition of the sample. A Minnesota scorecard based on these three factors has been used throughout the state, and at the first State Silage Show held at the 1956 Minnesota Farm and Home Week.

The various factors covered are described as follows:

Odor—High-quality silage will have a pleasant acid smell. It should not be sweet, burnt, sour, butyric, rancid, putrid, foul, musty, or moldy.

Color—High-quality silage will have a natural green color. It should not be yellow-green, olive-green, brown, dark-brown, or black.

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Condition — High-quality silage will be moist to the feel, cut at the proper time, and should be finely chopped. It should not be too dry, too wet, have a high weed content or be cut when overmature.

This particular type of scorecard would apply to grass legume silages or immature small grains. Late-cut small grain or corn silage would need an additional category to evaluate grain composition.

A national committee was appointed at the first National Silage Research Conference held at Beltsville in early 1956 to investigate the possibility of standardizing a scoring system or a standard evaluation technique for silage.

The evaluation of silage is needed to determine properly the supplemental feed required for all classes of livestock. Silages vary from relatively high-energy corn silage to high-protein legume silage. Therefore silage is not just "silage"—but each silage should be further designated to include some evaluation based on actual feed value and type of feed nutrients contained.

SWINE FEEDING

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The results shown in table 3 suggest that the level of feeding after breeding is important in determining the percent of embryo survival, although there appear to be residual influences from the early feeding levels. Additional research has shown that a limited-full-limited feeding program is most satisfactory.

The fundamental reason for these feeding influences is not known. Back fat measurements of the gilts show an unfavorable relationship between fatness and embryo survival. Blood fat levels vary considerably and are not always associated with feed intake and the condition of the sow.

Since sex hormones are fat-soluble, there may be hormone dilution in the heavily fed and fat animals to the extent that embryo maintenance is impaired.

Swine growers need to increase litter size to keep the hog competitive with other meat producing animals.

Table 3. Effects of levels of feeding on reproductive performance

Feed level					
70 days to puberty	Puberty to second heat period	Second heat (breeding) to 25 days gestation	No. of Eggs	No. of Embryos (25 days pregnancy)	Percentage of Survival
Full	Full	Full	13.6	3.9	32%
Limited	Full	Full	13.5	5.1	38
Full	Limited	Limited	10.7	5.7	49
Limited	Limited	Limited	10.8	6.4	57

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Preventive Measures Used for Bloat

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Our understanding of bloating, particularly insofar as causes and causes of death are concerned, is very incomplete. Bloat, of course, has long been associated with feeding of legumes. We can look to continued and expanding use of legume pasture as a means of economical beef and milk production.

Our Land Grant College Agricultural Experiment Stations, together with the United States Department of Agriculture, are therefore doing their best to anticipate a growing need for safe utilization of legume pasture in its most highly profitable form, the early growth stages.

The North Central region states—Ohio, Indiana, Illinois, Michigan, Wisconsin, Iowa, Minnesota, the Dakotas, Nebraska, Missouri, and Kansas — are so concerned over the bloat problem that a central coordinating committee, with representatives from each station, has placed special emphasis on this problem in the past two years. This indicates the breadth of the problem and that none of the presently available preventive measures is adequate.

The long-range objective of this group is to develop legume varieties which will have low toxicity and yet which will retain desirable nutritive and over-wintering qualities. In addition, the stations are studying other aspects of the problem including preventive measures.

The digestive mechanisms of the animal itself play a part in bloat. Of a group turned on to a pasture, only certain ones are severely affected, others mildly, and still others not at all.

The Michigan State University and University of Minnesota stations are concerned with the role played by "reflex" mechanisms controlling the rate of flow of saliva and the rate of belching or "eructation", respectively.

An adult steer or cow manufactures and swallows about 70 quarts of saliva a day. Saliva possesses important digestive properties, one or several of which appear to be related to the "foaminess" of the rumen contents. The rate and efficiency of belching appear to be important in that no extra gas is formed on "bloaty" pastures but rather that the animal's ability to get rid of it is decreased.

The U.S. Department of Agriculture Experiment Station at Beltsville has reported that the saponin group of compounds in alfalfa is one of the substances that decreases the animal's ability to belch.

The Iowa State College and Wisconsin University stations are continuing some excellent studies on a variety of materials which might be used in prevention — surface active agents, antibiotics, and the like.

The old-fashioned "remedies" such as turpentine or kerosene given in milk, while drastic, were, according to present work, not so far off base after all. They employed the identical principle used in the fancier preparations today, i.e., raising the "interfacial tension" in the rumen.

The reason the old-fashioned remedies were of some benefit was that they tended to reduce foaminess in the rumen. This is the same objective of silicone and detergent preparations being marketed today, and is the same objective as the peanut oil or mineral oil sprays.

From a practical standpoint, the oil sprays, at the rate of three ounces per animal, are the best crutch yet for use by the beef or dairy man—in conjunction with electric fence.

A variety of antibiotics has been fed, and even injected. For reasons no one understands, they are alike in two respects: (a) they are of no value once the animal is affected; (b) they have some value when given in advance.

Most of the commercial preparations being advocated today contain some penicillin, and are based upon a recent report by B. F. Barrentine of Mississippi State College regarding beef steers.

Barrentine reported that 50 to 75 mg. of procaine penicillin (or of potassium penicillin in equivalent amounts) was protective to 900-pound steers for one to three days, when given several hours or overnight before pasturing.

Field trials of several surface active agents are in progress at the Wisconsin and Iowa stations.

The South Dakota Agricultural College station is engaging in some very interesting work on both tetraploid and diploid forms of both blue- and yellow-flowered varieties of alfalfa in connection with bloat potential.

There may be extensive changes in the bacterial population of the rumen, under certain bloat conditions. This phase is under intensive study by the Ohio State University, University of Illinois, and Michigan State University stations. The so-called "feed-lot bloat" particularly may be susceptible to this approach.

Summary

1. No one measure, which is divorced from sound husbandry practice, is completely effective as a preventive.

2. Preventive measures today are of the kind applied, not every day throughout the spring-summer-early fall pasturing season, but just in the more dangerous periods.

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Medicated Feeds

Feeds have been used as carriers for medicaments for many years, but only within the past few years has this practice become widespread. The earlier products were often viewed with reprehension, and in many cases a stigma was attached to them.

Since specific drugs have been found which are exceedingly effective in combating specific diseases or parasites, this situation has changed. Feeders now demand that the service of mixing drugs in manufactured feeds be provided by feed manufacturers.

Preventive medication via the feed route is a well-accepted practice. It is used quite commonly to provide some measure of protection for the feeder, and to help safeguard the investment in adequate nutrition. The extremely small proportions of the drug required for this purpose make accurate mixing extremely important. This provides the feed manufacturer an opportunity to render an additional and vital service.

Treatment by the feed route is, at times, controversial. There must be an accurate diagnosis by well-trained, competent diagnosticians before treatment is instituted.

Indiscriminate use of medicated products is not only dangerous from the standpoint of the health of the animals, it is also economically unsound. Recommendations which result in misuse are a distinct disservice to all concerned. Similarly, the diagnostician who experiments with excessive levels of drugs, simply because they can be mixed in feeds conveniently, is also guilty of disservice.

Medicated feeds are a very valuable tool in economical livestock and poultry production, but they carry with them a mandate for accurate formulation, precision mixing, and careful usage.

—Harold L. Wilcke,
Ralston Purina Co.

Feeding and Managment of Turkeys

ELTON L. JOHNSON*

Advances in the art of feeding turkeys are almost unbelievable if we think back only a short decade ago. We not only know considerably more regarding the basic nutritive requirements of the turkey but we are also able to apply most of this fundamental information on a practical basis.

A typical example of today's use of nutritive information permits us to raise turkeys to maturity in our field experiments at our University of Minnesota Agricultural Experiment Station at Crookston, with only 3¼ pounds of feed for each pound of turkey. Five pounds was a more common feed conversion figure in the early "forties".

This improvement has been due principally to nutrition—although breeding, management, and disease control have improved considerably in practical production.

University research is conducted at several locations. Feeding and management research and broiler projects are conducted on the St. Paul Campus; breeder hen projects at Rosemount; and terminal range rearing studies at Crookston.

Let's take a look at what our turkeys have told us during recent years. We can start with several years work at Crookston under the direction of A. M. Pilkey.

Restricted mash feeding—One of our most successful range feeding programs was the 34 percent protein mash fed to turkeys on a restricted basis last year. Poults were fed the regular 28 percent starter until the 34 percent mash was started at eight weeks. Corn and oats were fed free choice, with the mash restricted to 15 pounds per 100 birds each day. The results at 24 weeks are given in Table 1.

These turkeys were sold on a grade basis and the profit over ingredient costs was 27 cents more per bird for the restricted 34 percent protein mash than for the Minnesota standard. (The Minnesota standard is made up of corn, oats, meat scraps, fish meal, soybean meal, alfalfa meal, minerals, and vitamins.) The 34 percent cafeteria was only 3 cents ahead of the standard ration.

The relative consumption of mash, corn, and oats is indicative of the reason for the reduced rearing cost. Additional study is being made of this restricted program. However, it looks very promising as a means of efficient production.

26 vs. 28 percent protein—A three-year comparison of the Minnesota standard ration (26 percent protein) and a 28 percent protein mash resulted in slightly more economical production to 24 weeks with the standard ration.

However, feed consumption and ingredient cost per pound of turkey were 70.0 pounds vs. 71.3 pounds and 12.2 cents vs. 12.7 cents, respectively. It is obvious that the more rapid growth on the 28 percent mash, and the reduced mash consumption with increased whole grain consumption, would favor the 28 percent protein program with most commercial turkey producers.

Separating sexes—The separate rearing of toms and hens during two different growing seasons failed to disclose any improvement in growth rate or market quality at 24 weeks. Mortality was slightly higher (11 percent vs. 8 percent) in the separate sex groups and appeared due primarily to fighting in the male pens.

The practice of debeaking or the use of anti-pick devices would probably decrease mortality and morbidity in pens containing only male turkeys.

Table 1. Results of restricted mash feeding of turkeys, at 24 weeks

	Hen and Tom (average weight)	Total feed	Feed conversion	Consumption		
				Mash	Corn	Oats
Minnesota standard	20.36	70.44	3.49	64.0%	28.9%	7.0%
34 percent cafeteria	20.51	70.55	3.45	50.8	35.2	13.7
34 percent restricted	20.46	67.44	3.25	37.9	43.6	18.4

Pelleting—A three-year study of pellets vs. mash from 8 to 24 weeks, completed at Crookston station, indicated a higher production cost when pellets were fed. Feed required per pound of gain was 3.7 pounds for mash or pellets, and market condition of each turkey group was similar. The average pellet-fed turkey weighed 19.2 pounds whereas the mash-fed bird weighed only 18.8 pounds.

However, the pellet program required 3.6 pounds more feed per turkey. And the pellet feed ingredient cost (including $2.00 for pelleting) was 1.2 cents **more** per pound of turkey. These results indicate that feed wastage and production costs can be kept to a minimum without the use of pellets in a range feeding program.

Breeder hen feeding systems — Two years of study with the feeding of an all-mash to turkey breeders indicated that whole corn and oats could be mixed in the mash, if desired. Although egg production and hatchability were slightly in favor of the grain-in-mash program, additional work is needed to establish whether this should be a preferred program.

Vitamin E in breeder mash—An experiment involving eight pens of turkey breeders (four with supplemental vitamin E at 2.5 I.U. per pound of ration) failed to disclose any improvement in eggs.

This preliminary work raises the question of whether supplemental vitamin E is needed in this area, where appreciable quantities of oats are included in breeder rations. Additional studies involving a lower level of oats are being conducted to test further the reputed value of vitamin E in breeder rations.

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