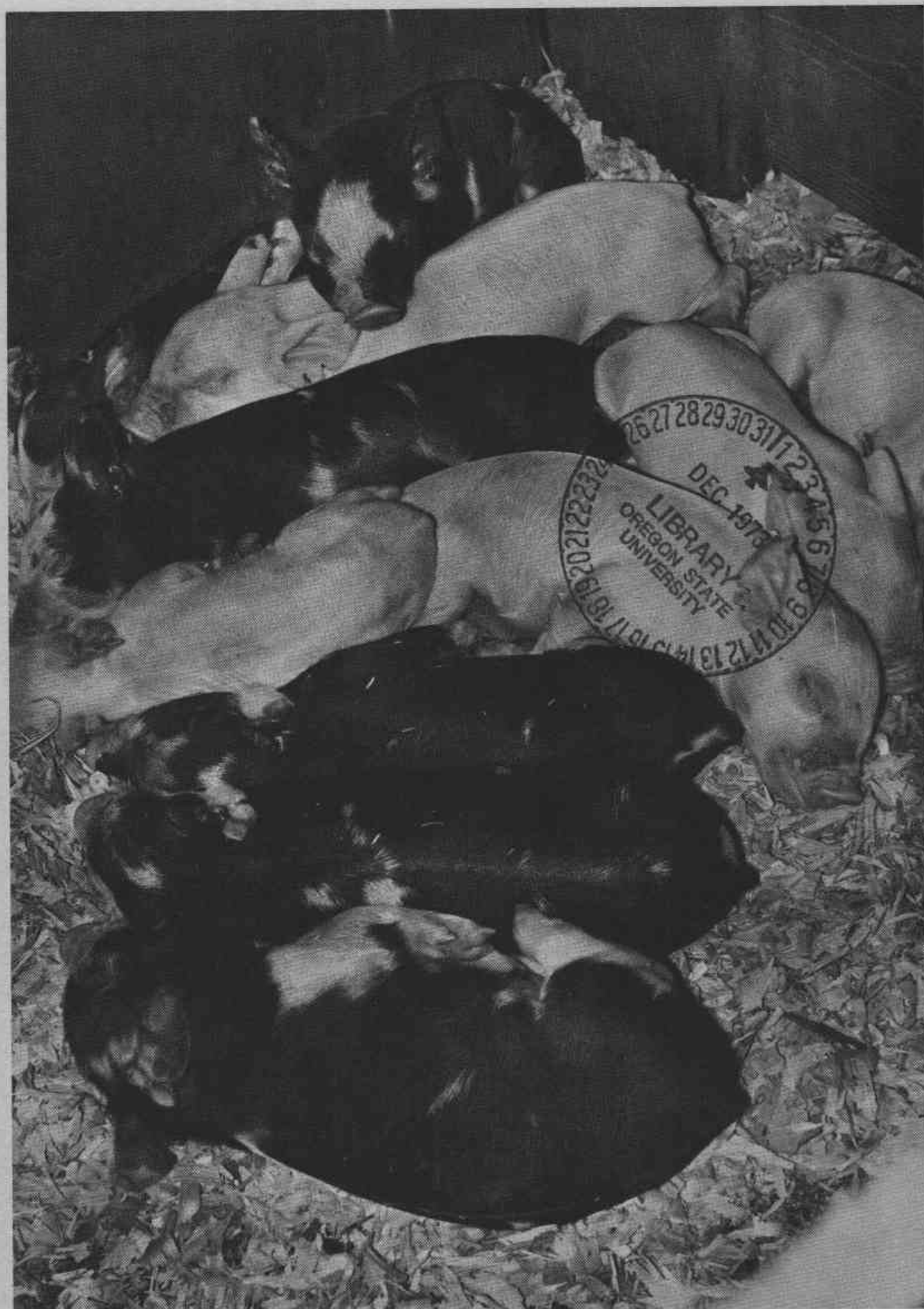

Reports of the fifteenth annual

SWINE DAY

Special Report 398, December 1973

Agricultural Experiment Station

Oregon State University, Corvallis

FIFTEENTH ANNUAL OSU SWINE DAY

December 1, 1973

Withycombe Auditorium

MORNING SESSION

9:00 - 9:45 Registration

9:45 Welcome: Dr. J. E. Oldfield

10:00 Expanded livestock feed grain program - W. E. Kronstad

10:30 Futures trading for swine producers - T. M. Hammonds

11:00 Some current disease topics - P. E. Gorham

11:45 Question Session

12:00 Lunch

AFTERNOON SESSION

1:15 Predictors of leanness in pork carcasses - J. O. Reagan

1:45 Students Contributions to the Swine Center and vice versa - Swine Center Personnel

2:15 Alfalfa protein concentrate - An alternative source of protein for swine - P. R. Cheeke

2:30 Mating and conception adequacy in gilts bred at first estrus - P. B. George and D. C. England

3:00 Audience Discussion

3:30 Adjourn

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EXPANDED LIVESTOCK FEED GRAIN PROGRAM

W. E. Kronstad

The 1971-72 legislature provided approximately $50,000 for a two-year period to expand the development of cereal grain varieties specifically for livestock feed. This support was increased by the 1972-73 legislature with $128,000 being provided during this current biennium. These actions were based on the fact that Oregon is deficient in livestock production and if self-sufficiency could be attained, it would add 55 to 100 million dollars annually to the state's income. This is to say nothing of the ever expanding need for livestock products on the export market. If these long-range goals are to be realized, a consistent source of a high energy feed grain with superior nutritional qualities for certain classes of livestock must be produced and made available at competitive prices.

Approximately 190,000 head of swine are slaughtered annually in Oregon and packing plants within the state process some 230,000, the balance being shipped in from other states. Based on current production, the Oregon swine growers have an annual requirement for over 34,000 tons of grain (assuming grain constitutes 80% of the ration); while if the industry expanded to produce at home those animals now imported, the requirement would be over 41,000 tons. Feed costs are commonly considered to represent 75% of the total cost of producing swine; therefore, availability of feed grains at reasonable costs is essential if hog production is to continue to be competitive and to expand in the state. The annual production-consumption deficit for slaughter hogs has been estimated to be in excess of 500,000 head, indicating a considerable potential for this industry if local grain supplies were available. Similar demands exist in both the poultry and beef industries.

The problem becomes one of developing varieties of cereal grains that the cereal grower can afford to produce at a price the livestock producer can afford to pay. In 1968 and 1969, the department of Agricultural Economics at Oregon State University conducted a study of the feasibility of feeding wheat to livestock. Their results, based on prices and production and consumption figures, indicated that a considerable demand exists for Pacific Northwest wheat as a feed grain when it is priced around $1.25 to $1.50 per bushel. If the Oregon wheat producers are to cover their production costs, feed wheat yields need to be increased by 10 to 30 percent over present yields for varieties grown for food.

W. E. Kronstad, Professor of Agronomy, Agronomic Crop Science Department, Oregon State University.

The other alternative is to develop cereal varieties which have superior nutritional properties thereby reducing the cost of supplements in complete livestock feed rations. To illustrate how important this latter factor might be, a comparison is made between the cost of two rations for swine which differ in the amino acid lysine and protein content. A savings of 28¢ will be realized by utilizing the second ration which contains the higher percentage of lysine.

Table 1. Protein supplement needed to produce maximum swine growth with two different barley rations.

RATION I	100 lbs Barley (11% protein, lysine 3% of protein)	$2.00
	12 lbs Soybean meal	.48
		$2.48
RATION II	100 lbs Barley (14% protein, lysine 4% of protein)	$2.00
	5 lbs Soybean meal	.20
		$2.20

In order to develop high yielding cereal varieties which can be utilized as a source of high energy and superior nutritional properties, several cereal grains are being investigated. These include wheat, barley, triticale, oats, sorghum, and corn.

A major breakthrough in raising the yield plateau has been achieved in soft white winter wheat in the Pacific Northwest. Since wheat is widely adapted to many areas within the state of Oregon, work is underway to breed wheat varieties designed specifically for livestock feed. To avoid possible mixing of these varieties with food varieties and to provide a consistent supply of a feed grain to the livestock producer, a genetic factor is being incorporated to color the grain purple. Currently, 252 different wheat parents are in the crossing block for hybridizing this spring. In addition, 500 F1 populations resulting from last year's crossing program will be top-crossed and double crossed in the greenhouses this winter and in the field next spring. A total of 108 F2 populations along with 8400 head row selections are being evaluated. Two hundred and twenty lines are currently being tested at 12 locations throughout the state of Oregon.

A new high protein barley has been identified which contains approximately 30 percent more of the essential amino acid lysine than barley varieties currently in commercial production. Lysine and methionine content in high protein barley is greater than in normal barley and normal corn (Table 2). However, the barley line identified as Hiproly has nearly the same amount of lysine when considered as a percentage of total protein as does the Opaque-2 corn. In terms of methionine, the Hiproly is actually higher. Genetic studies conducted suggest that a single recessive gene is responsible for this improved nutritional balance. This finding, coupled with a new technique to screen for high lysine, will enable a very rapid transfer of this property into adapted barley varieties. This year 107 diverse barley lines which represent superior germ plasm collected throughout the world are included in the crossing blocks. There are 276 early generation populations currently under evaluation and 2160 head row selections. A total of 800 lines have been entered into yield trials at a number of locations throughout the state. In addition 467 new lines are being evaluated for their winter hardiness, a factor which current winter varieties are lacking, particularly if they are to be grown in eastern Oregon.

Table 2. Lysine and methionine content of Hiproly and normal barley and Opaque-2 and normal corn.

		Hiproly	Normal Barley	Opaque-2	Normal Corn
Lysine	(% of protein)	4.1	3.0	4.4	2.8
Methionine	(% of protein)	2.1	1.8	1.9	2.0

Triticale lines obtained from the CIMMYT program in Mexico and from other sources are also being tested. From the best lines, 540 head selections were made and are currently on increase. In addition, 72 lines were in yield trials last year. Most of this material has a spring habit of growth and therefore the most promising plant types are being crossed to superior winter wheats. The resulting progeny will be back-crossed to the triticale and the winter habit types selected. Bulked F2 populations were grown at three locations with 50,000 plants making up these populations. The best plants were selected at each site for further testing.

A limited number of oat crosses were made this year; however, with the development of the variety, Compact, this program will be increased. Compact provides a source of short stiff straw which has not been exploited for oat improvement. This source of short stiff straw will be hybridized with the high protein lines which are now available.

Sorghum, although presently not an important commercial crop in Oregon, is receiving attention. This past year 2,000 selections representing both open pollinated and hybrids were evaluated. Such factors as seeding rates, date of seeding, and fertility were investigated. Several promising lines are being increased. The renewed interest in sorghum is the result of promising germ plasm developed under cool environmental conditions near Mexico City by the CIMMYT program.

On a preliminary basis, the feasibility of growing the new Midwestern high lysine hybrid corn varieties in the Pacific Northwest is being studied.

The major benefits realized through the development of new high energy feed grain varieties with superior nutritional and agronomic qualities would be: (1) availability of a consistent source of feed to livestock producers so that Oregon can become more self-sufficient in livestock production; (2) a sound basis for Oregon's competition in expanding domestic and export markets for feed grains and livestock products; (3) greater diversification for the wheat producer by the development of alternative markets; (4) more productive use of Oregon's natural resources; and (5) stimulation of the economy by providing more job opportunities both in the rural and urban areas.

FUTURES TRADING FOR SWINE PRODUCERS

T. M. Hammonds

Your timing is good in including commodity futures as part of your deliberations today. Futures trading has experienced a trading volume increase over the past few months which is unprecedented in American history. During fiscal 1973, commodity futures reached a trading value over two and one-half times as large as the value of all stock traded on the New York Stock Exchange during the same period. Twenty three and one-half million contracts traded during fiscal 1973 with a total value of almost four hundred billion dollars. This is more than double the fiscal 1972 value. Commodity futures are big business by any standards.

This trend is largely the result of the extreme price fluctuations which we have seen during the past year. Live hog futures moved from a low of $23.50 per hundred weight to a high of over $63.00. Soybean meal moved from a low of $104.00 per ton to a high of over $400.00. Corn moved from a low of $1.35 per bushel to a high of over $3.40. Wheat moved from a low of $1.81 per bushel to a high of over $5.40. In markets with prices fluctuating as wildly as these figures indicate, producers cannot afford to overlook the advantages offered by futures trading.

I can't tell you what price levels will be six months or a year from now, but I can tell you that you are living with a greater degree of price uncertainty than ever before. New information is constantly flooding into the market place which can have a drastic impact on prices. Even rumors of changes in foreign crop yields, import-export activity, dollar revaluation, and consumer preferences have a significant impact. Think for a moment what this means for you. It means that even the best decisions made in light of current information are more than likely to be proven wrong as new, unanticipated information comes into the market place.

Flexibility is the key to surviving in this economic climate. It is flexibility which commodity futures trading provides which is unmatched by any other pricing mechanism. With futures trading there is flexibility to:

1. Price hogs at any time up to one year before they are actually marketed.

2. Price feed up to one year before it is actually fed by using corn or soybean meal futures.

Most important of all, the flexibility to:

3. Reverse hog pricing or feed pricing decisions at any time before the actual product delivery dates.

Dr. Hammonds, Assistant Professor, Department of Agricultural Economics, Oregon State University.

We can best see how this flexibility works if we compare futures contracting with cash market contracting. A commodity futures contract is nothing more nor less than a committment to deliver or take delivery of a specified amount of product, at a specified price. In this sense, it accomplishes exactly what a cash contract accomplishes. However, the ground rules under which futures trading is carried out overcome many of the difficulties associated with cash contracts. Let's look at these difficulties:

1. Cash contracts for hogs on the output side, or feed grain on the input side, may not be available to you. In active futures markets, buyers and sellers are always ready to contract.

2. Cash contract prices are typically not public knowledge. You as a producer will often find yourself at a disadvantage in dealing with a buyer or seller with better price information than you have. In futures markets there are no secrets; all prices are public knowledge.

3. The producer is typically obligated to a greater degree than his counterpart on the other side of a cash contract. If the other party defaults, the producer typically has little if any recourse. If the producer defaults, he quickly finds himself in court. In futures markets, both buyer and seller are equally obligated by a regulatory scheme which guarantees the performance of all parties.

4. Once a cash contract is made, it must be settled by actual delivery. In futures markets, the original pricing decision is easily offset whenever the producer feels he needs to change his position.

Let me give you an example to help clarify this notion of flexibility. Suppose that on Monday, the 5th of November, I decided that corn prices were going to increase. Suppose further that I am going to need an additional supply of corn by early March of 1974. I check the newspaper and find that the current futures price for March delivery is $2.39½ per bushel for contracts of 5,000 bushel multiples. I forward price 10,000 bushels by purchasing two March corn futures contracts.

Cash Market		Futures Market (March Contracts)
will need 10,000 bushels by March, local price now $2.31 per bushel	Nov. 5	buy two contracts at $2.39½

I am now "hedged." Hedging may be defined simply as the process of forward pricing a crop or inventory through the futures market. How do I know whether to buy or sell futures contracts? I can always decide by asking myself the question: What am I afraid of? In this case I was afraid of a price increase, so I hedged my inventory requirement by purchasing a contract now while the price is still low.

If I had thought prices were going to decline, I would not have been afraid of anything (since lower corn prices would be beneficial to me) and would not have hedged.

Now, let's suppose futures prices really do increase to $2.45 per bushel by late February. What do I do? I simply resell the futures contracts and buy the corn locally.

Cash Market		Futures Market (March Contracts)
local price now $2.31 per bushel	Nov. 5	buy two contracts at $2.39½ per bushel
purchase 10,000 bushels locally at $2.36½ per bushel	Feb. 20	sell two contracts at $2.45 per bushel
		5½¢ per bushel profit

I was able to buy a futures contract at $2.39½ and resell it at $2.45 for a net gain of 5½¢ per bushel. My net cost for the actual corn is now $2.36½ local purchase price minus 5½¢ per bushel futures gain or $2.31.

This is an oversimplified example but it does illustrate several important points. For example, producers will not normally take or make delivery against futures contracts. They will normally use futures for price protection while maintaining the local buyer-seller relationship for the actual product. The other important points can be seen by considering why a producer would want to enter into this type of arrangement. My net price is the same under futures contracting (2.31) as it would have been if I had actually purchased the cash corn back in November. However, there are advantages to doing it through futures trading. Futures contracting allows the producer to set his price without the cash outlay required to actually purchase the crop. Typically, futures contracts require an initial deposit equal to approximately ten percent of the total contract value. In addition, the producer does not have to provide additional storage space until he actually purchases the corn locally. He also avoids any risk of quality loss during storage over the November to February period. Finally, and most importantly, he is in a more favorable position if price starts to decline.

Suppose that in mid-November it becomes clear that a record crop is being produced in the face of stabilizing demand. As a result, corn prices start to decline. If I (returning to the example) had purchased cash corn in early November, I would be stuck with it. However, as soon as I know prices are going to move lower, I will lift my hedge as follows:

Cash Market		Futures Market (March Contracts)
will need 10,000 bushels local price now $2.31 per bushel	Nov. 5	buy two contracts at $2.39½

local price stands at \$2.28 per bushel	Nov. 20	sell two contracts at \$2.36½
purchase 10,000 bushels locally at \$2.25	Feb. 20	no action needed
		net loss, 3¢ per bushel

The net price for the corn is now \$2.25 local purchase price plus 3¢ futures loss, or \$2.28. I am better off than the \$2.31 which would have been my cost under a cash purchase in November. The additional flexibility has paid off.

I am not telling you that forward pricing ingredients through the futures market will always work out better than trading strictly in the cash market. I am saying that this option can provide better pricing performance and that anyone who intends to use futures needs to spend a considerable amount of time learning to recognize those conditions favorable to successful hedging. This is not an easy tool to use. You must be willing to commit yourself to an educational program before you make that first trade.

Neither am I saying that hedging is good for all producers. The situation for each farmer or rancher is unique and any successful hedging program must be designed with this uniqueness in mind. Consider the previous feed cost hedge. Whether or not this would be attractive to an individual depends upon his belief as to the direction of price movement, his on-farm grain storage capacity, the storage quality of the corn available to him in November, his belief about the availability of local grain in February-March, and his personal cash flow position. Futures trading is not a simple add-on operation. It is an integral part of the entire production process.

Summary

This brief introduction has, I hope, served to whet your interest. Futures trading is, of course, much more complex than this brief introduction indicates. The actual contract terms for hogs and corn are indicated in the appendix. We may pursue further details in the question and answer period. However, before we do, I would like to summarize some of the key points which have been touched upon.

1. Futures trading offers no cure-all for producers. If your business was unprofitable before futures trading, it will be unprofitable afterward. The additional flexibility offered by the futures market can, however, improve the performance of an already profitable enterprise.

2. Futures contracts are essentially temporary substitutes for actual cash market transactions. To be sure, the trading ground rules are different but futures trading should not be entered into more lightly than actual cash market purchases or sales.

3. Always hedging is no better, and very probably worse, than never hedging. You will notice that the question, What am I afraid of?, was applied to the example used today. Futures can be used to protect you against unfavorable price movements. If you feel certain that prices will move favorably for you, then you will not hedge.

4. The classic textbook hedge where a producer buys or sells futures and then forgets about it does not exist. A producer who hedges must be alert to any new market developments and be willing to act accordingly.

5. Hedging hogs means not only using hog futures for your output, but corn or soy meal futures for your feed input just as well. In fact, it would have been disasterous for you this year if you had locked in a forward price for the hogs only to be squeezed by higher ingredient prices. You can hedge hogs only, ingredients only, or both by buying feed futures and selling hog futures. The last option is commonly known as a gross margin spread.

6. Futures trading has an advantage beyond improved pricing performance. There is no more efficient mechanism in existence for distilling and disseminating relevant market news than the commodity futures market. It is impossible to follow the news reports which accompany futures prices without becoming aware of the varied forces at work in your product market. You are then in a better position to make better production decisions on a day-to-day basis.

Even if you never trade a single futures contract, avail yourselves of the various commodity futures news reports. I guarantee that you will gain valuable information which will help you to make the hard decisions which today's markets demand.

Appendix

Hog Futures Contract

Pricing Unit: Dollars per hundred weight
Contract Unit: 30,000 lbs.
Par Delivery Animals: U.S.D.A. Grade No. 1, 2, 3, and 4
Barrows & Gilts
Average Weight to be 200-230 lbs.
Under 190 lbs. or over 240 lbs. are not deliverable

Par Delivery Point:	
Peoria, Ill. Omaha, Neb. East St. Louis, Ill. Sioux City, Iowa St. Paul, Minn.	at an allowance of 25¢/cwt.
Kansas City, Kan.	- at an allowance of 50¢/cwt.

Active Delivery Months: Feb., Apr., June, July, Aug., Oct., Dec.
Daily Trading Limit: $1.50 per hundred weight
Margin, Initial: $1200 per contract
Margin, Maintenance: $900 per contract
Commission: $35.00 per contract

Corn Futures Contract

Pricing Unit: Dollars per bushel
Contract Unit: 5,000 bushels
Deliverable Grades: No. 2 Yellow corn at par
No. 1 Yellow corn at ½¢ premium
No. 3 Yellow corn at 2½¢ discount
Maximum 15½% moisture

Delivery Point: Chicago, Ill.
Active Delivery Months: Mar., May, July, Sept., Dec.
Daily Trading Limit: 10¢ per bushel
Margin, Initial: $1200 per contract
Margin, Maintenance: $700 per contract
Commission: $30.00 per contract

SOME CURRENT DISEASE TOPICS

P. E. Gorham, D.V.M.

It makes very little difference where one goes in the United States to talk about swine diseases. The same topics are of interest to North Carolina pork producers, Iowa pork producers, and hopefully, Oregon pork producers. Unfortunately, these diseases are the ones for which no "pat answers" or easy solutions are available.

I have been asked to discuss four disease conditions: SMEDI, MMA, scours and arthritis.

SMEDI

The name SMEDI is derived from the conditions caused by a group of viruses--S for stillbirth, M for mummification, ED for embryonic death and I for infertility. Please note that I said this condition is caused by a group of viruses. Also, please note that the word abortion is not a part of the name. These two points are keys to understanding the syndrome.

The most common signs of the SMEDI syndrome include:

1. Many sows produce very small litters, sometimes only 2 or 3 pigs.
2. Many fetuses are mummified or stillborn. Newborn pigs may be weak or they may appear normal but have a poor survival rate.
3. After an apparently normal mating, sows fail to return to heat and do not farrow. Occasionally sows develop large mammary glands and other signs of impending parturition, but they do not farrow. Most will eventually return to heat.
4. There may be increased repeat breeding that results from embryonic death prior to calcium deposition in the skeleton.

Enteroviruses are ubiquitous among swine. Recent evidence indicates that at least 8 enterovirus serotypes are common in pigs in the United States. All herds tested by Dr. H. W. Dunne, Pennsylvania State University have exhibited antibodies to two or more enteroviruses.

Non-swine carriers of porcine enteroviruses have not been identified. The viruses are transmitted by direct contact or by fecal contact between pigs. They appear to move relatively slowly through the pig population. If an enterovirus infects a non-pregnant adult pig, no signs of disease will be noted. Enterovirus infection in neonatal pigs can lead to incoordination or other central nervous system signs.

Enterovirus infection in pregnant swine can destroy one or more developing embryos. If less than four live embryos are present at 15 days after mating, pregnancy is never established. The female will return to heat. If all the embryos are destroyed prior to day 35 of pregnancy resorption of the fetus occurs and the female returns to heat.

P. E. Gorham, D.V.M., Field Research Veterinarian, Eli Lilly & Co.

After day 35 calcification of the skeleton begins and complete resorption is more difficult. Death of fetuses after calcification usually results in mummification. If enterovirus infection occurs in late gestation, stillbirths are likely to occur.

Intrauterine enterovirus infection is gradual. Mummies of many sizes are commonly produced, indicating slow transmission of the virus between fetuses. Pigs that survive enterovirus infection may have decreased livability. In one experiment, Dr. Dunne has shown that the live pigs from gilts that had produced one or more mummies had increased susceptibility to enteric colibacillosis.

After enterovirus infection, gilts and sows apparently develop a serotype-specific immunity. Carrier swine have not been specifically identified, but clinical observations support their existence. SMEDI problems occur again only when susceptible swine are introduced into the breeding herd or when new enterovirus serotypes are introduced into the herd, presumably by the addition of pigs from another farm or herd.

Dr. Dunne has proposed the following control measures for the SMEDI syndrome:

1. Co-mingle sows and gilts one month prior to breeding. If any differences exist in resident enterovirus populations, all breeding animals, especially the susceptible gilts, will be equally exposed prior to pregnancy. One month should be sufficient for the development of immunity.
2. Isolate pregnant females from recently purchased or incoming animals that could introduce a new enterovirus.
3. Retain the sows and gilts that exhibit apparent SMEDI infection, if they return to heat and cycle normally. These females have probably developed immunity to at least one enterovirus and are therefore a better risk than replacement animals with the unknown immunity.

Currently the SMEDI syndrome is a common clinical diagnosis. Laboratory confirmation of the diagnosis is difficult to obtain. While several laboratories are now equipped to conduct enterovirus serology, no one is providing the appropriate paired samples of serum. Because of the wide occurrence of these viruses, only a significant change in titer of one enterovirus during or after suspected infection can be considered diagnostic. Veterinary practitioners should be encouraged to draw random samples of blood from 10 percent of the animals just prior to breeding. The serum should be frozen and stored. If gestation or parturition problems occur, additional blood samples should be drawn. These paired samples would provide the laboratory an opportunity to confirm enterovirus infection.

Because of the diagnostic difficulties, the prevalence of the SMEDI syndrome is unknown. The need for preventive measures is therefore, equally unknown. Comingling of sows and gilts prior to breeding is difficult to achieve under some management schemes. Additionally, the competition for food and the fighting between sows and gilts makes the comingling practice less attractive. If "across the fence contact" were sufficient to insure common exposure, the desired management would be easier to achieve. Vaccines are not a likely possibility in the near future.

MMA

MMA stands for mastitis, metritis, agalactiae (no milk). Unfortunately, we have been all too quick to put every non-milking sow into the MMA category and also to feel that we are dealing with a new, specific disease. In reality we are probably dealing with a syndrome of numerous causes or at the very least a set of interrelated factors.

A typical MMA problem herd is one in which normal size litters of healthy pigs are farrowed. The sow appears normal at farrowing and the mammary glands are pliable. Milk can be expressed from the teats. About 24 to 48 hours later the pigs appear hungry, the sow may or may not be off feed, she may lay up on her belly and refuse to allow the pigs to nurse. Her mammary glands may feel firm and hot; there may be a vaginal discharge and she is constipated. Obviously, the critical factor is that the pigs are in danger of starving.

Research at several midwestern universities over the past seven years has failed to discover any infectious cause--no consistent bacteria, viruses or mycoplasma.

Recent research by Dr. Dick Ross at Iowa State has pointed toward the possibility of an endotoxin (bacterial poison) produced either in an infected mammary gland or in the lumen of the gut.

Until a specific cause can be pinpointed our efforts at control or treatment must be directed toward the symptoms: oxytocin or POP to let down the milk, antibiotics to control infections, laxatives or bulky diets to combat constipation.

ARTHRITIS

When one talks about arthritis he must consider a number of specific bacterial infections: streptococcus, staphylococcus, corynebacterium and erysipelas. Also PPLO (mycoplasma). In the interest of time I shall limit my discussion to mycoplasmal arthritis of heavy hogs. Most of the important work in the area is being conducted at Iowa State and I might be able to give you some new information not available elsewhere.

The specific arthritis caused by M. hyosynoviae probably does not occur in pigs under 80 pounds in weight. Typically it occurs in heavy muscled animals as a very acute lameness. Only a few animals may be affected but occasionally as many as 40-50% of a herd may show symptoms. Spontaneous recovery can occur but injections of tylosin or lincomycin administered early can enhance recovery. Cortico-steroids are also frequently used to reduce inflamation and soreness during the recovery period.

Mycoplasma hyosynoviae is extremely common in swine herds. Probably 90% or more of our swine herds are infected. That means that one or more animals are harboring the causative organism in their naso-pharynx or tonsils. It is not known why we have such a common infection but such a relatively low incidence of arthritis.

Dr. Dick Ross at Iowa State can experimentally infect 100% of the animals exposed but only a small percentage develop typical symptoms of arthritis. He has found certain heavy muscled strains within certain breeds to be more susceptible. Animals that have not shown arthritis can still remain carriers within the herd.

Joints most frequently infected are the hock, stifle, shoulder and

Many diagnostic laboratories are not equipped to isolate the organism. Attempts to isolate the organism from joint fluid must be made soon after the onset of symptoms. About 5 to 7 days is the length of time the organism can be isolated from the joint.

Control measures to date have been limited to treating affected animals as they occur. Feed additives can make no claim for prevention or control. Early weaning and strict isolation can reduce the spread from older carriers to young susceptible animals but this is generally not practical.

No vaccine is available, nor is it a likely possibility in the next 5 years.

Tests to help us identify carrier animals and remove them from the herd is a distinct possibility.

POST WEANING SCOURS

Scours can occur at a number of different times in a pigs life but seldom is it more discouraging to the producer than when it occurs just following weaning. Healthy, smooth pigs are weaned and placed in a nursery pen. Within a few days nearly every pig is exhibiting some degree of scours. Very few pigs die but there is some obvious reduction in growth rate. Recovery can be hastened through the use of a wide variety of medications, most of which are aimed at controlling the E. coli and soothing or protecting the intestinal lining. Prevention is far more important from the standpoint of a profitable hog operation. However, it is not easily accomplished. Warmth, dryness and reduction of bacterial numbers sound good, but are not always possible. Never the less they are worth while goals to be strived for.

Most authorities agree that E. coli strains are involved; hence the name colibacillosis. The problem arises in determining just which strain might be the culprit since literally hundreds of strains have been identified to date. Despite our knowledge of these strains it is still not possible to produce typical post weaning scours using cultures of these organisms. Research must be conducted in naturally occuring outbreaks.

Once again vaccines do not appear likely.

PREDICTORS OF LEANESS IN PORK CARCASSES

James O. Reagan

During the past 15 years, we have witnessed a tremendous change in the type of swine being produced. Due to the changes in the consumer's perference and the importance of increased efficiency in meat production, the meat type hog has evolved and established an even greater precedence for the producer to evaluate his product on the rail.

The ultimate merit of an individual pork carcass results from observed differences in two value-determining characteristics: a) quality characteristics of the lean and, b) the combined yield of the four lean cuts (ham, loin, picnic and boston butt). Comparisons among carcasses are intended to relate quality and cutability determinants to visual indices or linear measurements.

A. Objective Measurements of Quantitative Characteristics.

Linear measurements or actual cut-out data are collected whenever objectivity has a monetary consequence. The following measurements may be obtained and used as indicators of leanness.

Carcass measurements:

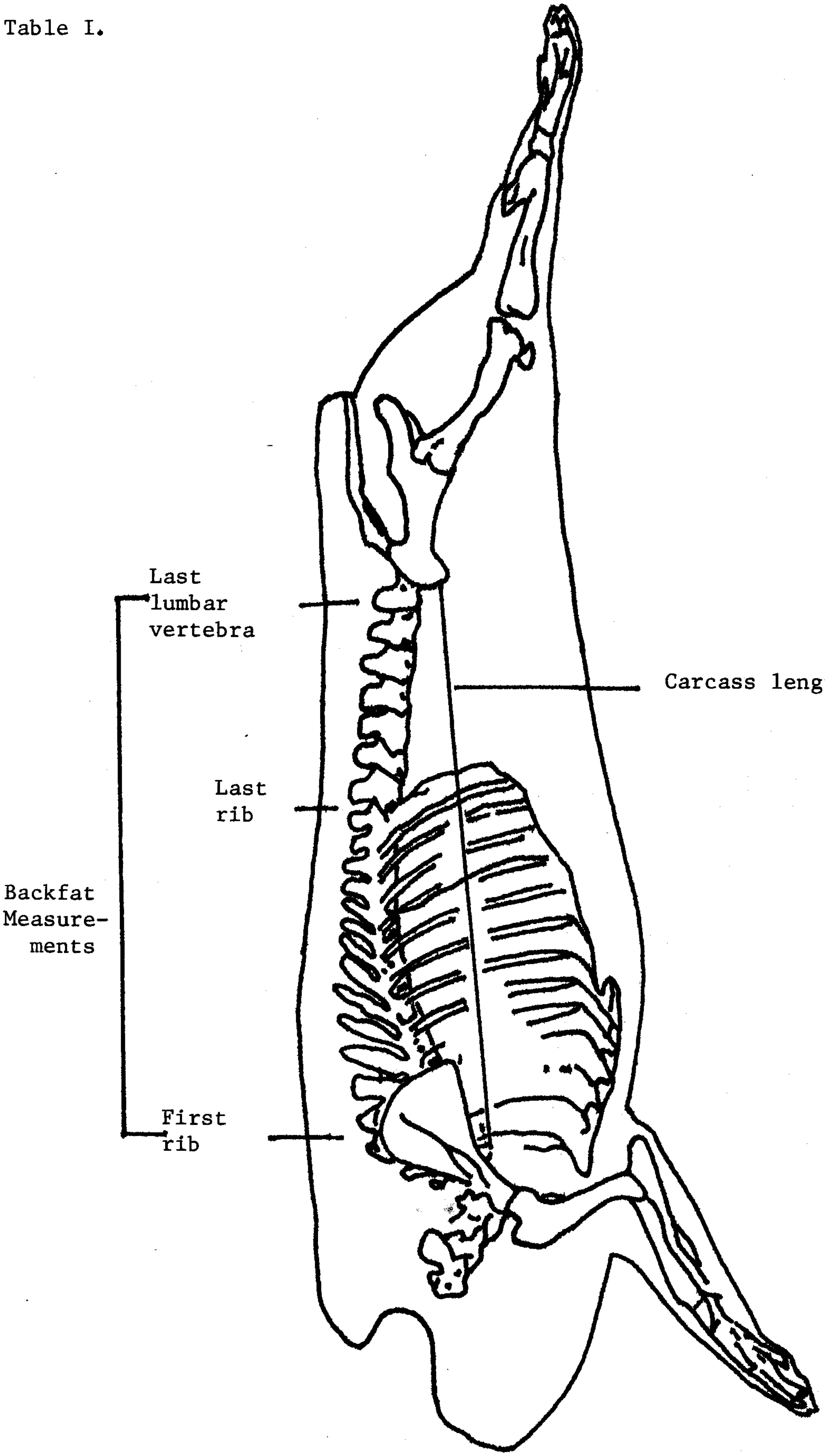
a. Carcass weight. This measurement is used primarily as an indicator of total volume from which the relative percentages of the various wholesale cuts may be obtained.

b. Carcass length. This measurement is defined as the distance from the anterior edge of the first rib to the anterior edge of the aitch bone (Table 1). Although length is a desireable trait in pork carcasses the association between carcass length and the total volume of lean is not high, thus a longer carcass does not necessarily indicate a greater total volume of edible meat.

c. Loin-eye area. The measurement of the *longissimus dorsi* muscle is made between the tenth and eleventh ribs of the carcass. Loin-eye size is a good indicator of the total muscle or lean in a carcass. This trait is of great importance from the consumer standpoint, whose primary concern is the actual size of the loin chops. The measurement may be determined by either a grid measurement or by tracing the loineye and using a compensating polar planimeter to determine the area.

James O. Reagan, Assistant Professor, Department of Animal Science, Oregon State University.

Table I.



Last
lumbar
vertebra
Carcass length
Last
rib
Backfat
Measure-
ments
First
rib

d. Average backfat thickness. The points of measurement for this trait are opposite the first rib, last rib and last lumbar vertebra. The average of these three measurements should be determined and used as a single indicator of trimness. The primary factor that effects leanness in pork carcasses is the subcutaneous fat cover.

e. Ham weight. The ham comprises approximately 19 percent of the total carcass weight and therefore, may be used as an indicator of muscling in the pork carcass.

f. Ham-loin weight. The combined weight of the ham and loin accounts for approximately 36 percent of the carcass weight and more than 50 percent of the total monetary value of the pork carcass.

g. Four lean cuts. The four lean cuts of the pork carcass are the ham (19%), picnic (8%), boston butt (9%), and loin (17%). These four primal cuts comprise 53 percent or more of the total carcass weight and 80 to 90 percent of the total monetary value of the carcass. Thus, the best single measurement of the carcass yield could be made by determining the relative percentage of these four cuts. It is unfortunate that these measurements are the most time consuming of all and the variation between meat cutters with respect to actual carcass fabrication and fat trim often makes it difficult to compare animals that are slaughtered at different times or at different facilities.

B. Procedures for Evaluating Pork Muscle Quality.

To supplement cutability data, quality evaluations are important to relate differences in expected palatability, consumer satisfaction and processing characteristics. Evaluations of pork quality indicators must be based on standards for the appearance of the exposed surface of one or more muscles (usually the l.dorsi at the 10th rib interface or the gluteus medius in the ham face). Wisconsin Special Bulletin #9 illustrates and describes several degrees of pork quality. The scoring system used consists of individual scores for (a) color, firmness and structure, and (b) marbling.

Objective measures of pork quality depend upon evaluations of tenderness and/or palatability of the cooked product. The Warner-Bratzler Shear Machine determines the pounds of force required to completely shear a 1/2 inch core of cooked meat. Another available method involves a subjective appraisal by a trained taste panel (often referred to as a sensory panel). Members of the sensory panel are served samples of the cooked meat and they evaluate the meat and rate it according to its desirability for flavor, texture, tenderness and overall satisfaction.

C. Procedures Used in U.S.D.A. Grading of Pork Carcasses.

Federal grades for pork carcasses are intended to relate market desirability and in effect to segment all carcasses of the same relative value into one of five grades. Carcass measurements and subjective scores are combined and used to classify carcasses according to their cutability and quality characteristics. Any carcass may then be segmentaed into one of the five grades (Table II). Four grades - U.S. No. 1, U.S. No. 2, U.S. No. 3, and U.S. No. 4 - are provided for carcasses which have indications of acceptable lean quality and acceptable belly thickness. These grades are based entirely on the basis of expected carcass yields of the four lean cuts. The expected yields of the four lean cuts for each of the U.S. Grades are as follows:

U.S. 1	53% or more
U.S. 2	50.0 to 52.9%
U.S. 3	47.0 to 49.9%
U.S. 4	46.9 or less

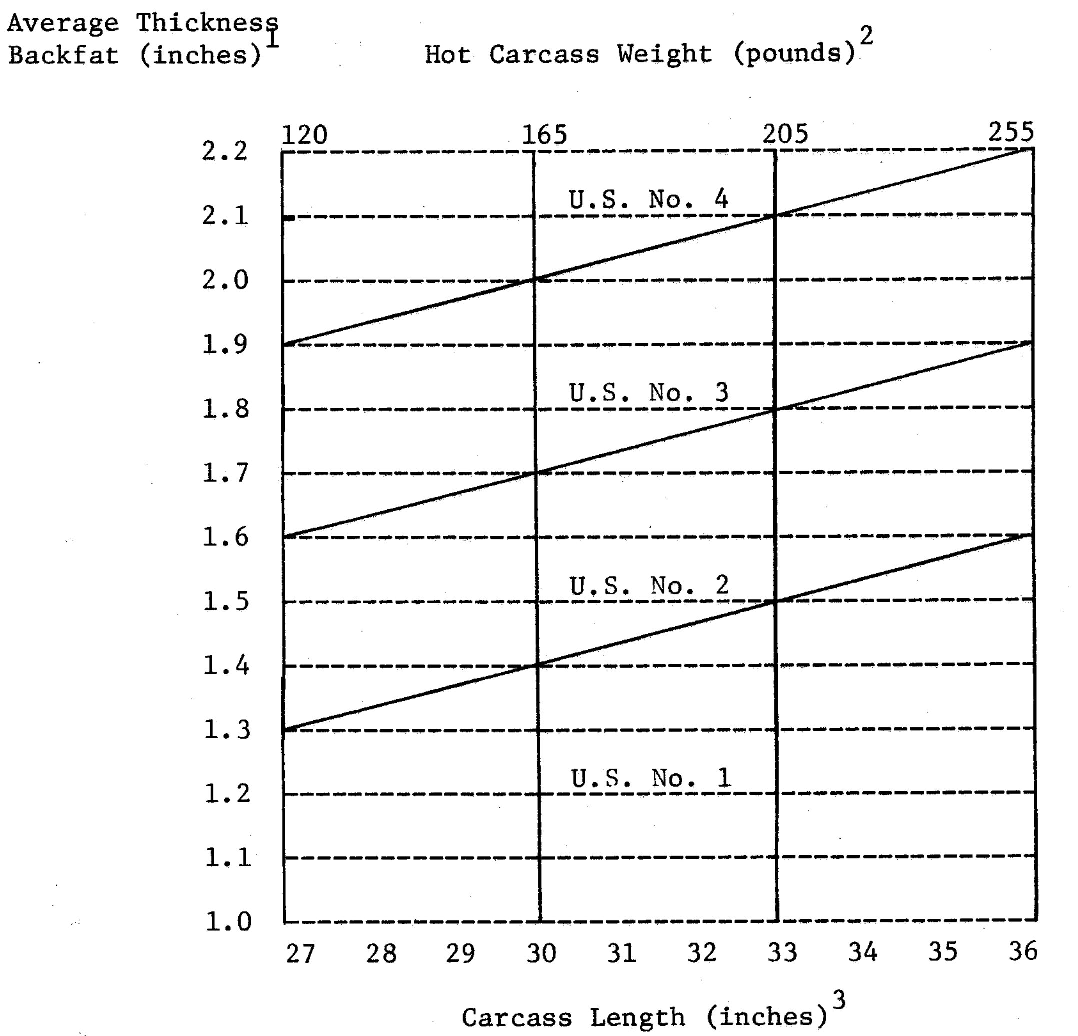
Carcasses which have quality characteristics indicating that the retail cuts would be less than acceptable in palatability or consumer preference, those with thin soft bellies and those which are soft and/or oily are all grouped together and graded U.S. Utility. The factors involved in estimating cutability and quality according to U.S.D.A. grading standards for pork carcasses are as follows:

CUTABILITY	CARCASS QUALITY
Carcass length or weight	Firmness of fat and lean
Average backfat thickness	Color of lean
Muscling score	Feathering in ribcage
	Belly thickness

D. Procedures For Obtaining Linear Measurements For Use In Prediction Equations.

Due to the extreme difficulty associated with obtaining actual cutability determinations, two alternative procedures are used to evaluate pork carcasses by the use of linear measurements. The swine certification program is recognized by all of the breed associations, having been initiated by a joint meeting of representatives of all interested breeds in 1952. At the time the program was begun the short, chuffy, overfat and undermuscled hog was predominant, thus length and muscling combined with the minimum quantity of fat necessary to ensure palatability and quality was the desired end-point in carcass selection. Correspondingly, the certification program has emphasized carcass length (assuming that long bodied swine are more productive and/or prolific than short bodied hogs), loin eye or l. dorsi area (as a measure of muscling) and average backfat thickness (to measure the amount of excess trimmable fat on the carcass). In order to "certify" as a meat type animal the market hog, slaughtered at 180 to 220 lbs. live weight must produce a carcass which is at least:

Table II. RELATIONSHIP BETWEEN AVERAGE THICKNESS OF BACKFAT, CARCASS LENGTH OR WEIGHT, AND GRADE FOR CARCASSES WITH MUSCLING TYPICAL OF THEIR DEGREE OF FATNESS.[4]



[1] An average of three measurements including the skin made opposite the first and last ribs and the last lumbar vertebra. It also reflects adjustment, as appropriate to compensate for variations - from - normal fat distribution.

[2] Carcass weight is based on a hot packer style carcass.

[3] Carcass length is measured from the anterior point of the aitch bone to the anterior edge of the first rib.

[4] Minimum muscling score for U.S. 1 is moderately thick.

29.5 inches in length
4.5 sq. inches of loin eye
1.4 inch or <u>less</u> of backfat

on the basis of 200 pounds live weight adjustment.

The procedures involved in obtaining data for pork carcass certification are as follows:

Carcass length - measured from the anterior edge of the first rib to the anterior edge of the aitch bone.

Average backfat thickness - The average of 3 fat measurements including the skin taken at the 1st rib, last rib and last lumbar vertebra.

Loin-eye area - measured at the 10th - 11th rib interface. The loin is split perpendicular to the backbone and only the l. dorsi muscle is measured.

These and other linear measurements can also be used to predict cut-out percentages by the use of a formula called prediction equations. By combining 2 or 3 of the best measurements, the predicted value for yields of trimmed cuts may rise to 70 percent accuracy or more. Consider the following prediction equation:

$$\text{Percent Four Lean Cuts} = 67.68 \text{ minus } 4.95\begin{pmatrix}\text{Fat}\\ \text{depth at}\\ \text{10th rib}\end{pmatrix} \text{ plus } 1.0\begin{pmatrix}\text{Loin-eye}\\ \text{at}\\ \text{10th rib}\end{pmatrix} \text{ minus } 6.27\begin{pmatrix}\text{Ave. backfat}\\ \text{thickness}\end{pmatrix}$$

where:

Fat Depth - the average of 3 measures taken opposite the l. dorsi at the 10th rib interface. Fat thickness is determined opposite points 1/4, 1/2 and 3/4 the length of the longitudinal axis of the loin-eye muscle in inches.

Loin-Eye Area - the surface area of the l. dorsi muscle (sq. inches) at the 10th rib interface.

Average Backfat Thickness - average of three measurements including the skin taken at points opposite the 1st rib, last rib and last lumbar vertebra in inches.

This equation has been used successfully with above 75% accuracy.

SUMMARY

In summary, the importance of knowing the ultimate endpoint of your product is more important now than ever before in the history of the pork industry. To maximize your breeding and selection programs and to more efficiently produce pork for the consumer, it is a MUST in the pork industry to know your final product.

ALFALFA PROTEIN CONCENTRATE
AN ALTERNATIVE SOURCE OF PROTEIN FOR SWINE

P. R. Cheeke

The use of alfalfa as a source of protein for swine appears to have considerable potential. Compared to other plant proteins, the yield of protein per acre from alfalfa is high, and its amino acid composition compares favorably with that of other plant proteins and with the requirements of swine. In the Pacific Northwest, commonly used protein supplements such as soybean meal are imported, whereas alfalfa is widely grown, providing abundant supplies of locally grown protein.

Direct use of alfalfa in swine rations to provide a major part of the protein requirements of growing pigs is not feasible. The major problem is that at levels exceeding about 25% alfalfa in the diet, the bitterness of the alfalfa causes a substantial reduction in palatability of the feed, with the result that feed intake falls. Thus instead of responding to a lower dietary energy level (caused by the inclusion of alfalfa) by increasing feed intake, as would normally be the case, feed consumption falls and performance is impaired. The major problem in utilizing alfalfa directly as a protein supplement for swine is consequently seen to be a palatability problem, rather than being directly due to its high fiber (low energy) content.

For many years, numerous investigators have searched for economical, practical means of extracting the protein from green plants such as alfalfa, for animal and human feeding. Researchers at the USDA Western Regional Research Laboratory have developed a process whereby part of the alfalfa protein can be isolated from green alfalfa for use in animal feeding. The details of the procedure have been described by Kohler et al (1973). Chopped alfalfa is pressed, and the juice is subjected to procedures to coagulate the protein, which is then dried. The USDA workers called this material Pro-Xan (Protein-Xanthophyll concentrate). A commercial company, Batley-Janss Enterprises of Brawley, California has developed this process, and currently produces in excess of 4,000 tons of alfalfa protein concentrate annually. They use the trade name X-Pro for the material. A typical analysis for X-Pro is shown in Table 1.

At Oregon State University we have conducted several experiments to determine the value of X-Pro as a protein supplement for swine. The first experiment was an evaluation of X-Pro as a protein source for growing-finishing pigs. Levels of 5, 10, 15, 20 and 24% X-Pro were substituted for soybean meal and meat bone meal in a barley-based ration. The composition of the rations, and the animal performance, are shown in Table 2. Six Yorkshire-Berkshire barrows, averaging about 90 lbs. each, were assigned to each of the 6 treatments. They were fed the experimental diets until they reached an average weight of about 180 lbs. The control, and the 24% X-Pro group, were continued to 200 lbs. on the experimental diets, and carcass data was obtained.

P. R. Cheeke, Assistant Professor, Department of Animal Science, Oregon State University.

Table 1. Composition of X-Pro (Alfalfa Protein Concentrate).*

Component	Percent
Crude Protein	38.8
Ether Extract	6.2
Crude Fiber	2.4
Ash	19.2
Calcium	2.35
Phosphorous	0.44
Lysine	2.15
Methionine	0.79
Cystine	0.43

*Adapted from Kuzmicky *et al* (1972).

Table 2. Percentage Composition of Rations, and Performance of Market Hogs Fed X-Pro.

Ration Ingredient	Treatment Number					
	1	2	3	4	5	6
X-Pro	----	5	10	15	20	24
Soybean meal	10	8	5	----	----	----
Meat and bone meal	7.5	5.5	5	5.5	2.5	----
Barley	80.8	79.8	78.3	77.9	75.9	74.4
Tricalcium phosphate	0.2	0.2	0.2	0.2	0.3	0.3
Trace-mineralized salt	0.5	0.5	0.5	0.4	0.3	0.3
Bentonite	1	1	1	1	1	1
Average daily gain (lbs.)	2.2	2.1	2.2	2.1	2.0	2.2
lb feed/lb gain	3.41	2.96	3.16	3.42	3.29	3.47

Each ration was supplemented with 120,000 IU vitamin D, 1,200,000 IU vitamin A, 230 g zinc sulfate, and 2 lbs Aureo-SP-250 per ton.

The gains in all treatments were excellent (Table 2). Growth performance of the group receiving X-Pro as the sole source of supplementary protein was the same as for the control, providing evidence that for market hogs, X-Pro can fully replace other protein sources. Because of the high ash content of X-Pro, scouring problems might be expected when high levels are used. None were observed; there was a tendency for loose feces at the 24% X-Pro level, but not to the extent of being a problem. For the control and 24% X-Pro groups, the carcass data were: dressing %, 74.3, 74.0; ham-loin %, 34.1, 34.0; backfat thickness, 0.60 cm, 0.54 cm. The results of this experiment indicate that X-Pro has considerable potential as a protein source for market hogs.

Another experiment was conducted using smaller pigs. Levels of 7.5, 12.5, and 20.0% X-Pro were used in a barley-based ration (Table 3). At the

20% X-Pro level, a treatment without added salt was included, to determine if the high ash content of X-Pro had detrimental effects that could be reduced by lowering the salt level. Nine Yorkshire-Berkshire barrows were assigned to each treatment, at an average weight of about 38 lbs. They were fed the experimental rations until their average weights were about 100 lbs. They were penned in groups of three.

Table 3. Percentage Composition of Rations, and Performance of Young Pigs (38-100 lbs.) Fed Diets Containing X-Pro.

Ingredient	Ration Number					
	1	2	3	4	5	6
X-Pro	----	----	7.5	12.5	20	20
Soybean meal	10	9	5	2	----	----
Herring meal	2.5	2.5	2.5	2.5	2.5	2.5
Meat and bone meal	5	5	5	5	1	1
Barley	79	72.5	76.5	74.8	73.0	73.3
Ground alfalfa	----	7.5	----	----	----	----
Molasses	1	1	1	1	1	1
Trace-mineralized salt	0.5	0.5	0.5	0.4	0.3	----
Dicalcium phosphate	1	1	1	0.8	1.2	1.2
Bentonite	1	1	1	1	1	1
Average daily gain (lbs.)	1.50	1.45	1.55	1.46	1.33	1.34

Each diet was supplemented with 3 lbs. Aureo-SP-250, 230 g zinc sulfate and 200,000 IU vitamin D per ton. Ration 1 was supplemented with 1,500,000 IU vitamin A per ton.

There was a slight depression in gain at the 20% X-Pro level (Table 3), indicating that with young pigs X-Pro at high levels is not utilized as efficiently as the soybean-meat meal combination. Further work will be required to determine if this is a result of amino acid inadequacy, poorer protein digestibility, or reduced palatability of X-Pro with young pigs. Growth at the 7.5% and 12.5% X-Pro levels was excellent, indicating that at least to this level, the alfalfa protein is well utilized by young pigs.

The third experiment was concerned with the value of X-Pro in creep and starter rations. The OSU creep ration was used as the control; in the experimental diets, X-Pro was tested at the 6.5% and 13.0% levels (Table 4). It was substituted for soybean meal and wheat in the control diet. In both the pre- and post-weaning periods, the X-Pro rations gave results comparable to those observed with the control ration (Table 5).

Although these are preliminary studies, it is apparent that X-Pro can be used with good results in swine rations. The development of this material has provided a means of separating alfalfa protein for use by non-ruminants, leaving the fibrous material as a high quality roughage source for ruminants. Development of a facility in the Northwest to produce this alfalfa protein concentrate would provide a competitive protein source for swine. Data reported by Kuzmicky et al (1972) indicate that X-Pro is also an excellent source of protein for poultry.

Table 4. Percentage Composition of Creep-Starter Ration.

Ingredient	Ration Number 1 (OSU Control)	2	3
Wheat	66	64.5	63.25
Alfalfa meal (sun dried)	5	5	5
Soybean meal	10	5	----
Herring meal	5	5	5
Dried buttermilk	6	6	6
Dried whey	2	2	2
Ground limestone	0.5	0.5	0.5
Trace-mineralized salt	0.5	0.5	0.5
Molasses	5	5	5
X-Pro	----	6.5	13.0

Each ration was supplemented with 5 lbs. Aureo-SP-250, 340 g zinc sulfate, and 180,000 IU vitamin D per ton.

Table 5. Performance of Pigs Fed Creep-Starter Rations Containing X-Pro.

	Pre-weaning Performance			Post-weaning Performance		
Treatment	Avg. start wt-lbs	Avg. finish wt-lbs	Avg. daily gain (lbs)	Avg finish wt-lbs	Avg daily gain wt-lbs	lb feed/ lb gain
Control	10.8	20.4	0.45	63.4	1.01	2.03
6.5% X-Pro	11.6	22.4	0.47	64.7	0.99	2.13
13.0% X-Pro	12.0	21.3	0.40	62.4	0.93	2.17

Acknowledgment

The supply of X-Pro provided by Mr. W. R. Batley, Jr. of Batley-Janss Enterprises, Brawley, California is gratefully acknowledged.

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MATING AND CONCEPTION ADEQUACY IN GILTS BRED AT FIRST OBSERVED ESTRUS

P. B. George and D. C. England

It is standard practice in swine production to mate gilts at 7 1/2 to 8 1/2 months of age at a live weight of 250-280 lbs. at the third or later heat periods. In today's competive production cost-market return situation, however, the feasibility of the early breeding of gilts is an economic potential that justifies experimental examination. The producer can ill-afford to absorb the costs of delaying mating until the third heat, approximately 42 days after the attainment of puberty, if reproduction at a younger age is substantially equal to reproduction at the delayed age.

Two approaches can be considered for the early mating of gilts, first, by breeding at first or pubertal estrus, or second, by the reduction of the age at puberty. In a study by England (1973) full-fed gilts mated at first estrus ovulated an average of 12.4 ova and had 9.3 embryos; these averages are comparable to data for gilts bred at conventional ages. Brooks and Cole (1973) in Great Britain reported that once gilt's have reached 160 days of age, puberty may be stimulated by changing the gilts environment. Mating can occur at this time with no economic advantage to be gained by delaying mating until the third estrus; the gilts should be on a full-feed diet prior to mating.

Experiments in this area are currently being conducted at Oregon State University. Thirty gilts of varying ages, weights, and genetic background have been used in a study designed primarily to determine the adequacy of conception and litter size when gilts are bred at first observed or pubertal estrus and, secondarily, to determine the age at which the occurrence of first estrus could be induced by environmental changes.

At the start of the experiment gilts were moved from their growing pens and mixed in unfamiliar pens with other gilts; in essence, each gilt was placed in a new and unfamiliar environment. These changes were made for several gilts at the same time to minimize injury from excessive fighting. The gilts were continued on a full-fed diet. Each gilt was observed daily for visual indications of estrus and exposed daily to a boar. This procedure was continued for 30 days after mating; if the gilt did not return to heat she was slaughtered at approximately 30 days following mating. Those that rebred were continued in the above pattern until successful conception or failure to return to heat for 30 days. If estrus was not observed by the time the gilt weighed 300 lbs., the gilt was slaughtered.

P.B. George, Graduate Research Assistant, Department of Animal Science; and D.C. England, Professor, Department of Animal Science, Oregon State University.

Data were collected at slaughter on the number of corpora lutea and number of live embryos; from these values the percent embryo survival was calculated. These and the age and weight of the gilt when put on test, weight at first observed estrus, and the number of estrus cycles before conception occurred, were analyzed by regression analysis.

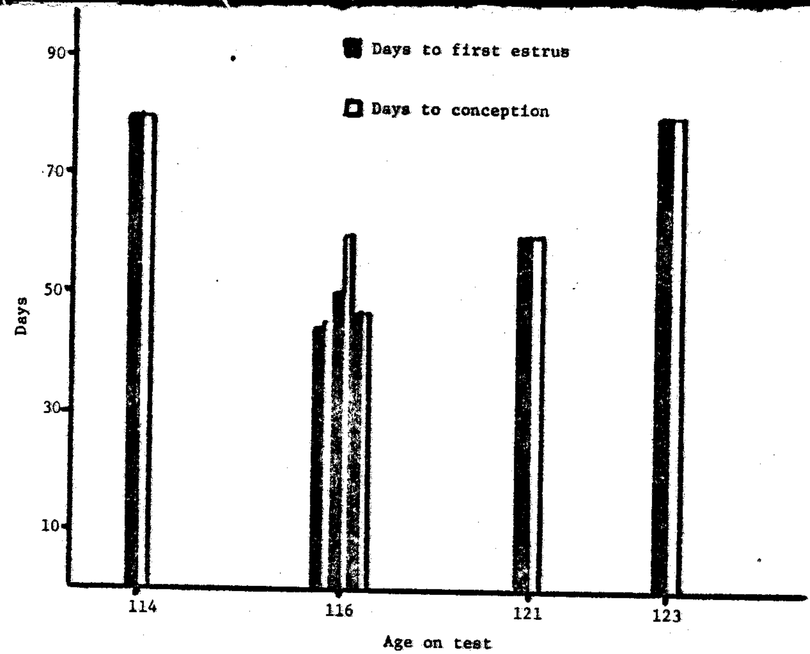
Table 1 shows data for gilts in three age groups. Table 2 shows data for the same animals by three weight classifications. Histograms 1, 2, and 3 show the distribution of mating response. Days to occurrence of first estrus after allottment was related to both age and weight; older gilts exhibited estrus sooner than younger ones and heavier gilts exhibited estrus sooner than lighter ones. Age and weight were highly correlated in this experiment (r = .74); their separate relationship to occurrence of estrus is thus not discernible in this experiment. Correlation of on-test weight and days to first estrus was -.64; that is, heavier animals came in heat sooner after being placed on experiment. This is evident in table 2; gilts weighing no more than 130 lbs. (118 lbs. average) when put on experiment showed first heat an average of 45 days later; those 131-160 lbs. (145 lbs. average) were in heat in an average of 39 days; and those 160-195 lbs. (186 lbs. average) were in heat in an average of seven days. In this experiment, average age at estrus and conception was lowest for gilts put on the experiment at the youngest age (Table 3); average weight at conception however, was almost identical for the three age groups. Average number of embryos was similar, considering the number of animals in the different groups.

Table 1. Age on test and days to the occurrence of estrus in gilts.

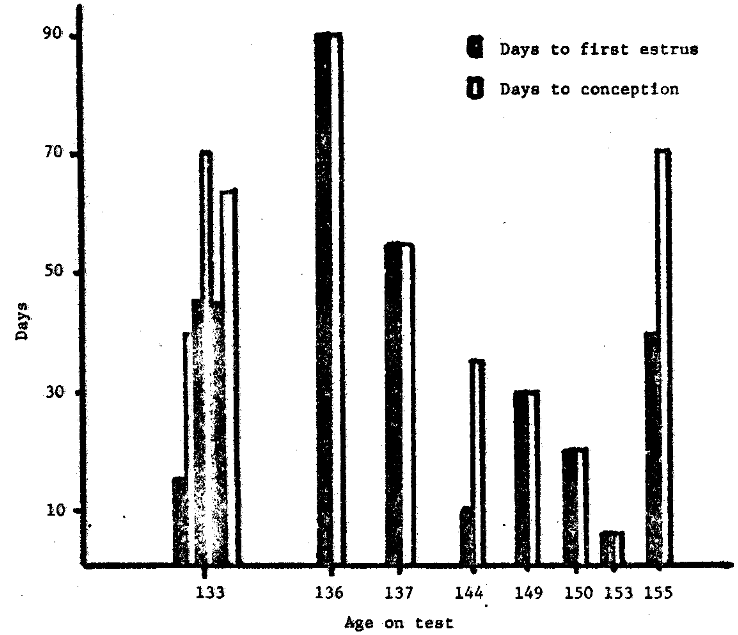
Age on Test (days)	114-130	131-160	161-190
Number of gilts	9	12	8
Average age on test (days)	120	143	185
Average weight on test (lbs.)	122	140	186
Average days to estrus	53	31	12
Average age at estrus	172	174	195

Table 2. Weight on test and days to the occurrence of estrus in gilts.

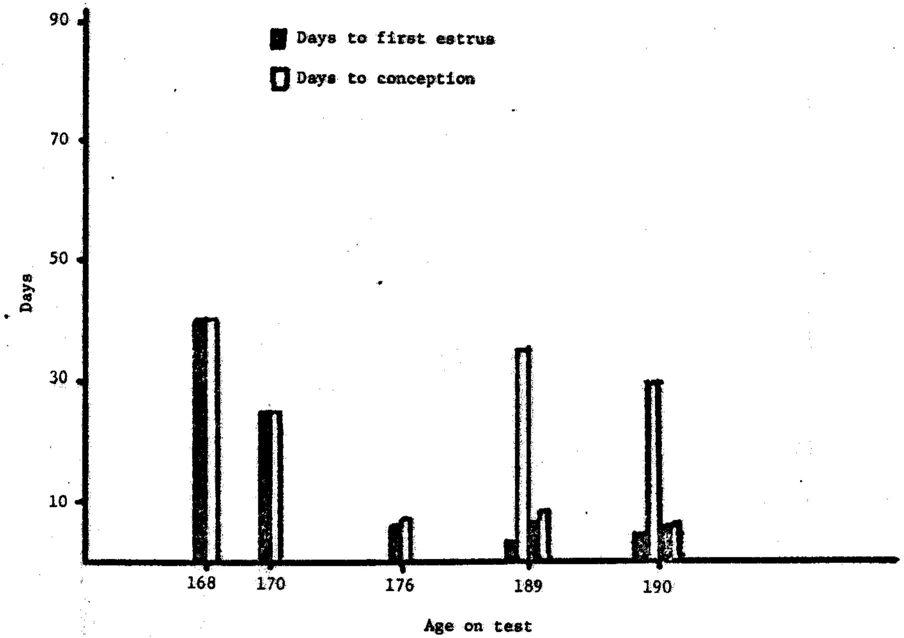
Weight on Test (lbs.)	102-130	130-159	160-195
Number of gilts	10	10	9
Average weight on test (lbs.)	118	145	183
Average age on test (days)	130	135	179
Average days to estrus	45	39	7
Average age at estrus	175	174	186



Histogram 1. Days on test to first estrus and to conception. (Group I, age on test 114-130 days)



Histogram 2. Days on test to first estrus and to conception. (Group II, age on test 131-160 days)



Histogram 3. Days on test to first estrus and to conception. (Group III, age on test 161-190 days)

The mean number of estrus cycles/gilt to final mating was 1.3 cycles for the 114-130 days-of-age group, 1.5 cycles for the 131-160 days-of-age group, and 1.6 cycles for the 161-190 days-of-age group. These values were not significantly different from each other.

Examination of the reproductive tracts at slaughter thirty days post-final-mating revealed that 24 of 30 gilts were pregnant. Table 3 contains descriptive data for each age group. Analysis of these data suggest no significant relationship between age or weight at conception and the number of corpora lutea or the number of embryos. From the average weight at conception (Table 3) for the age groups, it appears that weight would be the preferred indication of the proper time to use environmental changes to induce estrus with successful conception from mating at first and any succeeding estrus.

Table 3. Characteristics of gilts allotted to breeding experiments at different ages.

Age on Test (days)	114-130	131-160	161-190
Number of gilts	7	10	7
Average weight at 1st breeding (lbs.)	213	192	203
Average age at 1st breeding (days)	177	179	196
Average age at conception (days)	179	191	204
Average weight at conception (lbs.)	218	214	214
Average number of corpora lutea	12.6	13.6	12.0
Average number of embryos	8.9	9.0	8.3
% embryo survival	66.7	66.2	69.2

It should, however, be clarified that the weight at conception ranged from 129-280 lbs. and that age ranged from 160-227 days.

Sixteen of the 24 pregnant gilts conceived from mating at first estrus; seven conceived at second estrus and one at third estrus; in addition, six gilts including one with cystic ovaries were not pregnant when slaughtered thirty days post-final-mating. Corpora lutea numbers were 12.4 and 13.4 for gilts conceiving at first and second estrus respectively. These values, along with the 18 eggs ovulated by the one gilt that conceived at third estrus, suggest that ovulation rate was increasing with increasing age; with the small numbers in this study the ovulation rates were not significantly different. It has been demonstrated by other workers that ovulation rate increases with successive estrus periods until gilts are about 14 months of age.

The number of embryos present (8.8) in the reproductive tract of these gilts compares favorably with the litter size (8.6) of conventially mated gilts from this herd (George and England, 1973). It is well established that most of the death loss that occurs before birth has occurred by 30 days of pregnancy. It is thus expected that litter size at term in these gilts would have been comparable to that of gilts bred at conventional age. Experiments need to be conducted to determine this, however, and to assess the adequacy of ability of the young dams to nurse their pigs, mate at the usual time after weaning, and produce subsequent litters of usual numbers. The results to date are encouraging but need to involve larger numbers and to be extended.

Gilts in this study were continued on full-feeding until slaughter. Embryo survival data were comparable to that usually found for gilts fed a limited ration according to recommendations. Assessment needs to be made of feeding regimes for highest embryo survival in gilts bred at first estrus.

The current experiment has examined only a small segment of possible environmental manipulations to induce estrus. The response is sufficient to warrant further experiments; it is particularly encouraging in the heavier weight group, inasmuch as delayed estrus in gilts is a common and serious economic problem in many confinement swine operations.

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WHO'S WHO on the PROGRAM

Cheeke, Peter R., Assistant Professor, Department of Animal Science, Oregon State University.

England, David C., Professor, Department of Animal Science, Oregon State University.

Fancher, Roy E., Experimental Biological Aide II, Department of Animal Science, Oregon State University.

George, Philip B., Graduate Research Assistant, Department of Animal Science, Oregon State University.

Gorham, P. E., D.V.M., Field Research Veterinarian, Eli Lilly & Company, Indianapolis, Indiana.

Hammonds, T. M., Assistant Professor, Department of Agricultural Economics, Oregon State University.

Kronstad, W. E., Professor, Agronomic Crop Science Department, Oregon State University.

Oldfield, J. E., Professor and Head, Department of Animal Science, Oregon State University.

Reagan, J. O., Assistant Professor, Department of Animal Science, Oregon State University.