Fourth Annual

FALL LIVESTOCK DAY

September 12, 1950

LANDRACE-POLAND TEST PIGS FROM THE 1950 SPRING LITTERS

UNIVERSITY of MISSOURI COLLEGE of AGRICULTURE

AGRICULTURAL EXPERIMENT STATION

J. H. Longwell, Director

Progress Report 11 Columbia, Missouri September, 1950

AGRICULTURAL EXPERIMENT STATION

Department of Animal Husbandry

ANNUAL FALL LIVESTOCK DAY

Tuesday, September 12, 1950

Livestock Pavilion

MORNING - 10:00 o'clock

Meeting, Missouri Livestock Association
Don Pollock, Vice-President - Unionville, Missouri Presiding

The Livestock Outlook . . . . . Frank Miller, Professor of Agricultural Economics

The Livestock Farmer in a War Economy . Theodore Anderson, President Missouri Livestock Association, Montreal, Missouri

Anaplasmosis in Cattle . . . . . Dr. A. W. Groth, Professor of Veterinary Medicine

Results of Some Current Missouri Experiment Station Projects

CATTLE

A. J. Dyer
Paul Q. Guyer . . . . . Utilization of Roughage and Pasture in the Production of Fat Yearling Steers --
- Three types of winter rations compared, e.g., Roughage only, roughage and protein concentrate, roughage and grain.
- The effect of above winter rations on rate of gain on pasture.
- Feed required to fatten yearlings.

SHEEP

A. J. Dyer . . . . . Utilization of Roughage and Pasture in the Production of Late Lambs

NOON - 12:00

Luncheon . . . . . Served by Block & Bridle Club-Missouri College of Agriculture

AFTERNOON - 1:00 o'clock

SWINE

G. E. Dickerson
K. E. Gregory . . . . . Testing the Value of Missouri Inbred Strains for Pork Production --
- As measured by litter size, growth rate, economy of gains, and carcass quality.

A. G. Hogan . . . . . Antibiotics in Livestock Feeds

A. G. Hogan
J. F. Lasley
L. F. Tribble . . . . . Rations for Growing-Fattening Swine
- A.P.F. Concentrates
- Vitamin Supplements

ADJOURNMENT - 3:30 o'clock

CATTLE

UTILIZATION OF ROUGHAGE AND PASTURE IN THE PRODUCTION OF FAT YEARLING STEERS

A. J. Dyer and Paul Guyer

Beef Cattle are processing plants through which great quantities of roughage and pasture are converted into edible human food. The current grass farming era demands a livestock farming program on the majority of Missouri farms. One important task of the Agricultural Experiment Stations is to learn how to utilize large amounts of roughage and pasture in the production of livestock. At the Missouri Station, weanling calves have been developed into fat two year old steers with not more than ten bushels of corn, the grain being fed after the steers had been roughed through two winters and grazed through two summers. Eighty per cent of the total gain was made from roughage and pasture and these are cheap gains. For the past two years the primary objective of feeding tests has been to produce fat yearling cattle utilizing maximum amounts of roughage and pasture. The tests encompass three phases -- (1) wintering, (2) grazing and (3) full feeding in dry lot. The effect that the above winter rations or levels of gain might have upon the production of fat yearlings that could be marketed before December 1, has been studied and is reported herein.

Three types of winter rations were fed: namely, roughage only, roughage and protein concentrate, roughage and grain. Duplicate lots were fed as follows:

Lots 1 and 5 - Corn Silage
(Check Ration) Korean Lespedeza hay fed at the rate of 1 pound per cwt. live weight.

Lots 2 and 6 - Corn Silage
Lespedeza hay fed at the rate of 1 pound per cwt. live weight.
Soybean oil meal, 1 pound per head daily.

Lots 3 and 7 - Korean lespedeza hay - all they would clean up.

Lots 4 and 8 - Corn Silage
Lespedeza hay - 1 pound per cwt. live weight.
Shelled yellow corn and Soybean oil meal (10 parts to 1 part by weight) fed 4 pounds per head daily.

The steer calves were fed the foregoing rations in winter and then all grazed together on pasture at the Weldon Springs project area. Pertinent data obtained are listed in Tables 1 and 2.

Table 1. Total Feed Consumption and Cost of Wintering Steer Calves January 12 to April 19, 1950--97 Days, (Preliminary Data) (8 Steers Per Lot)

Lot Numbers	1 & 5	2 & 6	3 & 7	4 & 8
*Feed, (Avg. Per Head):				
Korean Lespedeza Hay, lbs.	541	543	1827	538
Corn Silage, lbs.	2111	2291	none	1725
Soybean Oil Meal, lbs.	none	100	none	43
Shelled Corn, lbs.	none	none	none	369(6.6 bu)
Cost:	$15.97	$20.89	$18.27	$26.08

Feed Prices - Hay, $20 ton; Silage, $10 ton; Soybean oil meal, $80 ton; Shelled Corn, $1.35 bu.

*Steamed bone meal and salt were supplied constantly.

Table 2. Effect of Winter Ration on Weights and Gains Made From Pasture April 19 to July 29, 1950--101 Days (Preliminary Data) (All Figures Represent Pounds (Avg.)

Lot Numbers	1 & 5	2 & 6	3 & 7	4 & 8
Beginning Wt., Jan 12, 1950	475	475	475	475
Wt. at Beginning of Grazing Season, April 19, 1950	544	621	568	615
Wt. July 29, 1950	684	718	690	715
Total Gain in Winter	69	146	93	140
Gain From Pasture	142	97	119	99
Gain, Winter & Pasture Combined	211	243	212	239

Observations

1. Both the ration of Korean lespedeza hay and corn silage (Lots 1 & 5) and Korean Lespedeza hay alone (Lots 3 & 7) produced good growth in winter. The corn silage was not of good quality.

2. Adding one pound of protein concentrate daily (Lots 2 & 6) to the check ration increased the winter gain significantly. The gain made was equal to the gain made by cattle fed grain.

3. The rate of gain from pasture was in reverse order to the rate of gain in winter.

4. As the grazing season progressed, the differences in weights between lots became smaller and smaller. The greatest difference at the beginning of the grazing season was 77 pounds, but on July 29, it was 32 pounds.

5. Total cost of production is an important consideration. Lots 1 & 5

and 3 & 7 had the smallest cost; Lots 4 & 8 the largest. Based on these data, the feeding of grain in winter is not indicated when pasture is to be used extensively thereafter.

6. If yearling cattle are to be fat enough to grade "good" prior to December 1, it is believed that grain should be fed either in dry lot or on pasture after August 1.

7. Based on past tests, from 20 to 25 bushels of grain will be required to finish the cattle which now are on a full feed of grain and grazing lespedeza pasture.

SHEEP

UTILIZATION OF ROUGHAGE AND PASTURE IN THE PRODUCTION OF LATE LAMBS

A. J. Dyer

Small farm flocks predominate in Missouri since very few feeder lambs are purchased for fattening. Stress has been placed for many years on the production of early lambs. This system requires the marketing of lambs before July 1 in order to "cash in" on a high market price. Many livestock men have been very successful in this enterprize but market reports indicate that 75% of all lambs produced in Missouri are marketed after July 1. No system of producing late lambs has been tested, until recently, at this station and the first results are contained in Progress Report 10 dated April 14, 1950.

The test is being repeated currently and the results that have been obtained are reported herein. It is not the desire of this department to discourage the production of early lambs; rather, the objective is to call attention to the fruitful possibilities of raising late lambs according to a good plan. When the present test is completed, a comparison will be made between early and late lamb production.

Table 3. Late Lamb Production (Preliminary Data)

Lot Number	2A	2B
Ration	*Concentrate mixture Bluegrass Pasture Korean Lespedeza Hay	No concentrates Bluegrass Pasture Korean Lespedeza Hay
Number of ewes per lot	14	13
Average Lambing Date	April 8	April 8
Range of Lambing Season	March 30 to April 20, 1950	
Feed Record (Avg. Amt.) per head		
Concentrate Mixture	111	12
Korean Lespedeza Hay	112	105
Bluegrass Pasture	Available at all times except during inclement weather	
Lambing Record		
**Total Number Born	23	16
Avg. Number per ewe	1.6	1.2
Number saved	22	15
Gains or Loss of Weight During Pregnancy (lbs.)	8.0	none
Weights and Gains of Lambs		
Birth Wt.		
Singles	10.6	10.8
Twins	8.8	8.0
Weaning Wt. Aug. 16, 1950	73.5	78.1
Weight Sept. 2, 1950	85.2	88.9
Difference between sheared and non-sheared lambs to Sept. 2, 1950	none	none

*Grain mixture, by weight: shelled corn, 6 parts
wheat bran, 3 parts
soybean oil meal, 1 part

**Difference due to chance - not due to difference in the ration

In the present test, 27 6-year-old range ewes commonly referred to as "Northwesterns" were utilized. All were bred to a purebred Hampshire ram in November for April lambs Except when inclement weather made hay feeding necessary, all were grazed together on bluegrass pasture during pregnancy. Half of the ewes were fed a concentrate mixture during the last six weeks of pregnancy to study the effect of grain feeding.

None of the ewes and none of the lambs of either group was fed grain after lambing except for the first few days or until the lambs would follow their dams on pasture. Bluegrass pasture was grazed until early July and then a mixed pasture containing an abundant amount of Korean lespedeza. Half the lambs from each group of ewes was shorn on July 11 to see whether or not they would gain faster during hot weather than lambs in full fleece. All lambs were weaned August 16.

To control parasites, all ewes were drenched with

liquid phenothiozine in March and after that, a salt-phenothiozine mixture was kept constantly before the ewes and lambs. The lambs and ewes have been treated twice this summer with bluestone-blackleaf 40. Some of the pertinent results are given in Table 3.

The test is not complete but a few of the more important observations are given below for this method of producing late lambs.

1. The lambing season was of short duration, only 21 days. This approximates the results obtained in the preceding test and indicates that the fertility of the ram was at a high level in November when the ewes were bred.

2. Feeding a grain ration during the last 6 weeks of pregnancy had little effect on the birth weight of lambs. It did, however, increase the weight of the ewes. Where pasture is to furnish the only subsistence in summer, there may be little value, if any, to feeding grain during gestation.

3. Very small amounts of grain and hay were required by the ewes and none at all, thus far, by the lambs.

4. The gains during pregnancy were small, only 8 pounds where grain was fed and none at all where no grain was provided. While it is not desirable for ewes to lose weight during pregnancy, these data indicate that if they have an adequate reserve of flesh in the fall and are provided good pasture, satisfactory results can be obtained with small or no gain in weight.

5. According to results obtained in the preceding test and in this one, thus far, nearly all the feed required for both the ewes and lambs will be furnished from roughage and pasture.

6. Shearing of lambs did not result in higher gains either this summer or last.

A complete report will be rendered at our Spring Livestock Day Program.

SWINE

TESTING THE VALUE OF MISSOURI INBRED STRAINS FOR PORK PRODUCTION

G. E. Dickerson, J. F. Lasley, and K. E. Gregory

Missouri Swine Breeding research has, as its objective, developing more effective breeding methods for improving both the economy and the quality of pork production. Previous work with inbreeding and crossing of strains indicates that methods of selecting for maximum cross performance between particular strains offers much promise as a means of obtaining further improvement. Last Fall, data were presented showing the performance of three inbred lines of swine, Hampshire line V and Poland China lines II and VI, as inbreds and in crosses. During the Fall and Winter of 1949-50, additional information on the performance of these strains, under limited and full feeding, has been obtained. During the Spring and Summer of 1950, nine different strains of five breeds have been tested in crosses with Poland lines II and VI to determine which are most promising as foundation stock for development of new strains that would give maximum performance in crosses with these Poland lines.

Results Obtained With the 1950 Spring Pigs

During the spring and summer of 1950, the Poland inbred lines II and VI were further tested in crosses with certain strains of Hampshires, Polands, Yorkshires, Duroc, and Landrace. The outbred strains of Poland, Duroc, Hampshire, and Yorkshire were selected from herds with outstanding performance records. The inbred Duroc, or T-line, was obtained from the Oklahoma Station, whereas the Poland cross-line was obtained from the Iowa Regional Swine Breeding herd. The Missouri inbred Hampshire line V was also used in this study. It was the only strain that had been used previously in testing the two Poland China lines. Reciprocal matings were made within each cross. In other words, part of the

Table 1. Litter size in various crosses with Lines II and VI.

Cross	Litter size at							
	Birth		Weaning		154 Days		No. Litters	
	II	VI	II	VI	II	VI	II	VI
II or VI	7.5	7.5	5.8	5.8	5.3	5.3	4	4
Outbred Poland	6.7	7.0	6.3	6.3	6.0	5.3	3	4
Cross-line Poland	5.8	6.2	5.3	4.8	5.3	4.8	4	4
Outbred Hampshire	8.0	9.0	6.5	6.0	6.5	6.0	2	3
Inbred Hamp. V	5.5	9.0	4.8	8.0	4.5	8.0	4	1
Outbred Duroc	6.7	6.0	5.7	5.5	5.3	5.5	3	4
Inbred Duroc	7.3	6.5	6.0	6.3	5.8	5.5	4	4
Landrace	8.7	6.6	7.6	5.6	6.8	5.5	9	8
Yorkshire	9.0	8.0	7.0	8.0	5.5	8.0	2	1
Ave & total	7.3	7.0	6.2	5.9	5.8	5.6	35	33

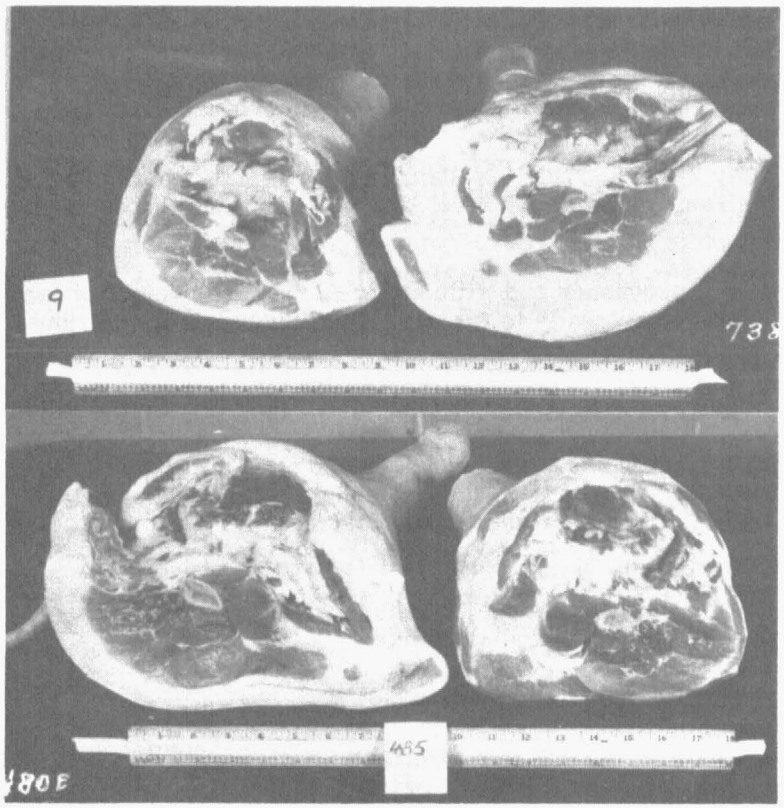

Figure 1. Demonstrating differences in quality of hams from pigs slaughtered during the experiments conducted during the winter of 1949-50.

litters were farrowed by the inbred Poland sows and the remainder by sows from the strain being tested. Although the numbers of litters produced within each cross was somewhat limited in this first test, evidence was thought to be sufficient to warrant the discarding of some strains and the further testing of others. Some of the strains which gave best results in the spring test, are being further tested in fall litters.

Litter Size at Various Ages.--The average number of pigs per litter at birth, weaning, and 154 days of age for the various crosses is shown in Table 1 (page 5). In general, there was little difference between lines II and VI in average litter size of all crosses at the different ages of litters. However, there was considerable variation in litter size between individual crosses with each line. Line II Polands crossed with outbred Hampshires, Landrace, or outbred Polands produced largest litters at 154 days of age, while inbred Hampshires, Yorkshires, Landrace, and cross-line Polands produced the largest litters at that time when crossed with Line VI Polands.

Growth Rate of Spring Farrowed Pigs.--The average weights of the crossbred pigs at birth, weaning, and 154 days of age are summarized in Table 2. Line II-crossbred pigs averaged 0.2 pounds heavier at birth than did Line VI-crossbred pigs. The reverse was true as the pigs became older. Line VI-crossbred pigs averaged 2.7 pounds heavier at weaning and 5.3 pounds heavier at 154 days of age. In Line II crosses, outbred Hampshires, outbred Durocs, and inbred Hampshire pigs were heavier at 154 days of age than pigs from other crosses with this line. In Line VI crosses, the Yorkshire, inbred Hampshire, and outbred Duroc pigs were the heaviest.

The average litter weight at 154 days of age and the average daily gains of the pigs from weaning to 154 days of age are shown in Table 3 (page 7). Since total litter weight at this time is determined by the size of the litter and the weight of the pigs, this is one of the most important measures to apply in determining which strains perform the best in crosses with the two inbred Poland lines. From this standpoint the tests indicate that the Landrace, outbred Hampshire, and outbred Duroc strains show promise of giving desired performance in crosses with both Poland lines II and VI. Only one Yorkshire-Poland line VI litter was farrowed in spring tests, but this litter proved to be one of the heaviest at 154 days of age. This indicates that further testing may be desirable to determine the true value of this breed for crossing with line VI Polands.

Table 2. Average weights of pigs in various crosses with lines II and VI.

Cross	Litter Size					
	Birth		Weaning		154 Days	
	II	VI	II	VI	II	VI
II X VI	3.6	3.6	30.0	30.0	151.6	151.6
Outbred Poland	2.7	3.2	25.3	26.5	131.9	137.4
Cross-line Poland	3.1	3.1	29.1	31.4	147.1	136.5
Outbred Hampshire	3.3	2.9	31.9	31.1	172.3	147.6
Inbred Hampshire-V	3.2	2.5	31.6	29.9	166.9	172.9
Outbred Duroc	3.2	3.4	33.7	37.0	173.4	174.5
Inbred Duroc	2.7	2.6	24.6	29.1	137.7	144.8
Landrace	3.3	3.2	29.0	34.2	150.4	161.1
Yorkshire	3.7	3.6	24.1	32.5	138.2	176.0
Average	3.2	3.1	28.9	31.6	151.1	156.8

Records on economy of gain and carcass desirability of the various crossbred pigs are being obtained but are not yet available. These two characteristics will play an important part in determining which strains give maximum performance in crosses with the two Poland lines.

Results Obtained with 1949 Fall Pigs

During the fall and winter of 1949-50, sixteen representative pigs were selected at weaning from eleven different breeding groups for the purpose of (1) further testing cross-performance of three inbred lines and (2) studying the influence of crossing and the plane of nutrition on the rate and economy of gains, digestion, and carcass composition of pigs. The breeding groups represented were three inbred lines and line crosses, the three inbred lines top-crossed on Durocs, crossline Poland China gilts mated to Duroc boars, and outbred Durocs. The inbred lines represented were two Poland China lines (II and VI) and one Hampshire line (V) that are maintained at the Missouri Station in cooperation with the Regional Swine Breeding Laboratory. The crossline Poland China gilts were a cross of lines II and VI, and the Durocs used were outbred Durocs from the College herd. The average inbreeding of the inbred pigs used in this study was 43 per cent for the line II Polands, 34 per cent for the line VI Polands, and 42 per cent for the line V Hampshires.

Table 3. Average litter weight at 154 days and average daily gain in pounds from weaning to 154 days of pigs in various crosses.

Cross	Total litter weight at 154 Days*		Average daily gain Weaning to 154 Days of age**	
	II	VI	II	VI
II X VI	796	796	1.24	1.24
Outbred Poland	791	721	1.10	1.13
Cross-line Poland	772	648	1.20	1.07
Outbred Hampshire	1120	885	1.43	1.19
Inbred Hampshire-V	751	1383	1.38	1.46
Outbred Duroc	925	960	1.43	1.40
Inbred Duroc	792	796	1.15	1.18
Landrace	1194	886	1.24	1.29
Yorkshire	760	1408	1.16	1.46
Average	917	855	1.26	1.25

* In pounds.
** Average for each pig per day.

Each group represented was divided into two lots of eight pigs, equalizing sex, litter, and initial weight as well as possible. One lot was full-fed, the other limited. For the limited-fed crossline pigs, the daily intake per unit of live weight was limited to the average of the inbred parental lines under full-feeding. The limited-fed, top-crosses were limited to the full-fed inbred line used in the cross. The limited-fed Durocs were limited to the average intake of the three full-fed inbred lines on a unit weight basis. The limited-fed inbred lots were reduced by the same average proportion as the limited-fed crosses of that line. In general, full-fed inbreds consumed about four-fifths as much as the full-fed crosses.

Results

A general summary of the results is presented in Table 4 (page 8). When cross line pigs were limited to the same level of intake as the parental inbred pigs they showed, in general, a marked superiority in rate and economy of gain. The advantage of full-fed crosses was even greater in rate of gain, but less in economy of gain. In general, the top-cross pigs did not show any marked advantage over the outbred Durocs in rate and economy of gain. The limited fed pigs gained one-tenth to two-tenths pounds less per day than the full-fed pigs in the same cross, but, with the exception of one cross, the limited-fed pigs required less feed per unit of gain. As shown in the table, digestion trials indicated no differences between breeding groups or between feeding levels in ability to digest the ration.

All pigs were slaughtered at about 205 pounds live weight and complete carcass data were taken. Some of the results are presented in Table 5 (page 9). In carcass desirability, the cross line pigs were intermediate to the two parental inbred lines. The outbred Durocs produced the poorest carcasses and the top-crosses yielded carcasses that were nearer the inbred lines in desirability. The limited-fed pigs dressed from 1 per cent to 2 per cent less than the full-fed pigs but were less fat, and yielded cuts of higher quality. Thus there were no consistant differences between the limited and full-fed pigs in yield of loin equivalent when adjusted for quality.

ANTIBIOTICS IN LIVESTOCK FEEDS

A. G. Hogan

The term, Animal Protein Factor, was in wide circulation long before it was ever used in print, and no one knows who originated that expression. It never had official sanction and it was never defined, but in the minds of most investigators it stood for whatever vitamins swine or poultry required, in addition to those that had been recognized at the time. It was called the Animal Protein Factor, APF, because the only known sources were protein concentrates of animal origin. Liver was probably the best source but was not readily available and was of little practical significance. Milk and fish meal were excellent, tankage and meat scraps were poor or mediocre. It seems quite certain now that animals themsleves do not manufacture

Table 4. Gains, Feed Consumption and Utilization, and Digestibility for 1949 Fall Pigs, by Feeding Levels in Each Line and Cross.

Breeding Group	Feeding Level	Inb. %	No. Pigs Std. on Expt.	No. Pigs Finishing Expt.	Av. Wt./ Pig at Beg. (lbs.)	Av. Wt./ Pig off Expt. (lbs.)	Av. Daily Gain/Pig (lbs.)	Feed Cons./100# L.W./Day (lbs.)	Feed Req./100# Gain (lbs.)	Coeff. of Dig. of Dry Matter
Line II	Full	43.18	8	6	29.3	202	.94	3.98	380	79.3
	Ltd.	43.18	8	8	30.4	205	1.06	3.72	336	77.3
		43.18			29.8	204	1.00	3.85	358	78.3
Line VI	Full	32.30	7	7	30.7	208	1.08	4.65	425	78.4
	Ltd.	35.87	7	6	30.4	206	1.03	4.32	394	79.1
		34.08			30.6	207	1.06	4.48	409	78.8
Line V	Full	40.85	8	5	25.5	194	.70	3.89	453	79.0
	Ltd.	42.31	8	3	25.9	204	.56	3.64	452	77.9
		41.58			25.7	199	.63	3.77	452	78.4
II X VI	Full	9.00	8	6	35.1	205	.97	4.20	408	77.7
	Ltd.	9.00	8	6	35.3	207	.88	3.87	424	78.8
		9.00			35.2	206	.93	4.04	416	78.2
II X V	Full		8	8	36.1	207	1.26	4.33	359	79.7
	Ltd.		8	8	36.3	207	1.12	3.89	343	77.0
					36.2	207	1.19	4.11	351	78.4
V X VI	Full		8	8	32.4	209	1.32	4.92	374	80.6
	Ltd.		8	8	33.4	209	1.09	4.21	372	78.6
					32.9	209	1.21	4.57	373	79.6
II X D	Full		8	8	31.1	207	1.14	4.69	405	79.9
	Ltd.		8	8	30.8	208	1.13	3.96	330	79.0
					30.9	207	1.13	4.32	368	79.5
VI X D	Full		8	8	32.1	207	1.36	5.07	369	78.6
	Ltd.		8	8	32.1	212	1.30	4.51	344	79.0
					32.1	210	1.33	4.79	356	78.8
V X D	Full		8	8	28.9	204	1.22	4.64	361	79.3
	Ltd.		8	8	29.6	202	1.02	3.84	345	77.7
					29.3	203	1.12	4.24	353	78.5
D X (II X VI)	Full		8	8	32.3	208	1.28	5.27	413	79.2
	Ltd.		8	8	31.6	210	1.17	4.23	351	79.4
					31.9	209	1.23	4.75	382	79.3
Duroc	Full		8	8	30.6	205	1.27	5.18	394	78.8
	Ltd.		8	8	31.1	210	1.18	4.07	337	79.3
					30.9	207	1.22	4.63	365	79.1

APF. It is not a protein and is not directly of animal origin, hence the name is a misnomer. In most cases, in the past, the "new" vitamins that were announced turned out to be mixtures, and the original designation was forgotten when the components were identified. One would expect APF to meet the same fate, though its disappearance may be delayed for several years. In the immediate future, the APF terminology will probably be as confused as it has been in the past.

In April, 1948, vitamin B_{12} was announced. It was evident at once that the new vitamin was at least part of the Animal Protein Factor. As a matter of fact vitamin B_{12} may be the only component of APF as the term was commonly used up to 1948. However that may be, it soon became apparent that certain natural foodstuffs contain an important nutrient, in addition to vitamin B_{12}. For example, chicks and pigs grow well on synthetic diets that contain no vitamins except those now recognized, including vitamin B_{12}. However, under some circumstances at least, the rate of growth of chicks is tremendously accelerated when liver is added to the diet. Sometimes, not always, milk or egg yolk is equally effective. This acceleration was commonly interpreted to mean that APF includes some factor besides vitamin B_{12}. One would suppose that this factor is a definite chemical substance or substances, and that they will be identified in time.

The most recent development in the APF field is the use of antibiotics. On April 9, 1950, Stokstad and Jukes announced that the addition of aureomycin to the ration of pigs increased the rate of growth by as much as 50 per cent. Jukes, Stokstad, and Cunha (Florida) used a ration made up chiefly of yellow corn and peanut meal, along with added minerals and vitamins including B_{12}. The pigs had initial weights of about 30 pounds and the pigs made a daily gain of 0.62 lbs. in a 28 day feeding trial. When aureomycin was added to the diet, the pigs made a daily gain of 0.87 lbs., a 25% increase.

Luecke and associates of Michigan used a ration of yellow corn and soybean oil meal, along with added minerals and vitamins, vitamin B_{12} not included. The pigs in the basal group had an initial weight of about 25 lbs. and made an average daily gain of 0.88 lbs. in a 6-week period. When vitamin B_{12} was included in the ration, the daily gain was 0.98 lbs. When both vitamin B_{12} and streptomycin were included, the average daily gain was 1.48 lbs., a 50% increase. When streptomycin was fed the feces were of normal consistency; when omitted they were soft and pasty. Undoubtedly, both sets of investigators fed their pigs in dry lot though that point was not mentioned.

Table 5. Summary of Carcass Merit for 1949 Fall Pigs By Feeding Levels in Each Line and Cross.

Breeding Group	Feeding Level	No. Pigs	Live Weight (lbs.)	Dressing Percentage	Loin Score	Primal Cut Score	Backfat Thickness
II P.C.	Full	6	204	70.5	49.2	3.8	34.8
	Ltd.	8	205	68.9	48.4	4.0	35.2
			204	69.7	48.8	3.9	35.0
VI P.C.	Full	7	208	70.2	47.2	3.6	38.0
	Ltd.	6	206	69.2	46.3	3.5	34.2
			207	69.7	46.8	3.5	36.1
V Hamp.	Full	5	194	71.0	52.7	4.3	32.7
	Ltd.	3	204	70.8	50.2	4.1	33.9
			199	70.9	51.4	4.2	33.3
II X VI	Full	6	204	71.4	47.8	3.4	36.9
	Ltd.	6	207	70.9	48.6	3.7	37.6
			206	71.2	48.2	3.5	37.2
II X V	Full	8	206	73.4	51.8	4.1	36.5
	Ltd.	8	207	69.8	50.1	4.2	35.2
			206	71.6	51.0	4.1	35.9
V X VI	Full	8	210	71.1	46.2	3.2	42.0
	Ltd.	8	209	69.5	48.1	3.8	38.4
			210	70.3	47.1	3.5	40.2
II X D	Full	8	204	71.3	48.4	3.6	35.3
	Ltd.	8	208	68.2	48.1	3.9	33.8
			206	69.7	48.3	3.8	34.6
VI X D	Full	8	208	71.6	45.9	3.3	43.6
	Ltd.	8	212	68.7	45.6	3.4	41.2
			210	70.1	45.8	3.4	42.4
V X D	Full	8	204	71.6	49.9	3.9	37.6
	Ltd.	8	202	68.8	49.7	4.1	32.9
			203	70.2	49.8	4.0	35.2
D X (II X VI)	Full	8	207	71.4	44.6	3.0	42.8
	Ltd.	8	210	69.9	46.7	3.5	39.7
			208	70.7	45.7	3.2	41.3
Duroc	Full	8	204	72.0	41.9	2.3	48.6
	Ltd.	8	210	70.2	43.7	2.9	42.4
			207	71.1	42.8	2.6	45.5

As to comments on the above investigations, there can be no doubt that under the conditions they describe the growth rate of pigs will be accelerated by including antibiotics in the ration. If the price relations are favorable they may have an important place in swine rations of the future, but their effect has not been determined when used under the conditions that prevail on Missouri farms. Comments on the experimental work are:

1. The rations reported were made up of corn and either peanut or soybean oil meal. The farmer would like to have trials on rations that contain tankage or meat scraps, and other commonly used swine feeds such as wheat bran and shorts, or alfalfa meal.

2. The tests were carried out in dry lot. The farmer would like to have trials with pigs on pasture.

3. The antibiotics used in the tests were presumably prepared with special care to insure high activity. The farmer would like to have specifications on the antibiotics that are available to him, and to be sure that their potency is high enough to be useful.

A question frequently asked is, by what mechanism do the antibiotics exert their effect. No one has suggested that they are vitamins. One plausible theory is they inhibit the growth of intestinal bacteria which may be harmful, and the results of inhibition may have two explanations. According to one explanation when harmful bacteria are killed beneficial bacteria have a better chance to grow and they synthesize the Animal Protein Factor. A second explanation of the theory is, pigs may have a low grade infection, and this infection is cleared up by the antibiotic. A second theory is the bacteria in the intestinal tract use up a considerable amount of feed. Antibiotics kill the bacteria and the feed the bacteria would consume is available to the pig. All theories seem to agree though that when antibiotics are effective the feed intake increases, and this increase explains the more economical gains. It seems to be established that aureomycin, streptomycin, terramycin, and penicillin are all useful in the rations of swine, and other effective antibiotics will probably be discovered.

The most common question is, where can antibiotics be obtained but we have no information on that point. We were told some weeks ago that the producers sell directly to the feed mixers and none was being distributed through jobbers. We ourselves know of no way by which individual feeders can easily obtain antibiotics. If one wishes to obtain them it would be prudent to begin with the products sold by established firms with a standardized product.

RATIONS FOR GROWING AND FATTENING SWINE

A. G. Hogan, J. F. Lasley, and L. F. Tribble

During the summer months, two separate feeding trials involving 180 pigs were conducted at the Missouri Agricultural Experiment Station. The main purposes of these experiments were as follows: (1) to determine the value of certain crystalline vitamins and vitamin carriers when added to swine rations (2) to determine whether or not certain antibiotics produce more rapid and efficient gains (3) to determine if the level or concentration of the antibiotic in the ration influences the rate and efficiency of gains and (4) to determine the value of these materials in swine rations.

Some of these feeding trials are not yet complete, but they have been conducted for a long enough period of time to show certain definite trends in the results. These two feeding trials were conducted simultaneously under the same general plan although different kinds of pigs and the manner of feeding varied between trials. Because of this fact, they will be reported separately.

Feeding Trial Number 1

Ninety spring farrowed pigs from a three way cross involving Chester White, Duroc Jersey, and Poland China breeding were used in this feeding trial. All of the pigs were farrowed on concrete and remained

Table 1. The composition of experimental rations fed to growing, fattening pigs in feeding trial 1.

Lot No.	Composition of Rations
1	Yellow corn 57 per cent, soybean oil meal 40.5 per cent, cod liver oil 0.5 per cent and a complex* mineral mixture 2.0 per cent.
2	Same as ration 1 plus rivoflavin 3.7 grams, ca-pantothenate 12.5 grams and nicotinic acid 18.5 grams per 1,000 pounds of the ration. (These three vitamins are hereafter referred to as B-vitamins.)
3	Ration 2 plus a B_{12} concentrate to supply 6.3 micrograms of this vitamin per pound of feed.
4	Ration 2 plus 0.05 per cent of an APF supplement containing B_{12} and 5 grams of streptomycin per pound.
5	Ration 2 plus 0.05 per cent of an APF supplement containing B_{12} and 30 grams of streptomycin per pound.
6	Ration 2 plus 0.05 per cent of an APF supplement containing B_{12} and 5 grams of penicillin per pound.
7	Ration 2 plus 0.05 per cent of an APF supplement containing B_{12} and 15 grams of penicillin per pound.
8	Ration 2 plus 0.25 per cent of an APF supplement containing B_{12} and chloromycetin.
9	Ration 2 plus 0.50 per cent of an APF supplement containing B_{12} and chloromycetin.

* The complex mineral mixture contained 50 lbs. of salt, 100 lbs. of steamed bone meal, 50 lbs. of ground limestone, 500 gms. of iron sulfate, 15 grams of copper sulfate, 30 grams of cobalt chloride, 300 grams of manganese sulfate and 30 grams of potassium iodide.

there throughout the experiment. These pigs were very thrifty and growthy averaging between 75 and 85 pounds in weight at the time they were placed on experiment. They were divided into 9 lots of 10 pigs each and were hand fed throughout the feeding trial. The composition of the rations fed the different lots are described in detail in table 1. At the beginning of the experiment the rations were balanced so as to contain approximately 18.9 per cent digestible protein. As the experiment progressed and the pigs became older and heavier, the protein content of the ration was gradually lowered until at the end of the experiment the protein content was approximately 13.5 per cent.

Results

Vitamin supplements for pigs (trial 1) -- The results of this feeding trial are summarized in table 2. All of the pigs in this experiment made satisfactory gains of 1.5 pounds per head per day or more. The pigs in lot 2 which received the three B-vitamins, riboflavin, pantothenic acid and nicotinic acid, in addition to the basal ration made the most rapid and efficient gains. As compared to pigs in lot 1 on the basal ration, they gained an average of 0.19 of a pound more per head per day and required approximately 18 pounds less feed for each 100 pounds of gain. The addition of a B_{12} concentrate to a ration which conatained the three B-vitamins was not beneficial, the gains being approximately the same as in the basal group, and considerably below those of the pigs in lot 2. The pigs in lot 2 not only gained faster and more economically, but they also had much sleeker hair coats and appeared more thrifty throughout the experiment than did the pigs in lots 1 and 3. These results do not agree with previous reports, indicating that further experiments of this nature should be carried out for further clarification of this point.

Table 2. Vitamin supplements for growing, fattening pigs hand fed twice daily in dry lot. (trial 1)

Lot Number	I	II	III
Ration*	Basal	Basal + B-Vitamins	Ration 2 + B_{12} Concen.
Number of pigs	10	10	10**
Avg. initial wt. (lbs.)	83.5	85.5	75.1
Avg. final wt. (lbs.)	180.1	193.9	172.6***
Avg. daily gain (lbs.)	1.53	1.72	1.55
Avg. daily feed per head	5.7	6.0	5.6
Feed per 100 lbs. of gain	372	354	361

* Rations were fed for a period of 63 days.
** One pig died in this lot 7 weeks after the start of the experiment.
*** Average of 9 pigs.

APF supplements for growing, fattening pigs (Trial 1) -- The results of this experiment are summarized in table 3. All of the rations fed contained the basal ration of corn and soybean meal as described in table 1 (page 10) plus the three B-vitamins. An APF concentrate containing B_{12} and presumably no antibiotic was added to the ration fed the pigs in lot 3 which served as the control lot. The pigs in lots 5 and 7 received an APF supplement which contained both vitamin B_{12} and an antibiotic. Sufficient APF supplement was added to each of these rations to supply 6.3 micrograms of B_{12} per pound of feed. Pigs in lots 8 and 9 were fed an APF supplement containing variable amount of antibiotic and B_{12}. The pigs in those lots which received APF supplements containing streptomycin and penicillin made more rapid and efficient gains in this experiment. On the otherhand, the pigs in lots 8 and 9 which received chloromycetin gained at approximately the same rate as the pigs in the control lot, but they required from 8 to 15 pounds less feed for each 100 pounds of gain. However, the pigs which received this antibiotic were observed to scour badly at various times during the course of the experiment. This may have been responsible for the slower gains of the pigs in these two lots.

Table 3. APF supplements for growing, fattening pigs hand fed twice daily in dry lot for a period of 63 days. (Trial 1)

Lot Number	III	V	VII	VIII	IX
Ration	Basal B-Vit. B_{12}	Ration 3 + Strepto-mycin	Ration 3 + Peni-cillin	Basal B-Vit. Chloro-mycetin	Basal B-Vit. Chloro-mycetin
Number of pigs	10*	10	10	10	10
Avg. initial wt.	75.1	76.3	75.3	74.9	74.0
Avg. final wt.	172.6*	183.9	186.2	170.0	166.2
Avg. daily gain	1.55	1.71	1.76	1.51	1.46
Avg. daily feed	5.62	5.86	5.93	5.32	5.07
Feed per 100 lbs. gain	361	343	337	353	346

* One pig in this lot died 7 weeks after the start of the experiment. Avg. final weight is based on 9 pigs.

The results in which different levels of streptomycin and penicillin are compared are summarized in table 4 (page 12). The rations fed each lot were similar except in the kind and amount of antibiotic they contained. In general, the higher level of either streptomycin or penicillin in the ration gave the most rapid gains and slightly more feed was consumed by the pigs in these lots. However, there was no difference in

Table 4. A comparison of different levels of streptomycin and penicillin in rations for growing, fattening pigs hand fed twice daily in dry lot for a period of 63 days. (Trial 1)

Lot Number	IV	V	VI	VII
Ration	Ration 3 + 5 gms of Strepto-mycin*	Ration 3 + 30 gms of Strepto-mycin*	Ration 3 + 5 gms of Peni-cillin*	Ration 3 + 15 gms of Peni-cillin*
Number of pigs	10	10	10	10
Avg. initial wt. (lbs.)	75.8	76.3	76.4	75.3
Avg. final wt. (lbs.)	178.4	183.9	176.7	186.2
Avg. daily gain (lbs.)	1.63	1.71	1.59	1.76
Avg. daily feed (lbs.)	5.55	5.86	5.60	5.93
Feed per 100 lbs. gain	341	343	352	337

* Amount of antibiotic per pound of the APF concentrate.

economy of gains on the different levels of streptomycin. The pigs which received the higher level of penicillin made the most efficient gains.

Feeding Trial Number 2

Ninety pigs which were raised in dry lot and averaged approximately 60 pounds were divided into 9 lots and self fed in dry lot for a period of 70 days. Each of the lots contained 5 purebred Duroc and 5 Hampshire-Duroc crossbred pigs. They were fed the rations described in detail in table 5. At the beginning of the experiment the rations were balanced to contain approximately 18.9 per cent digestible protein, but as the pigs became older and heavier the percentage of digestible protein was gradually lowered as in feeding trial 1. At the end of the experiment the digestible protein content of the ration was approximately 13.5 per cent.

Table 5. The composition of experimental rations fed to growing, fattening pigs in feed trial number 2.

Lot No.	Composition of Rations
1	Yellow corn 57 per cent, soybean oil meal 40.5 per cent, cod liver oil 0.5 per cent and complex mineral mixture* 2.0 per cent.
2	Same as 1 plus riboflavin 3.7 grams, ca-pantothenate 12.5 grams and nicotinic acid 18.5 grams per 1,000 pounds of the ration.
3	Ration 2 plus B_{12} concentrate added to supply 6.3 micrograms of this vitamin per pound of feed.
4	Same as ration 2 with 50 per cent of the protein supplied from an animal source (tankage).
5	Ration 1 (basal) plus 5 per cent dried brewer's yeast.
6	Ration 2 plus 0.5 per cent of an APF supplement containing aureomycin.
7	Ration 2 plus 0.25 per cent of an APF supplement containing streptomycin.
8	Ration 2 plus 0.05 per cent of an APF supplement containing 30 grams of streptomycin per pound.
9	Ration 2 plus 0.05 per cent of an APF supplement containing 30 grams of streptomycin per pound.

* See table 1 for composition of the mineral mixture.

Results

Vitamin supplements for pigs (Trial 2) -- The data obtained in this feeding trial showing the influence of the addition of various vitamin supplements to a basal ration of corn and soybean meal are shown in table 6. The addition of the three crystalline B-vitamins, pantothenic acid, riboflavin and nicotinic acid at the levels described in table 5 increased gains only slightly. The addition of a B_{12} concentrate to a ration containing the three B-vitamins had little or no effect on growth rate. This was also true when 5 per cent dried brewer's yeast was added to the basal ration. There was little or no difference in economy of gain between the 4 different lots. The feed required to produce 100 pounds of gain was almost identical varying between 374 and 384 pounds for the 4 different groups. The failure of the addition of a B_{12} concentrate to a ration containing other B-vitamins may have been due to the fact that all of the pigs used in this experiment were fed

Table 6. Vitamin supplements for growing, fattening pigs self fed in dry lot. (Trial 2)

Lot Number	I	II	III	V
Ration*	Basal	Basal + B-Vit.	Ration 2 + B_{12} Concen.	Ration 2 + 5% yeast
Number of pigs	10	10	10	10
Avg. initial wt. (lbs.)	60.6	60.6	60.6	60.6
Avg. final wt. (lbs.)	171.5	176.2	178.8	177.4
Avg. daily gain (lbs.)	1.58	1.65	1.69	1.67
Avg. daily feed per head	5.98	6.34	6.44	6.25
Feed per 100 lbs. gain	378	384	382	374

* Rations fed for a period of 70 days.

a ration containing fish meal, dried milk and tankage from the time they were weaned until the experiment began. These feeds contain varying amounts of B_{12}, and the pigs may have stored sufficient amounts of this vitamin in their bodies to meet growth requirements before the experiment was begun. However, these results were similar to those obtained in feeding trial number 1.

APF supplements for growing, fattening pigs (Trial 2) -- Five different APF supplements were compared in this feeding trial. The ration fed to pigs in lot 3, table 6 (page 12), was used as a control. This ration consisted of the basal ration of corn, soybean oil meal, cod liver oil and minerals to which was added the three B-vitamins and a B_{12} concentrate. The B_{12} content of the control ration was approximately 6.3 micrograms per pound of feed, and was added in the form of an APF supplement which contained little or no antibiotic. The other four APF supplements were added to the rations in amounts to furnish 6.3 micrograms of B_{12} per pound of feed. This was the same as was present in the control ration. These four APF supplements, however, contained certain antibiotics in addition to the vitamin. No attempt was made to control the amount of antibiotic present in any of these rations. By planning the experiment in this manner, the differences in performance of the pigs in the various lots as compared to those in lot 3 should be due to the action of antibiotics. Another lot of pigs was fed a ration similar to the others in this experiment except that 50 per cent of the protein was supplied by tankage and no APF supplement was included. Therefore, this ration contained some animal as well as plant proteins in addition to an unknown amount vitamin B_{12}, since tankage is thought to contain varying amounts of this vitamin. As far as is known there was no antibiotic present in this ration.

The results of this portion of the feeding trial are summarized in table 7. The most rapid and efficient gains were made by the pigs which received aureomycin and penicillin in their rations. These gains were excellent for pigs of this weight fed under dry lot conditions. The two lots of pigs which received streptomycin did not make as rapid nor as efficient gains as did those which received the other two antibiotics. However, they did slightly exceed the control group in rates of gain and their gains were made more economically, requiring 30 to 32 pounds less feed for each 100 pounds of gain. The group of pigs in lot 4 which received tankage in their ration grew more rapidly than the pigs in the control lot and at about the same rate as those in the two lots which received streptomycin. The tankage fed pigs made less efficient gains requiring 19 to 21 pounds more feed for each 100 pounds of gain.

Table 7. APF supplements for growing, fattening pigs self fed in dry lot. (Trial 2)

Lot Number	III	IV	VI	VII	VIII	IX
Ration*	Ration 2 + B_{12} Concen.	Ration 3 + Tankage	Ration 3 + Aureo-mycin	Ration 3 + Strepto-mycin	Ration 3 + Strepto-mycin	Ration 3 + Peni-cillin
Number of pigs	10	10	10	10	10	10
Avg. initial wt. (lbs.)	60.6	60.6	60.4	60.6	60.6	60.6
Avg. final wt. (lbs.)	178.8	188.1	200.4	184.7	185.6	198.9
Avg. daily gains (lbs.)	1.69	1.80	2.00	1.77	1.79	1.98
Avg. daily feed per head	6.44	6.67	6.81	6.23	6.25	6.74
Feed per 100 lbs. gain	382	371	341	352	350	341

* Rations fed for a period of 70 days.

Summary

1. In these two feeding trials with growing, fattening pigs the addition of the three B-vitamins, riboflavin, ca-pantothenate and nicotinic acid, as well as 5 per cent dried brewer's yeast to a basal ration of corn and soybean oil meal gave only slight increases in rate and efficiency of gains.

2. The addition of a vitamin B_{12} concentrate to the basal ration which contained the three B-vitamins did not increase the rate and economy of gains.

3. Under the conditions of these experiments the antibiotics, aureomycin, penicillin, and streptomycin, the latter two at the higher level tested, increased growth rate in pigs by as much as 18 per cent and saved up to 11 per cent of the feed required to produce 100 pounds of gain as compared to a basal ration of corn and soybean meal fortified with vitamins and minerals. In general, the rations containing the higher concentration of antibiotics gave most satisfactory results.

4. The lower levels of streptomycin and penicillin tested in trial 1 increased growth rate only slightly as compared to the control ration. However, they seemed to have a slightly beneficial effect in producing more economical gains. Chloromycetin, which was also fed to pigs in trial 1, apparently decreased growth rate slightly but the gains were a little more economical than in the control group of pigs.

5. In trial 2, a ration containing both soybean oil meal and tankage produced as rapid gains as the rations containing streptomycin, but the gains were less economical. In this same experiment pigs which received penicillin or aureomycin made 10 to 12 per cent faster gains and required 8 per cent less feed for each 100 pounds of gain than did the pigs which received the tankage-soybean oil meal ration.