Dickinson Research Extension Center
1089 State Avenue
Dickinson, ND 58601

An Evaluation of the Replacement Value of Field Peas For Soybean Meal in Sow Lactation Diets

D.G. Landblom[1], R.L. Harrold[2], W.W. Poland[1], and K. Miller[2]
[1]Dickinson Research Extension Center, North Dakota State University
[2]Animal and Range Science Department, North Dakota State University

Abstract

One hundred ninety-two sows were used to evaluate the effect on sow and litter performance, sow body condition change, milk composition, and days to first estrous when field peas replaced 10, 20, and 30% of the dietary soybean meal. Parity and lactation days for the four treatments were 3.10, 3.27, 2.96, and 2.90, and 19.2, 18.7, 19.0, and 19.2 days, respectively. Daily feed intake and calculated metabolizable energy (ME) consumption of 19.3, 20.9, 19.4, and 20.2 Mcal/day were similar across treatments suggesting field pea replacements for soybean meal up to 30% of the diet did not compromise diet acceptance or dietary energy consumption. Sow performance was unaffected by the level of pea grain in the lactation diet, and, as such, lactation sow weight change from farrowing to weaning, and days to first estrous did not differ.

Sow milk composition at mid-lactation on day 14 to include milk solids, protein and fat, and backfat depth change did not differ between the corn/soy control and the test diets containing 10 to 30% peas. Litter performance favored pigs nursing sows receiving the 10% pea test diet. Sows that received the 10% pea diet weaned more ($P<.05$), and heavier ($P<.05$) pigs, and had a numerical greater, but non-significant, increase in pig survival than the corn/soy control and other test diets containing 20 and 30% peas.

Results of this investigation suggest pork producers can effectively use up to 30% field peas as a dietary protein and energy substitute for soybean meal in sow lactation diets without compromising sow performance, milk composition, return to estrous, litter performance, and litter survival rate. The decision for replacing up to 30% of the soybean meal in sow lactation diets with 30% peas would be based solely on the cost per unit of protein and energy between the two supplements.

Introduction

Previous research at this Center focused on the replacement value of field peas in the diets of nursery and growing-finishing pigs (Landblom and Poland, 1997[a, b, c]; Landblom and Poland, 1998), and defined dietary inclusion levels for growing pigs. Grain energy sources evaluated by Carter, et al. (1998) determined barley with added fat and naked oats compare favorably with corn as energy sources for lactating sows. Information pertaining to the utilization of field peas in sow lactation diets is limited, indicating the need to define the efficiency range of field peas for lactating sows.

Hog numbers have been declining in North Dakota, but this trend should be reversed since raising hogs makes good business sense. Despite the red ink that flows from time to time in the swine business, on average, hogs are a very profitable enterprise. Ron Plain, Missouri Extension Economist, in his Weekly Swine Report, stated that over the 10 year period from 1987 to 1996, Missouri farms that kept their records on the University's MIR program had an average annual return on investment of 11.2% for their swine enterprises. And, when averaged over the 20 year period from 1977-96, the average return on investment from swine enterprises was a consistent 11.8%.

Crop diseases, rotational farming techniques, and the desire to grow nitrogen are the driving forces behind a greater number of acres being seeded to pulse crops like field peas in North Dakota. Since 1997, acres seeded to peas have ranged from 60,000 to 103,000 acres statewide. This is up from 14,500 acres in 1994, when records of pea acreage began. Acreage for the 2000 cropping season is estimated to be approximately 60,000 acres. Acreage growth has created an enhanced need for market expansion.

Healthy agricultural economies are a win/win situation for individual producers and all of North Dakota. With respect to expanding marketing options for field peas to include the lactating sow, any avenue by which locally grown peas, feed grains, and supplements can be consumed locally in value adding enterprises or segments of production, will result in a healthier economy for producers and subsequently, healthier local and state economies. Should the results of this investigation demonstrate that peas can be a suitable substitute for a portion of the imported soybean meal customarily used in lactation diets, producers farrowing sows will have a wider array of protein sources from which to formulate least cost diets. Data from this sow lactation study will also help commercial feed manufacturers, swine nutrition consultants, extension personnel, and individual producers formulate diets using peas as a protein substitute. Given the agronomic fit of field peas in small grain rotations ravaged by scab disease, expanding marketing options for peas in a larger array of swine production phases will contribute to sustainability throughout agriculture in North Dakota.

Research to evaluate the utilization of pea grain in sow lactation diets will provide the state's field pea growers, and pork producers alike, with farrowing and re-breeding performance data when peas are used as a source of supplemental protein and energy in place of soybean meal.

The project objectives are as follows:

1. Determine the nutritive value of field peas when replacing soybean meal in the diets of lactating sows.

2. Correlate litter performance to sow body condition change as measured by ultrasonography.

3. Document economic return to management and North Dakota's economy when peas replace soybean meal.

Materials and Methods

A cooperative study utilizing two hundred primi- and multi-parous sows from two experiment stations (NDSU, Fargo and DREC, Dickinson) in North Dakota were utilized to determine the effects of energy source on lactational performance of sows.

Crossbred (Duroc x Yorkshire x Hampshire) sows at the Fargo station and PIC (Line C-22) sows at the Dickinson Research and Extension Center were randomly allotted at day 109 of gestation to four dietary treatments. Dietary treatments included: 1) corn/soy based control diet, 2) Corn-soy based diet with 10% pea replacement for SBM, 3),Corn-soy based diet with 20% pea replacement for SBM, and 4) Corn-soy based diet with 30% pea replacement for SBM (Table 1). All diets were formulated to 1.0% lysine, and to meet or exceed NRC (1988) standards for minerals and vitamins. Diets were fed on an ad libitum basis during lactation. Sow feed intake was recorded on a weekly basis in order for determination of feed intake during the entire lactation period.

Within 24 hours of farrowing, number of pigs born and litter weight were recorded. All litters were adjusted to equal to or greater than 10 pigs by day 2 of lactation in order to equalize the energy needs of the litter across diet. On day 2 of lactation, new litter weight and number of pigs were recorded. Pigs were processed according to each station's standard practices.

Sows were weighed as they entered the farrowing house (d 109 of gestation), within 12 hours post-farrowing, and at weaning in order to determine sow weaning weight and lactation weight change. Additionally, backfat was measured by ultrasonagraphy on each sow within 24 hours of farrowing and at weaning. Backfat change during lactation was then calculated. After weaning, sows were monitored for days to estrus.

All litters were weighed on day 2, 14, and at weaning. At weaning, the number of pigs weaned was recorded. These data allowed for the calculation of litter weaning weight, average pig weaning weight, litter gain, and survivability. On day 14 of lactation, twenty sows per treatment were randomly chosen for milk collections. Sows were manually milked following injection of 20 IU of oxytocin. Approximately, 100 mL were collected and frozen. Milk samples were analyzed by standard procedures for dry matter, crude protein, and fat.

Data were analyzed as a completely randomized design using appropriate statistical procedures (SAS, 1996).

Results and Discussion

One hundred ninety-two sows were used to evaluate the effect on sow and litter performance, sow body condition, and milk composition when field peas replaced 10, 20, and 30% of the dietary soybean meal. Parity and lactation days for the four treatments were 3.10, 3.27, 2.96, and 2.90, and 19.2, 18.7, 19.0, and 19.2 days, respectively. The number of sows in treatments 1 through 4 were 50, 49, 46, and 47.

Feed and Energy Intake

Feed intake and subsequent sow acceptance are critical to lactation performance. Daily feed intake, shown in Table 2, did not differ between control and diets containing pea replacements for soybean meal. Sows fed diet 2 containing 10% peas tended to consume more daily feed, but the observed increase was not considered to be significant (P>.10). Daily calculated energy consumption was a non-significant 19.3, 20.9, 19.4, and 20.2 Mcal, respectively, for the four test diets suggesting that replacing soybean meal with peas did not compromise total dietary energy content.

Sow Performance

Sow performance has been summarized in Table 2. Sow body weight, measured within eight hours of farrowing, averaged 497 pounds (range 483 to 511 lb), and did not differ between the four test diets. Sow weight at weaning also did not differ (P>.10). During the lactation period, sows gained weight in all dietary treatments. There was a tendency for a greater, although non-significant, weight gain for sows that received the 30% pea test diet. The number of days necessary for sows to return to estrus following weaning was not affected (P>.10) by dietary treatment.

Litter Performance

Litter performance is also summarized in Table 2. The number of pigs on day 2 was 9.77, 10.38, 9.54, and 10.26, respectively for the four dietary treatments. Sows receiving the 20% pea diet started the experiment with less (P<.05) pigs (9.54) than the other treatments. Due to the smaller number of pigs that started the study in the 20% pea diet, litter weight on day 2 was also lower (P<.05). Pigs receiving the 10% pea diet weaned more (P<.05), and heavier (P<.05) pigs than the soybean control and other pea test diets. Average pig weight at weaning did not differ, although there was a tendency for pigs receiving the 10% pea diet to be heavier. Pig survival tended to be greater for pigs nursing sows that received the 10% pea test diet (Fig. 1).

Sow Body and Milk Composition

The effect of field pea replacement on sow backfat change and milk composition was uneventful and is summarized in Table 3. Backfat depth at farrowing and weaning differed numerically, but the differences observed were not significant (P>.10). Milk solids (DM), crude protein and fat content did not differ between control and treatments containing 10 to 30% pea replacement for soybean meal.

Economics

Based on the results of this evaluation of replacing soybean meal with field peas, the decision as to which of these protein/energy ingredients to formulate with would be based on input cost per unit of protein.

Conclusion

Results of this investigation suggest pork producers can effectively use up to 30% field peas as a dietary protein and energy replacement for soybean meal in sow lactation diets without compromising sow performance, milk composition, return to estrus, litter performance, and litter survival rate. The decision for replacing up to 30% of the soybean meal in sow lactation diets with 30% peas would be based solely on availability and the cost difference per unit of protein and energy between the two supplements.

Table 1. Composition of diets, as-fed basis.

Diet:	1	2	3	4
Pea Replacement Level:	**Corn/Soy 0%**	**Corn/Soy 10% Pea**	**Corn/Soy 20% Pea**	**Corn/Soy 30% Pea**
Ingredients,%				
Corn	65.93	58.91	51.79	44.79
Field Peas	--	10	20	30
Soybean Meal (44%)	28	25.1	22.25	19.25
Dicalcium Phosphate	2.48	2.45	2.43	2.43
Limestone	0.83	0.83	0.83	0.83
Salt	0.4	0.4	0.4	0.4
Vitamin/Mineral Premix	0.3	0.3	0.3	0.3
Zinc Sulfate	0.02	0.02	0.02	0.02
L-Lysine	0.06	--	--	--
Vegetable Oil	2	2	2	2
Calculated Analysis				
Metabolizable Energy, kcal/kg	3276	3262	3247	3232
Crude Protein, %	18.9	18.9	18.9	18.9
Lysine %	1.01	1.02	1.08	1.12
Threonine %	0.90	0.72	0.74	0.76
Methionine + Cystine, %	0.57	0.56	0.55	0.54
Tryptophan, %	0.26	0.25	0.25	0.24

Calcium,%	0.91	0.91	0.91	0.91
Phosphorus, %	0.80	0.80	0.80	0.80
Available Phosphorus, %	0.45	0.45	0.45	0.45

Table 2. Effect of field pea level on sow and litter performance.

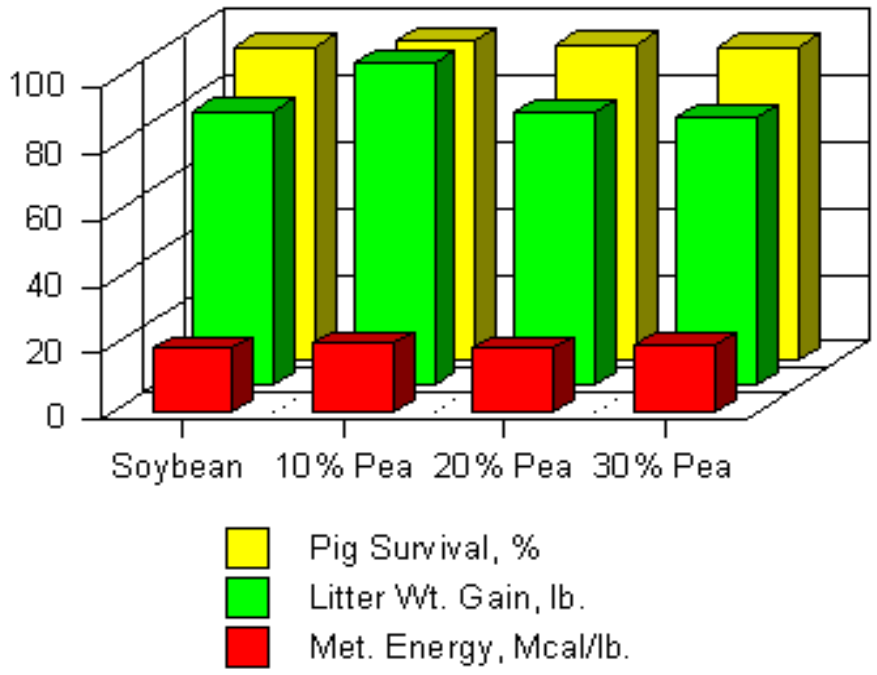
Diet:	**1**	**2**	**3**	**4**	
Protein Replacement:	**Soybean Meal**	**10% Field Pea**	**20% Field Pea**	**30% Field Pea**	**Treatment P-Value**
No. Sows	50	49	46	47	
Parity	3.10	3.27	2.96	2.90	
Lactation Days	19.2	18.7	19.0	19.2	
Daily Feed Intake, lb.	13.0	14.1	13.2	13.8	.226 NS
Energy Consumed, Mcal/lb.	19.3	20.9	19.4	20.2	
Sow Performance					
Sow Wt. Post-Farrowing, lb.	498	483	511	491	.247 NS
Sow Weaning Wt., lb.	550	537	543	558	.375 NS
Sow Wt. Change, lb.	52	54	32	67	
Return to Estrus, Days	9.4	10.4	11.5	11.0	.831 NS
Litter Performance					
No. Pigs on Day 2	9.77^{a}	10.38^{a}	9.54^{b}	10.26^{a}	.044
Litter Wt. on Day 2	41.71^{a}	40.59^{ab}	37.0^{b}	41.89^{a}	.048
No. Pigs Weaned	9.22^{ab}	9.99^{a}	9.07^{b}	9.68^{ab}	.044
Survival, %	94.4	96.2	95.1	94.3	
Litter Weaning Wt., lb.	124.5	138.0	119.6	122.8	.116 NS
Litter Gain, lb.	82.8^{a}	97.4^{b}	82.6^{a}	80.9^{a}	.048
Average Pig Wt., lb.	13.5	13.8	13.2	12.7	

[ab]Means in a row with unlike superscripts differ (P<.05).

Table 3. Effect of field pea replacement on sow backfat change and milk composition.

Diet:	1	2	3	4	
Protein Replacement:	Soybean Meal	10% Field Pea	20% Field Pea	30% Field Pea	Treatment P-Value
Body Composition					
No. Sows	50	49	46	47	
Backfat Depth at Farrowing,	.75	.68	.72	.70	.479
Backfat Depth at Weaning,	.99	.58	.62	.65	.155
Backfat Change, in.	.24	-.10	-.10	-.05	
Milk Composition, Day 14					
No. Sows	24	23	22	27	
Milk Solids, %	19.7	19.7	20.1	19.3	
Milk Crude Protein, %	5.6	5.3	5.4	5.8	
Milk Fat, %	8.5	8.9	9.1	7.9	

Figure 1. Relationship between metabolizable energy (ME) intake, litter weaning weight, and pig survival for sows fed soybean meal or three levels of field peas as soybean meal replacements.



Literature Cited

Carter, S., D. Landblom, R. Harrold, K. Miller, and R. Zimprich. 1998. Effects of differing energy sources on performance of lactating sows. In Dickinson Research Extension Center, 47th Annual Livestock Research Roundup bulletin, pp. 9-15.

Landblom, D.G. and W.W. Poland. 1997. Nutritional value of raw and extruded field pea in starter diets of segregated early weaned pigs. In Dickinson Research Extension Center, 46th Annual Livestock Research Roundup bulletin, pp. 11-19.

Landblom, D.G. and W.W. Poland. 1997. Weanling pig response when naked oat and extruded field pea replaced corn and soybean meal in the diets of segregated early weaned pigs. In Dickinson Research Extension Center, 46th Annual Livestock Research Roundup bulletin, pp. 25-30.

Landblom, D.G. and W.W. Poland. 1997. Seasonal growth performance of barrows and gilts fed either soybean meal or Trapper field

pea with two levels of lysine. In Dickinson Research Extension Center, 46th Annual Livestock Research Roundup bulletin, pp. 31-37.

Landblom, D. and W. Poland. 1998. Supplementing grain energy sources with field peas and full-fat canola seed in swine growing-finishing diets. In Dickinson Research Extension Center, 47th Annual Livestock Research Roundup bulletin, pp. 16-27.

SAS. 1996. SAS User's Guide: Statistics. SAS Inst. Inc., Cary, NC.

[Back to 2001 Annual Report Index] [Back to Swine Reports]

[DREC Home] [Contact DREC] [Top of Page]
