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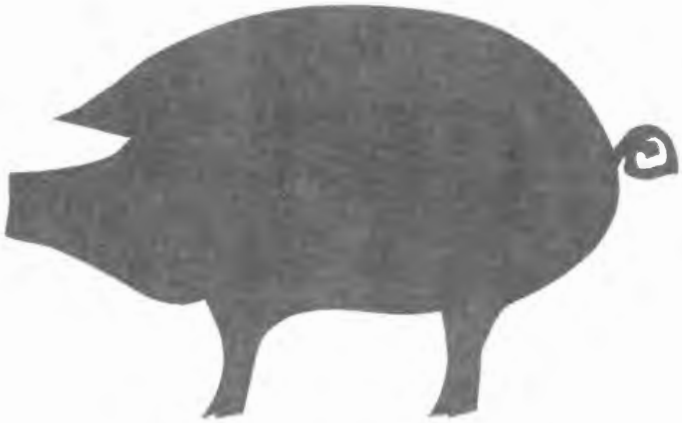

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Dehydrated Alfalfa Meal in Rations for Pigs and Brood Sows in Confinement

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Alfalfa in the form of ground hay or alfalfa meal has been widely used in swine rations. Prior to the extensive use of supplemental vitamins in swine rations, the inclusion of alfalfa in gestation and lactation rations fed in drylot improved litter size and survival of baby pigs (Freeman, 1938; Hogan and Johnson, 1941; Cunha *et al.* 1944; Fairbanks *et al.*, 1945). Teague (1955) found the addition of sun-cured alfalfa to a gestation ration fed in drylot increased the number of live pigs farrowed and the percent surviving at weaning compared to a vitamin-fortified ration. Alfalfa has also been used in growing-finishing rations as a source of supplemental vitamins in the ration. Some nutritionists suggest the possibility of valuable unidentified factors in alfalfa meal; however, the role of alfalfa meal in modern swine rations needs to be clarified. To evaluate dehydrated alfalfa meal in rations for swine continually confined in pens with concrete floors, two experiments were started in 1958. Experiment 1 included four trials with growing pigs and Experiment 2 included four trials with breeding gilts.

EXPERIMENT 1

Growing-Finishing Pigs

Trials 1 and 2. In trial one, 96 pigs, 8 to 9 weeks of age, were assigned to 16 lots of six pigs each on the basis of sex and breed. Pigs used in each treatment were of Hampshire, Duroc and Spotted breeds with three barrows and three gilts assigned to each pen. The treatment variables were 0%, 2.5%, 5%, and 10% dehydrated alfalfa meal. The four basic rations shown in table 1 were mixed and one-half of each was pelleted. The protein, calcium and phosphorus levels were adjusted to be equal in all rations, however, no effort was made to equalize the energy content of the rations. Water and all rations were fed *ad libitum*. Dehydrated alfalfa meal used in all trials was purchased from the same source. The guaranteed analyses were 17% minimum

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crude protein, 3% minimum fat and a maximum of 27% crude fiber.

The same four levels of alfalfa meal that were used in trial 1 were repeated in trial 2 during the summer of 1961. Procedures were similar in both trials, except there were six gilts per treatment and only the meal form of the rations was used in trial 2. The basal ration was modified to exclude tankage, but this change would not be expected to influence the performance of the pigs.

Trials 3 and 4. These two trials were similar, except for a small difference of nutrient sources in the rations. The rations fed are shown in table 1. Crude protein, calcium and phosphorus levels were adjusted to be equal between the two rations, but the energy content was not adjusted to be equal. For trial 3 twenty-four weanling Duroc gilts were assigned into four pens for each treatment of 0% or 5% alfalfa meal in the ration. For trial 4, 16 Duroc gilts were assigned to two lots per treatment. Feed and water were provided *ad libitum*. Gilts in trial 3 were on test to nearly 250 pounds, body weight, but trial 4 was concluded when the pigs weighed approximately 205 pounds.

Results and Discussion

Trials 1 and 2. In trial 1, an orthogonal contrast comparison indicated there was a non-significant increase in daily gain of pigs fed rations containing 2.5% or 5.0% alfalfa meal in either meal or pelleted form, but rations with 10% alfalfa meal significantly ($P<.05$) decreased average daily gain (table 2). Differences in daily gains due to the form of feeding as meal or pellets were not statistically significant. Bohman *et al.*, (1955) reported that rations with 10% alfalfa meal decreased daily gains of weanling pigs and increased feed required per pound of body weight gain, whereas Becker *et al.* (1956) found that pigs weighing between 100 pounds and 200 pounds utilized rations with 10% alfalfa meal as efficiently as pigs fed alfalfa-free rations.

Rations with more than 10% alfalfa meal generally decrease daily gain and increase the feed required per unit of gain (Crampton *et al.* 1954; Becker *et al.*, 1956; Merkel *et al.*, 1958; Heitman and Meyer, 1959).

Pigs fed rations without alfalfa and the ground rations with 2.5% alfalfa meal required significantly ($P<.05$) less feed per pound of gain than pigs fed the highest level of alfalfa in the meal rations. Pigs fed the pelleted rations were more efficient in feed conversion than pigs fed the meal rations ($P<.10$). It appeared that the pigs fed the 2.5% and 5% alfalfa meal rations attempted to compensate for the lower energy content of the rations by consuming more feed, whereas the lower consumption with the 10% alfalfa ration indicated a moderate decrease in palatability and therefore some sacrifice in rate and efficiency of daily gain. Average daily feed consumption with 5% and 10% alfalfa in pelleted rations was less than consumption of the same rations in meal form.

Results from trial 2 are shown in table 3. Although there appeared to be some variation in rate of gain, the differences were not significant-

Table 1. Rations Used in Growing-Finishing Studies, Experiment 1, Trials 1, 2, 3 and 4.*

Ingredient, %	Trial 1 Alfalfa level, %				Trial 2 Alfalfa level, %				Trial 3 Alfalfa level, %		Trial 4 Alfalfa level, %	
	0	2.5	5.0	10.0	0	2.5	5.0	10.0	0	5.0	0	5.0
Ground yellow corn	80.3	79.4	76.4	72.3	78.7	77.4	75.8	71.9	81.3	77.5	80.0	76.4
Dehydrated alfalfa meal	.....	2.5	5.0	10.0	.....	2.5	5.0	10.0	.....	5.0	.....	5.0
Soybean meal†	13.5	13.05	12.75	12.15	18.5	2.5	5.0	10.0	12.5	11.5	17.0	5.0
Tankage	4.5	4.35	4.25	4.05	.....	.....	.....	.....	4.0	4.0	.....	.....
Diacalcium phosphate	0.7	0.8	0.8	0.8	1.0	1.0	1.0	1.0	1.0	0.9	1.2	1.2
Limestone	0.3	0.2	0.1	.....	1.0	0.9	0.8	0.6	0.5	0.4	0.8	0.6
Trace mineral salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vitamin-antibiotic premix‡	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Calculated analyses												
Crude protein, %	16.0	16.0	16.0	16.0	15.3	15.3	15.2	15.2	15.5	15.5	15.7	15.7
Calcium, %	.60	.60	.61	.61	.70	.69	.69	.69	.73	.73	.65	.66
Phosphorus, %	.56	.56	.55	.54	.50	.49	.49	.49	.58	.56	.52	.52

*The rations appearing in this table are grower rations which were fed up to 110 pounds body weight. Finisher rations were used thereafter and their protein content was approximately 4% lower and the calcium levels and phosphorus levels were lowered to approximately 0.55% and 0.5%, respectively.

†Soybean meal with 45% crude protein was used in trials 1, 2 and 3, and soybean meal with 50% crude protein was used in trial 4.

‡Premix in trials 1, 2 and 3 provided 1 mg. of riboflavin, 2 mg. of pantothenic acid, 4.5 mg. of niacin, 5 mg. of choline, 5 mcg. of vitamin B_{12}, 1134 I.U. of vitamin A, 142 I. U. of vitamin D and 15 mg. of chlortetracycline per lb. of ration. Premix in trial 4 provided 2 mg. of riboflavin, 4 mg. of pantothenic acid, 9 mg. of niacin, 10 mg. of choline, 5 mcg. of vitamin B_{12}, 1100 I. U. vitamin A, 240 I. U. vitamin D, and 10 mg. of chlortetracycline per pound of ration.

Table 2. Mean Feedlot Performance of Growing-Finishing Pigs. Experiment 1, Trial 1*.

Items	Level of alfalfa meal, % 0		2.5		5		10	
	Meal	Pellet	Meal	Pellet	Meal	Pellet	Meal	Pellet
No. of pigs	12	12	11	12	12	12	12	12
Average:								
Initial wt., lb.	37.0	37.1	37.5	36.8	36.9	37.0	37.2	36.8
Final wt., lb.	206	205	205	205	205	204	204	204
Daily gain, lb.	1.58	1.66	1.60	1.70	1.64	1.74	1.50	1.56
Daily feed, lb.	4.85	4.88	4.88	5.00	5.22	5.01	4.91	4.71
Feed/lb. gain, lb.	3.07	2.94	3.06	2.94	3.17	2.88	3.28	3.02

*There were significant differences in average daily gain and feed efficiency due to the level of alfalfa meal ($P<.05$). Feed efficiency was improved by pelleting ($P<.10$).

ly different. Feed required per unit of gain was relatively high in this trial because feed wastage was high particularly in three of the four lots. The results of this trial are not in complete agreement with the previous trial or with subsequent trials, but less importance is placed on this trial due to the small number of animals involved.

Trials 3 and 4. A summary of these trials is shown in table 4. Rate of gain and feed efficiency of pigs fed the two rations were not significantly different in either trial. In trial 3, pigs fed the ration containing 5% alfalfa meal gained 0.06 of a pound faster per day and required 0.4 of a pound more feed per pound of gain than pigs fed the ration without alfalfa meal. The faster gain of the alfalfa-fed group can be attributed to the greater daily feed consumption. The poorer feed utilization by the same group was due, in part, to the lower energy content of the ration and the greater feed wastage by the pigs. The heavier final weight in this trial would also contribute to the poorer efficiency in both groups. In trial 4, the performance of all pigs fed either the 0% or 5% alfalfa meal ration was similar indicating no real difference between the two rations.

A summary for all four trials emphasizing the two levels of 0% and 5% alfalfa meal in rations is shown in table 5. Average daily gain was essentially the same for both treatment groups indicating that 5% al-

Table 3. Mean Feedlot Performance of Growing-Finishing Pigs, Experiment 1, Trial 2.

Item	Level of alfalfa meal, % 0	2.5	5	10
No. of pigs	6	6	6	6
Average:				
Initial wt., lb.	49.3	49.5	49.5	49.5
Final wt., lb.	208	198	196	207
Daily gain, lb.	1.62	1.52	1.50	1.60
Daily feed, lb.	6.16	6.11	5.19	6.16
Feed/lb. gain, lb.	3.80	4.02	3.46	3.84

Table 4. Effect of 5% Alfalfa Meal in Growing-Finishing Rations, Experiment 1, Trials 3 and 4.

Item	Level of alfalfa meal, % Trial 3 0	Trial 3 5	Trial 4 0	Trial 4 5
No. of pigs	23	22	16	16
Average:				
Initial wt., lb.	40.5	41.0	31.2	31.1
Final wt., lb.	246	254	203	207
Daily gain, lb.	1.64	1.70	1.60	1.61
Daily feed, lb.	5.61	6.05	4.79	4.85
Feed/lb. gain, lb.	3.41	3.81	2.99	3.02

Table 5. Summary of Four Trials with 0% and 5% Alfalfa Meal in Rations

Item	Level of alfalfa meal, % 0	5
Total number of pigs	69	68
Average:		
Daily gain, lb.	1.62	1.66
Daily feed, lb.	5.23	5.57
Feed/lb. gain, lb.	3.22*	3.55

*Significantly less than the group fed the ration with 5% alfalfa meal ($P<.05$).

falfa meal did not improve or reduce rate of gain. Pigs fed the alfalfa ration required significantly ($P<.05$) more feed per unit of gain than pigs fed the corn-soybean meal type ration without alfalfa. The need for more pounds of feed per unit of gain can be explained on the basis of the lower energy value of the ration with alfalfa meal.

Diggs *et al.* (1965) found the metabolizable energy of corn and soybean meal is about 2.5 times the metabolizable energy in alfalfa meal. The corn ration and 5% alfalfa rations used in those trials contained approximately 1,575 calories and 1,525 calories of metabolizable energy per pound, respectively. When these values are multiplied by the feed efficiency values in table 5 the calories needed per pound of gain were within 350 calories for the two rations.

Summary

Two hundred weanling pigs were used in four growing-finishing trials to study the effect of adding alfalfa meal to high-energy, vitamin - supplemented rations. It appeared that daily gain of pigs was approximately the same on high energy alfalfa-free rations and rations that had up to 5% dehydrated alfalfa meal included; however, the feed required per pound of gain was increased by the inclusion of alfalfa meal. To maintain optimum growth rate, pigs compensated for the lower energy content of the rations with 5% alfalfa meal by eating more feed. The poorer utilization of the ration with 5% alfalfa meal was due to its higher fiber and lower energy content. A level of 10% alfalfa meal appeared to affect palatability of the ration as well as lower the energy of the ration and thereby decreased average daily gain and increased the quantity of feed needed per unit of gain.

Pelleting of rations containing alfalfa meal increased rate of gain and improved feed efficiency.

EXPERIMENT 2.
Brood Sows

Trial 1. Forty-four gilts were removed from the growing phase (Experiment 1, trial 1) at 200 pounds and were placed on the reproductive phase of the study. Gilts were fed rations with the same level of dehydrated alfalfa meal that they had received since weaning. Rations shown in table 6 were hand-fed at the rate of 6 pounds per head daily during pregestation and gestation. The rations contained approximately 16% crude protein, 0.58% calcium and 0.54% phosphorus. Minerals and vitamins were considered adequate for normal reproduction. Sows were group fed in each lot with two troughs providing more than 2 feet of space per sow.

Breeding was started in early November 1958, when the gilts

were about 8 months of age. Sows failing to conceive or to show estrus after a 2-month period were slaughtered and their reproductive tracts were examined for abnormalities. The remaining sows were kept for three farrowings, providing they conceived at each subsequent breeding.

During gestation each lot of 11 sows had access to an inside pen 14x20 feet in size with an adjoining outside concrete-floored pen 14x20 feet in size. On the 109th day of pregnancy the sows were moved to individual pens in the farrowing house. They remained in these pens until the pigs were weaned at 6 weeks of age, and then the sows were returned to their respective gestation pens. Lactation rations contained the same level of alfalfa meal as the gestation ration. Lactation rations were withheld for 12 hours after farrowing and were then fullfed to the end of lactation. Baby pigs were fed a starter ration during lactation. Water was provided for the sows in the farrowing pens by automatic waterers with lids over the cup. During the third farrowing baby pigs were provided

RATIONS FOR BROOD SOWS IN CONFINEMENT

Table 6. Composition of Gestation Rations; Experiment 2*

	Trial 1				Trial 2							
Lot No.	1	2	3	4	1	2	3	4	5	6	7	8
Ingredients												
Ground yellow corn, lb.	42.5	41.5	40.5	39.4	44.7	39.8	43.8	38.8	42.9	37.8	40.9	35.9
Ground oats, lb.	42.5	41.5	40.5	38.4	44.7	39.7	43.7	38.7	42.8	37.8	40.9	35.9
Dehydrated alfalfa meal, lb.	.....	2.5	5.0	10.0	.....	.....	2.5	2.5	5.0	5.0	10.0	10.0
Soybean meal (44%), lb.	9.9	9.6	9.3	8.7	6.0	15.1	5.5	14.7	5.0	14.2	4.0	13.2
Tankage (60%), lb.	3.3	3.2	3.1	2.9	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Diacalcium phosphate, lb.	0.6	0.6	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Limestone, lb.	0.4	0.4	0.3	0.2	0.8	0.6	0.7	0.5	0.5	0.4	0.4	0.2
Trace mineral salt, lb.†	0.5	0.5	0.5	0.5	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Vitamin-antibiotic premix, lb.‡	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

*The rations in trial 1 were calculated to contain 16% crude protein, 0.58% calcium, and 0.54% phosphorus. Rations for lots 1, 3, 5 and 7 were calculated to contain 14% crude protein and rations 2, 3, 6 and 8 were calculated to contain 18% crude protein in trial 2. All eight rations contained approximately 0.84% calcium and 0.54 phosphorus.

†Trace mineral salt contained 0.58% manganese, 0.015% cobalt, 0.08% copper, 0.8% zinc, 0.3% iron, and 0.016% iodine.

‡Premix provided 2 mg. riboflavin, 4 mg. pantothenic acid, 9 mg. niacin, 10 mg. choline chloride, 5 mcg. vitamin B_{12}, 2270 I. U. vitamin A, 284 I. U. vitamin D and 5 mg. antibiotic per pound of ration in trial 1 and 1 mg. riboflavin, 2 mg. pantothenic acid, 4.5 mg. niacin, 5 mg. choline chloride, 5 mcg. vitamin B_{12}, 900 I. U. vitamin A, 113 I. U. vitamin D_3, and 5 mg. antibiotic per pound of ration in trial 2.

with drinking water in a shallow pan.

Trial 2. In the summer of 1960, 48 gilts that had been reared on concrete were selected from Experiment 1, trial 2 at approximately 200 pounds body weight for this trial. The gilts were allotted to eight lots on the basis of breed, litter and body weight. The factorially designed experiment had treatments of 0%, 2.5%, 5% and 10% dehydrated alfalfa meal in the rations and 14% or 18% crude protein. The rations were fed at 4 pounds per head per day until 2 weeks prior to breeding, when the amount was increased to 5 pounds per head daily. After the breeding period daily feed was limited to 4 pounds per head per day, then increased to 5 pounds after about 70 days of pregnancy. The same rations were fed during lactation. After farrowing, wheat bran was added to the ration for 1 week. The sows were handfed twice daily all the feed they would consume between feedings. During gestation each group of sows was fed once daily (a.m.) in two troughs, which provided more than 2 feet of feeder space per sow. Housing was similar to trial 1.

Twenty-four sows (three from each lot) were slaughtered 25 days after breeding. The number of corpora lutea and embryos was recorded. The remaining 24 sows farrowed in the spring and again in the fall of 1961.

The same levels of alfalfa meal and crude protein were studied during 1962. Forty-eight gilts were fed the same level of alfalfa meal as growing pigs that they received later as sows. The young gilts were allotted to eight pens, and the four levels of alfalfa meal were compared. Each level of alfalfa meal was compared with either ground shelled corn or ground ear corn as the major energy source in the ration.

After the growing phase the gilts were kept on the same level of alfalfa meal, but were re-allotted in order to minimize the effects of corn versus ear corn in subsequent performance. Thereafter, the experimental design, feeding and management of the sows were similar to that of the first group of 48 sows. Data from both groups of gilts were combined for reporting and statistical analysis. Evaluation criteria for the treatments were conception rates, live and stillborn pigs farrowed, birth weight, litter size and pig weight at 6 weeks of age.

Trial 3. In the summer of 1962, 44 Duroc and 4 Hampshire weanling gilts were allotted into four equal groups on the basis of breed and body weight. These gilts were selected from litters out of high producing dams which were on the previous alfalfa study. These gilts were self-fed one of three different rations until they averaged 255 pounds body weight. Group 1 was fed an alfalfa-free ration, groups 2 and 3 were fed a ration with 5% dehydrated alfalfa meal. Group 3 also had access to a mineral mixture free-choice. The fourth group was fed a ration which contained 10% dehydrated alfalfa meal. After 255 pounds body weight, the experimental rations were: group 1, control ration with no alfalfa meal; group 2, 10% alfalfa meal; group 3,

10% alfalfa meal and fortified with more protein, mineral and vitamins; and group 4, 20% alfalfa meal (table 7). Yellow grease was added to the alfalfa rations to equalize the caloric content of the rations. These rations were fed at the level of 4.5 pounds per head per day except for a 2-week period prior to breeding when the quantity was increased to 5.5 pounds per head daily. The quantity was increased again to 5.5 pounds daily when the sows had been pregnant about 70 days. Sows were group-fed within each pen in open troughs which provided slightly more than 2 feet of space per sow.

Two Duroc boars were used and, insofar as possible, the boars mated an equal number of sows within each group. Four sows on each treatment were slaughtered after they were pregnant 25 days for an evaluation of fertility in early pregnancy. Sows failing to settle were included in this group. The 32 other sows were kept to farrow two litters; however, if a sow failed to farrow, she was sacrificed and the

Table 7. Percent Composition of Gestation Ration, Experiment 2, Trials 3 and 4.

	Trial 3, Alfalfa Level, %				Trial 4, Alfalfa Level, %	
Ingredients	0	10	10 plus more protein minerals, vitamins	20	0	10
Ground yellow corn	43.4	38.6	35.0	32.6	43.3	39.5
Ground oats	43.3	38.6	35.0	32.6	43.3	39.5
Dehydrated alfalfa meal	.....	10.0	10.0	20.0	.....	10.0
Soybean meal, 44%	8.5	6.4	12.8	6.0	8.5	6.4
Meat and bone scraps, 50%	3.0	3.0	3.0	2.5	3.0	3.0
Diacalcium phosphate	0.2	0.3	1.3	0.5	0.4	0.5
Limestone	0.8	0.3	.....	.....	0.4	.....
Trace mineral salt*	0.6	0.6	0.7	0.6	0.5	0.5
Yellow grease†	.....	2.0	2.0	5.0	.....	.....
Vitamin-antibiotic premix	0.2‡	0.2‡	0.3§	0.2‡	0.6‖	0.6‖
Calculated analysis						
Crude protein, %	14.4	14.4	16.4	14.4	14.4	14.4
Calcium, %	0.71	0.70	0.88	0.73	0.61	0.64
Phosphorus, %	0.51	0.50	0.71	0.50	0.54	0.54

*Trace mineral salt contained 0.58% manganese, 0.015% cobalt, 0.08% copper, 0.8% zinc, 0.3% iron and 0.016% iodine.

†The product was made from low grade offal after the separation of choice white grease. A stabilizing agent was added.

‡Each lb. of ration contained 1 mg. riboflavin, 2 mg. pantothenic acid, 4.5 mg. niacin, 5 mg. choline chloride, 4 mcg. vitamin B_{12}, 2000 I.U. vitamin A, 250 I. U. units vitamin D_3 and 5 mg. chlortetracycline.

§Each lb. of ration contained 1.5 mg. riboflavin, 3 mg. pantothenic acid, 6.75 mg. niacin, 7.5 mg. choline chloride, 6 mcg. vitamin B_{12}, 2500 I. U. vitamin A, 300 I. U. vitamin D_3 and 5 mg. chlortetracycline.

‖Each lb. of ration contained 2 mg. riboflavin, 4 mg. pantothenic acid, 9 mg. niacin, 10 mg. choline chloride, 6 mcg. vitamin B_{12}, 1500 I. U. vitamin A, 200 I. U. vitamin B_3 and 5 mg. chlortetracycline.

reproductive tract was examined. On the 109th day of pregnancy, the sows were moved to the farrowing quarters and fed lactation rations. The lactation ration for the control group was similar to their gestation ration, but all alfalfa-fed sows were fed a ration similar to the ration with 10% alfalfa meal for group 2. After the pigs were weaned at 4 weeks of age, sows were returned to their respective pens and bred to farrow a second litter. Housing and care of the sows were similar to the previous trial.

Trial 4. Duroc gilts were selected from Experiment 1, trial 4 for this trial. When the gilts averaged approximately 210 pounds body weight, they were fed the rations shown in table 7. Gilts receiving the 5% alfalfa growing ration were changed to the ration with 10% alfalfa meal and the other group was continued on an alfalfa-free ration. Sixteen gilts in each group were slaughtered at the end of the initial breeding period. Management of the sows including quantity of diet was as described for trial 3.

In all trials data were analyzed statistically by the approximate method of unweighted means since disproportionate subclass numbers were encountered (Snedecor, 1956).

Results and Discussion

Trial 1. Conception rates of sows for all three farrowings averaged 67%, 79%, 93%, and 86% for the alfalfa levels of 0%, 2.5%, 5% and 10%, respectively (table 8). The low conception rate for sows fed the ration without alfalfa meal occurred during the first and second farrowing periods. Prior to the first farrowing, two of the sows in this group failed to show estrus, and two were bred once but returned to estrus later in the gestation period. During breeding for the second litter two sows failed to show estrus, and a third was bred but did not farrow. Abnormalities were noted in the reproductive tracts of these sows. The fourth sow was in estrus twice after having been bred; she had eight approximately 60-day-old embryos when slaughtered.

Conception rate was low among sows fed 2.5% alfalfa meal during the first breeding season. One of these sows did not exhibit estrus, and three were bred but failed to farrow. All four had gross ovarian abnormalities when examined at slaughter. Three exhibited large cystic (15 mm. or larger in diameter) follicles, and the fourth sow had hemorrhagic follicles with neoplastic tissue developing. At the second farrowing one of the two nonpregnant sows on the 5% alfalfa ration had cystic follicles, and the other sow had no apparent abnormality. In the 10% alfalfa group one sow had a small infantile tract, two had cystic follicles and one sow aborted 14 days before she was due to farrow her second litter. She was kept for another litter after being found negative for brucellosis and leptospirosis.

Sows fed 10% alfalfa meal in the ration farrowed an average of 0.97 more pig per litter than the control sows. Although the number of pigs born alive increased as the level of alfalfa meal in the ration increased, the differences were not significant. Increased litter size of 1.19 pigs was

reported by Teague (1955) when 18% sun-cured alfalfa meal was included in gestation rations.

Significantly ($P<.05$) more pigs per litter were farrowed at the third than at the second farrowing. Alfalfa treatment did not influence the number of stillborn pigs farrowed. Birth weight of the pigs increased for the second and third litters as the level of alfalfa meal was increased in the ration. The two

Table 8. Dehydrated Alfalfa Meal for Brood Sows in Confinement, Experiment 2, Trial 1.

Item	Alfalfa level, % 0	2.5	5	10
Number of sows	11	11	11	11
Number of sows farrowing at				
First farrowing	7(11)*	7(11)	11(11)	10(11)
Second farrowing	3(7)†	6(7)	9(11)	7(10)
Third farrowing	3(3)	6(6)	9(9)	8(8)
Total	13(21)	19(24)	29(31)	25(29)
Average litter size at birth				
First farrowing	8.28	7.28	8.91	9.90
Second farrowing	8.00	7.50	7.22	8.00
Third farrowing‡	8.67	10.83	9.89	9.62
Average	8.31	8.47	8.69	9.28
Average birth weight, lb.§				
First farrowing	2.91	3.04	2.90	2.85
Second farrowing	2.94	2.98	3.32	3.59
Third farrowing	2.99	3.20	3.24	3.28
Average	2.94	3.08	3.12‖	3.17‖
Average litter size at 42 days				
First farrowing	6.71	6.00	6.00	7.50
Second farrowing	4.00	2.33	5.22	6.57
Third farrowing	5.00	7.17	5.89	7.25
Average	5.69	5.21	5.72	7.16**
Average pig weight at 42 days, lb.††				
First farrowing	22.7	22.6	18.9	19.5
Second farrowing	19.7	24.1	20.0	21.3
Third farrowing	25.1	25.4	26.7	25.5
Average	22.7	24.0§§	21.7	21.7
Average litter weight at 42 days, lb.	129.1	125.0	124.3	155.6
Average stillborn pigs per litter	0.46	0.37	0.65	0.20

*The number in parenthesis indicates the possible number of litters. When a sow failed to breed or farrow, she was slaughtered; therefore, 33 litters were not possible for all treatments.

†One sow was pregnant, but was rebred at two subsequent heat periods. She was shown as pregnant (conceived) but as not farrowing, because she was slaughtered due to postconception estrus.

‡Sows kept for a third litter farrowed significantly ($P<.05$) more pigs than at the second farrowing.

§A birth weight litter x alfalfa level interaction was significant ($P<.01$).

‖Significantly ($P<.01$) more than the control pigs.

**Significantly ($P<.05$) greater than the other treatments.

††A weaning weight litter x alfalfa level interaction was significant ($P<.01$).

§§Significantly ($P<.01$) heavier than pigs in groups 3 and 4.

groups fed the higher levels of alfalfa farrowed significantly heavier pigs than control sows; the pigs in the high-alfalfa group averaged 0.23 of a pound more at birth than the control pigs. These results are in contrast to those of Teague (1955), who did not find any effect of alfalfa on birth weight of pigs.

Second- and third-litter pigs were significantly heavier than first-litter pigs. The interactions between alfalfa level in the sows' rations and first, second or third litters were significant for birth weight of pigs. Sows fed the higher levels of alfalfa meal farrowed heavier pigs than the 2.5% alfalfa-fed or control sows at the second and third but not at the first farrowing. All of the physiological factors involved in this interaction are not known.

Litter size was generally small at 6 weeks of age for all treatments; however, sows fed 10% alfalfa meal weaned significantly ($P<.05$) more pigs than sows on other treatments. Mastitis was a persistent problem in the herd and probably reduced litter size at weaning. In addition, at the second farrowing the sows farrowed in August and September, when the temperature on several days was above 90° F., and pig loss was high. Weaning weights at 6 weeks were significantly different among alfalfa treatments and farrowing periods. Pigs from sows on the 2.5% alfalfa meal ration were heavier at weaning; however, these sows also weaned fewer pigs per litter. The trend in weaning weights for the alfalfa levels was not the same for each farrowing. A significant ($P<.01$) interaction was observed between the alfalfa treatment and farrowing period. Pigs from sows fed the 2.5% alfalfa ration were consistently among the heavier treatment groups for the three farrowings, while weaning weights at the three farrowings in the other treatment groups were variable. Average litter weight was greatest for litters from sows fed 10% alfalfa. Third-litter pigs were heavier at weaning than first- and second-litter pigs. Providing drinking water for the pigs at this farrowing and higher milk production by the older sows may have affected weaning weights.

Trial 2. Tables 9 and 10 show the results of this trial. In contrast to the results of trial 1 with respect to the percent of sows farrowing, the per cent of sows farrowing in trial 2 was similar for all groups. The rations for trials 1 and 2 were similar and probably would not account for the difference in performance of the two control groups. Vitamin deficiency should not have been a factor influencing conception rate of control sows in trial 1, since the ration contained more vitamin supplement than in trial 2.

Eleven sows were slaughtered, because they did not show estrus during the breeding periods. One of the two sows failing to farrow litters in the alfalfa-free, 14% protein group had an underdeveloped reproductive tract, and the other sow had small ovaries with 2 mm. follicles. In the 2.5% alfalfa group, one sow had cystic follicles (15 mm. or larger in diameter), two sows had small white fibrous-appearing ovaries, and one sow had a normal-appearing reproductive tract in the

Table 9. Effect of Dehydrated Alfalfa Meal and Crude Protein on Performance of Sows, Experiment 2, Trial 2.

Lot number	1	2	3	4	5	6	7	8
Alfalfa level, %	0	0	2.5	2.5	5	5	10	10
Crude protein, %	14	18	14	18	14	18	14	18
Number sows	6	6	6	6	6	6	6	6
Number litters farrowed	9(11)*	12(12)	8(11)	10(12)	10(12)	12(12)	11(12)	8(11)
Average:								
Sow weight, first breeding, lb.	280	264	284	279	270	281	283	288
Sow weight, first farrowing, lb.	382	384	402	412	388	389	409	407
Sow weight at weaning, lb.	372	371	385	429	373	395	412	397
Sow weight, second farrowing, lb.	512	499	499	528	488	512	490	522
Sow weight at weaning, lb.	503	484	465	509	460	488	455	502
Litter size, birth	6.89	9.58†	7.88	7.80	8.90	8.42	8.18	9.38
Birth weight, lb.	2.95	2.74	2.88	2.75	2.76	2.87	2.79	2.99
Litter size, 42 days	5.22	7.18	7.00	6.00	6.70	6.73	6.27	7.38
Pig weight at 42 days, lb.	21.8	18.9	22.8	22.6	20.8	22.7	22.0	23.1
Number stillborn pigs	10	7	1	16	9	0	13	10
Average number stillborn pigs per litter	1.11	0.58	0.12	1.60	0.90	0.00	1.18	1.25
Number sows slaughtered at 25 days pregnancy‡	6(5)	6(6)	6(6)	6(5)	6(5)	6(5)	6(5)	6(4)
Average number corpora lutea§	11.8	12.5	14.0	12.4	11.3	14.8	12.6	13.0
Average number embryos§	10.2	10.8	9.2	10.6	9.2	8.8	10.2	10.2

*Figure in parenthesis indicates the number of possible litters. Sows failing to conceive were slaughtered.
†Significantly ($P<.50$) greater than lot 1.
‡Six gilts slaughtered in each lot. The figure in parenthesis is the number pregnant.
§Average of pregnant animals.

luteal stage of the cycle. In the 5% alfalfa group one sow had a normal-appearing tract, and the other sow had a small tract even though she had had a previous pregnancy. In the 10% alfalfa group two sows had normal - appearing reproductive tracts, and another sow had undersized ovaries. One sow in the 2.5% alfalfa group was slaughtered for reasons unrelated to treatment, and one sow in the 10% treatment group was not pregnant. She was bred and farrowed at the next farrowing.

Sows for all groups gained an average of 118 pounds from the start of breeding to first parturition and 114 pounds from the end of lactation to second farrowing. Weight losses were 5 pounds and 22 pounds during the first and second lactations respectively. The effect of rations on weight change cannot be fully assessed, because litter size and milk production had some effect on weight change. However, sows fed the 10% alfalfa rations finished the trial 19 pounds lighter than the control sows, even though they were 14 pounds heavier at the start of the trial. Sows fed the high-protein rations were 23 pounds heavier at the end of the trial than those fed the low-protein ration.

Number of pigs farrowed per litter was signficantly ($P<.05$) affected by protein level in the alfalfa-free ration. On the alfalfa-free ration sows fed the higher level of protein farrowed 2.69 more pigs per

Table 10. Effect of Alfalfa Meal and Crude Protein Levels on Performance of Sows, Experiment 2, Trial 2.

Item	Alfalfa level, %				Crude protein, %	
	0	2.5	5	10	14	18
Number of litters	21	18	22	19	38	42
Average:						
Sow weight at first breeding, lb.	271	282	276	284	279	278
Sow weight at first farrowing, lb.	383	408	389	408	396	397
Sow weight at weaning, lb.	371	407	384	405	386	396
Sow weight at second farrowing, lb.	504	515	502	502	497	512
Sow weight at weaning, lb.	492	490	477	473	470	493
Litter size at birth	8.43	7.83	8.64	8.68	8.00	8.79
Birth weight, lb.	2.81	2.81	2.82	2.88	2.83	2.83
Litter size at 42 days	6.30	6.12	6.71	7.11	6.46	6.67
Pig weight at 42 days, lb.	20.0	22.7	21.8	22.5	21.8	21.6
Number stillborn pigs	17	17	9	23	33	33
Average stillborn pigs/litter	0.81	0.94	0.41	1.21	0.87	0.79
Number sows slaughtered at 25 days pregnancy*	12(11)	12(11)	12(11)	12(9)	24(21)	24(21)
Av. number corpora lutea†	12.2	13.3	13.5	12.4	12.6	13.1
Average number embroys†	10.5	9.8	9.9	10.2	9.7	10.6

*First figure is the number slaughtered and the figure in parenthesis is the number pregnant
†Average of pregnant animals.

litter than those fed the lower level of protein. The differences in litter size due to alfalfa and protein levels for all alfalfa treatments were not significant. Sows fed 18% protein rations farrowed more pigs per litter, but this difference was not significant. Clawson *et al.* (1963) reported that the level of protein fed to gilts appeared to have little effect on total pigs farrowed. Clawson's data indicated that gilts receiving 1.2 pounds of protein daily farrowed more pigs in three of four trials than did gilts receiving only 0.3 of a pound of protein. However, the difference was not significant. In the trials reported herein sows fed 14% protein rations received about 0.56 of a pound of protein daily, and those fed the 18% protein rations received approximately 0.72 pound. Neither alfalfa meal nor protein level had a significant effect on the number of stillborn pigs.

Neither alfalfa treatment nor protein level alone influenced average weight of the pigs; however, there was a significant ($P<.01$) interaction between these factors. Birth weight of pigs in the low-protein groups decreased as the level of alfalfa meal was increased, whereas birth weights of pigs in the high-protein groups increased as the level of alfalfa meal increased. Sows fed no alfalfa meal and the 14% protein rations and those fed 10% alfalfa meal and 18% protein rations farrowed the heaviest pigs.

Litter size at weaning and weaning weights were not affected significantly by alfalfa or protein treatments. As in trial 1 sows fed 10% alfalfa meal rations weaned the largest litters. Also, mastitis was a problem at farrowing, and this may have confounded the true value of alfalfa in regard to litter size at weaning and weaning weights.

Data from sows slaughtered after 25 days of pregnancy showed that differences in ovulation rate or embryonic death loss could not be attributed to alfalfa meal. The higher protein level in the ration did not increase significantly the ovulation rate or the number of embryos at 25 days after breeding.

Trial 3. Breeding, farrowing and lactation data are presented in table 11. Forty-five of 48 gilts were bred at their first breeding period, but only 22 of 30 were observed in estrus after weaning their first litters. This complete absence of estrus was observed in all four treatment groups, but the percent of litters farrowed was 94%, 73%, 87%, and 81% for the control, 10%, 10% plus additional nutrients, and 20% alfalfa meal groups respectively. Teague and Grifo (1965) in a study on gilts under drylot conditions for successive generations also observed a complete absence of external signs of estrual behavior in a number of second- and third-generation gilts. They reported no gross abnormality of the reproductive tracts related to breeding failure or to ration treatment. The reproductive tracts of the eight sows in the trial reported here were similar in appearance. The uterine horns were small and avascular and the ovaries were small with several 2 mm. follicles. The absence of new or old corpora lutea on the ovaries indicated that the sows were not having normal estrus cycles.

Table 11. Dehydrated Alfalfa Meal for Brood Sows in Confinement, Experiment 2, Trial 3.

Item	Alfalfa level, % 0	10	10 plus more protein, minerals, vitamins	20
Group Number	1	2	3	4
Number of sows,*				
First litter	8(8)†	7(8)	7(8)	8(8)
Second litter	7(8)	4(7)	6(7)	5(8)
Average sow weight, lb.				
First litter				
Before farrowing	434	437	447	445
4 weeks after farrowing	382	386	390	408
Second litter				
Before farrowing	518	535	508	526
4 weeks after farrowing	489	481	448	464
Average litter size, birth				
First farrowing	8.62	9.57	9.71	9.12
Second farrowing	8.43	9.25‡	9.33	7.20
Average	8.53	9.45	9.54	8.38
Average pig weight, lb.				
First farrowing	3.06	2.93	3.03	3.46
Second farrowing	3.03	2.68	2.91	3.78
Average	3.05	2.84	2.98	3.56¶
Average litter size, 4 weeks				
First farrowing	7.00	7.50	7.71	6.50
Second farrowing	5.71	4.75	6.67	5.40
Average	6.40	5.82	7.23¶	6.08
Average pig weight at 2 weeks, lb.				
First farrowing	13.2	13.0	12.8	14.9
Second farrowing	15.7	16.1	16.4	19.7
Average	14.2	13.9	14.3	16.5¶
Stillborn pigs per litter				
First farrowing	0.88	0.29	0.88	0.38
Second farrowing	0.86	3.20	1.67	1.60
Average	0.87	1.50	1.31	0.85
Number sows slaughtered at 25 days pregnancy	2§	4	4	3‖
Average number corpora lutea	13.6	15.2	17.5	15.0
Average number embryos	10.0	12.8	15.2	14.3

*One sow failed to farrow in each of groups 2 and 3 in the first farrowing. The group 2 sow aborted 11 days before she was due to farrow. The cause could not be determined. The group 3 sow was bred and did not have another estrus. When she did not show pregnancy, she was slaughtered and the reproductive tract appeared functional and normal. All 8 sows failing to breed for their second litters had small uterine horns and ovaries.

†Number in parenthesis represents the number of possible litters.

‡One litter of 12 pigs which aborted near termination of normal pregnancy was not included.

§Two sows were not pregnant. One sow had a small uterus and the other sow had small ovaries and enlarged oviducts.

‖The nonpregnant sow had 17 functional corpora lutea and numerous 2 to 5 mm. follicles. Since she did not have another estrus after breeding, she probably was not cycling.

¶Significantly ($P<.01$) different from the other treatment groups.

Palmer *et al.* (1965) found that the uterus decreases in weight rather rapidly after parturition and remains small until after weaning. They observed that corpora lutea of pregnancy rapidly diminish in size after parturition. Ovarian follicles also decreased in size in early lactation but gradually increased in size in late lactation and after weaning. Therefore, the small tracts and follicles in these sows were probably normal in appearance for lactation but some condition may have influenced hormone balance resulting in diminished follicular development.

Sows fed the 10% alfalfa meal rations farrowed nearly one more live pig than the control sows in the first and second litters although the differences were not statistically significant. Sows fed the 20% alfalfa meal rations had large litters in their first gestation, but small litters in their second gestation. The number of stillborn pigs farrowed was rather variable between treatments and between gestations within a treatment, but no one treatment group of sows farrowed significantly more stillborn pigs than any other group.

Pigs in the 20% alfalfa treatment group were on the average significantly ($P<.01$) heavier at birth and weaning than pigs in the other three treatment groups. This group of sows farrowed fewer pigs in the second gestation and one might expect heavier weights because of fewer numbers.

Sows fed the 10% alfalfa meal ration and supplemental protein, minerals and vitamins weaned significantly ($P<.01$) larger litters than the other three treatment groups. Larger litters at weaning appeared to be the only important advantage to providing more protein, minerals and vitamins in the ration.

The number of corpora lutea and 25-day embryos found when a small number of gilts were slaughtered after 25 days pregnancy appears to be greater for the alfalfa groups in the table; however, an evaluation cannot be made with only two control animals pregnant and providing data.

Trial 4. An attempt was made in this trial to have more animals per treatment in order to make a better evaluation of the treatments. Although there were 16 sows assigned to each treatment group and each was to farrow two litters, the control sows farrowed only 17 of a possible 30 litters (57%) and sows fed 10% alfalfa meal in their ration farrowed 23 of a possible 32 (72%) litters (table 12). All of the alfalfa-fed sows and all except two of the control sows farrowed their first litters. A large number of sows, 11 control sows and nine alfalfa-fed sows, would not breed after their first litter of pigs was weaned. Two reproductive tracts from control sows were normal, one had cystic follicles and eight tracts had small, avascular uterine horns and small inactive ovaries. Three alfalfa-fed sows had normal appearing tracts, but six sows had small, avascular uterine horns and inactive ovaries. This was the same condition that occurred in the previous trial, however, the percent of the control sows farrowing litters was much lower in this trial.

Data on litter size at birth and weaning, pig weight at birth and

weaning and the number of stillborn pigs per litter were similar for both treatment groups. When three gravid sows in each group were slaughtered after a 25-day pregnancy, there were no differences in the number of corpora lutea or embryos between treatments. Therefore, the only important difference between the two groups in this trial was the number of sows farrowing.

Data in the earlier trials as well as the data in this trial show that

Table 12. Effect of 10% Dehydrated Alfalfa Meal in Rations for Brood Sows in Confinement, Experiment 2, Trial 4.

Item	Alfalfa level, % 0	10
Number of sows	16	16
Number of sows farrowing at		
First farrowing	14(16)*†	16(16)
Second farrowing	14(16)	7(16)
Total	17(30)	23(32)
Average:		
Sow weight at first farrowing, lb.	390	394
Sow weight at weaning, lb.	323	345
Sow weight at second farrowing, lb.	486	506
Sow weight at weaning, lb.	445	452
Litter size, birth		
First farrowing	8.65	7.12‡
Second farrowing	8.33	9.71
Average	8.59	7.91
Birth weight, lb.		
First farrowing	2.86	2.83
Second farrowing	2.34	2.48
Average	2.77	2.70
Litter size, 42 days		
First farrowing	7.00	6.29
Second farrowing	6.67	7.86
Average	6.94	6.81
Pig weight, 42 days, lb.		
First farrowing	20.3	21.1
Second farrowing	18.6	16.7
Average	19.9	19.4
Average number stillborn pigs per litter	0.47	0.17
Number sows slaughtered after first breeding	6	6
Number of sows pregnant§	3	3
Average number corpora lutea	12.7	13.0
Average number embryos	11.3	10.0

*The number in parenthesis is the total possible litters.

†One of the nongravid sows had a normal appearing reproductive tract and was ready to ovulate, but the other sow's tract was small and the ovaries were inactive.

‡Includes one litter of one stillborn pig at birth.

§The nongravid sows were slaughtered also. One of these sows in each group had a normal tract and two in each group had small uterine horns and small inactive ovaries.

sows fed alfalfa meal have performed a little differently than sows fed alfalfa-free rations in regard to certain traits, but the differences have not been consistently repeatable. These data suggest that the effect of alfalfa meal can be negligible, as occurred a number of times in these trials, or alfalfa may have a small influence on conception rate, birth weight of the pigs, or litter size at weaning under certain conditions, as occurred at least once during these trials. Alfalfa meal did not significantly influence the number of live and stillborn pigs farrowed, or the number of embryos or corpora lutea after 25-day pregnancies.

The data illustrate the extensive variation that can occur in reproductive studies and that many animals are necessary to show differences in treatments. A summary of the groups fed alfalfa-free rations and the groups fed rations with alfalfa meal at the 10% level in all four trials is shown in table 13. A total of 47 sows were used in each treatment and 73.3% of the possible litters were farrowed in the control group and 78.8% of the possible litters were farrowed in the 10% alfalfa meal group.

Average birth weight of the pigs and the number of stillborn pigs farrowed were essentially identical for the two treatment groups. Sows fed 10% alfalfa meal rations farrowed 0.29 more pig per litter and weaned 0.48 more pig per litter, but these differences between treatment groups were not statistically significant due to the extensive variation in litter size within the treatment groups.

Reproductive problems in these trials were largely due to sows failing to show estrus, especially after they had weaned their first litters. The tracts from these sows were characterized by small uterine horns and small inactive ovaries. This condition became more prevalent in each subsequent trial and the condition was observed in all treatment groups in this report.

Summary

Four trials were conducted to evaluate dehydrated alfalfa meal in rations for sows reared and housed continuously in concrete-floored pens. In trial 1, levels of 0%, 2.5%, 5% and 10% alfalfa meal were compared. In trial 2 the same levels of alfalfa meal were used, and two levels of protein (14% and 18%) were compared.

In trial 3, levels of 0%, 10% and 20%

Table 13. Summary of Four Trials. The Effects of 10% Alfalfa Meal in Gestation Rations*

Item	Alfalfa level, % 0	10
Number of sows	47	47
Number of litters	66(90)†	78(99)
Per cent of potential litters farrowed	73.3	78.8
Average live pigs at birth per litter	8.47	8.76
Average birth weight, lb.	2.88	2.91
Average litter size, weaning	6.37	6.85
Average number stillborn pigs per litter	0.67	0.63

*These data represent the averages of the two treatments for four trials which have been conducted since the start of the experiment in 1958.

†The number in parenthesis is the total possible litters.

alfalfa meal were compared. A fourth group of sows was fed the 10% alfalfa meal ration fortified with additional protein, minerals and vitamins. In trial 4, a level of 10% alfalfa meal was compared with an alfalfa-free ration.

A higher percent of sows fed the alfalfa-free or 2.5% alfalfa meal rations failed to farrow litters than sows fed 5% or 10% alfalfa meal in trial 1. Sows fed 10% alfalfa meal weaned significantly more pigs than those on the other three levels of alfalfa meal. Individual pigs in the 2.5% alfalfa group were heavier at weaning, but average litter weight was greatest for sows fed 10% alfalfa.

In trial 2 alfalfa meal and protein level did not affect significantly the number of sows farrowing, number of stillborn pigs, birth weight of the pigs or litter size and pig weight at weaning. Litter size at birth was improved by the higher level of protein in the alfalfa-free ration.

There were no signficant differences in litter size at birth or the number of stillborn pigs per litter in trial 3. Sows fed the 20% alfalfa meal ration had significantly heavier pigs at birth and at weaning than sows in the other treatment groups. Litter size was significantly larger at weaning in the group fed the 10% alfalfa meal ration which was more highly fortified with protein, minerals and vitamins.

In trial 4, there were no significant differences in litter size at birth or weaning, pig weights at birth or weaning or the number of stillborn pigs between the two treatment groups.

Conception rate was low among second litter sows in trials 3 and 4. Most of these sows did not have an estrus period after farrowing their first litters and their reproductive tracts appeared small and inactive.

A summary of combined data for sows fed the alfalfa-free rations and sows fed 10% alfalfa in their rations showed there was no statistical difference in the reproductive performance of the sows on these two treatments. However, sows fed 10% alfalfa had a slightly higher conception rate, more live pigs farrowed and more pigs weaned than those fed the alfalfa-free ration.

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