THE EFFECT OF SEASON ON RESPONSE OF GROWING-FINISHING PIGS TO DIETARY FAT LEVELS

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Summary

This experiment was conducted to examine the influence of season on the response of finishing pigs to practical levels of fat addition. A total of 378 pigs (average initial weight per trial ranging from 83 to 98 pounds) were utilized in four finishing trials conducted during time frames approximating the 4 seasons of the year. Groups of pigs were taken off trial as they reached market weight (230 pounds). There was no season x fat level interaction for any of the criteria measured. Therefore, it is concluded that season has essentially no effect on fat level response. Fat addition influenced average daily gain (ADG), resulting in significant ($P<.05$) linear and quadratic effects. Average daily feed intake (ADFI) and feed efficiency (F/G) responded linearly ($P<.05$) to fat additions to the finishing diet. The ADG and ADFI responses to fat additions were not affected by season. However, F/G was influenced by season. The pigs were more feed efficient during the warmer seasons of the year.

Introduction

It has been suggested that the growth rate and efficiency response of pigs to dietary fat supplementation is dependent on environmental temperature. In particular, some studies have demonstrated little or no response to dietary fat addition in an animal exposed to a cold environment. Heat is produced during the process of digestion aiding the animal in sustaining normal body temperature. This heat of digestion is referred to as the heat increment. Fat has a lower heat increment than protein or carbohydrate, thus, fat addition will reduce the overall heat increment of a diet. It has been postulated that a reduction in heat increment will be detrimental to the cold stressed animal, because of the increase in heat production required for maintenance of body temperature. However, other studies have demonstrated consistent response to fat addition independent of environmental temperature. Fat addition does decrease dietary heat increment, but it also increases the caloric density of the diet. By increasing the caloric density of the diet, fat addition may increase the efficiency of protein and carboyhdrate utilization by sparing their use in thermoregulatory processes. This should result in an improvement in efficiency and gain.

The objective of this study was to determine the influence of seasonal variation in environmental temperature on finishing pig response to dietary fat addition.

Procedure

This study consisted of four trials conducted during time periods corresponding to the 4 seasons of the year. The dates and environmental temperature data during each trial are given in table 1 and figure 1.

A total of 378 pigs were used. Average initial weights per trial ranged from a low of 83.4 lbs in the fall trial to a high of 97.7 lbs in the summer trial. Pigs were blocked by weight within each trial and randomly assigned to pens. Blocks were taken off trial as they reached an average weight of 230 lbs.

Criteria measured were average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G). Pigs received feed and water ad libitum. Feeders were checked twice daily, and feed was weighed out and added or weighed back and recorded as necessary. Individual pig weights were collected every 3 weeks until pigs reached 210 lb. Weights were taken weekly thereafter. Animal health was excellent throughout the trial period.

The compositions of the experimental diets are given in table 2. These diets were formulated to contain 14.6% crude protein and .68% lysine. Calculated metabolizable energy values for each diet are also given in table 2. All treatments were formulated to contain the same levels of calcium, phosphorus, and salt.

Animals were housed in 15 ft x 4 ft pens in a modified open-front facility with solid concrete floors. The open-front facility faced south. Each pen contained one single-hole, self-feeder.

Results and Discussion

This study was analyzed as a split plot design using season as the whole plot and fat levels as the subplot. Initial weight was used as a covariate because of the difference in initial weights across season. Means reported are corrected for initial weight.

The analysis showed no season x fat level interaction for any of the criteria measured. The response to fat addition was consistent across seasons (see Tables 3-5). This indicates the response to fat addition is not dependent on seasonal temperature variation. Since there were no significant interactions, the main effects of season and fat addition will be discussed separately.

There were no differences in ADG or ADFI as a result of season (Fig. 2 and 3; Table 6), although season did influence ($P<.01$) F/G (Fig. 4; Table 6). The analysis indicates a curvilinear response to season, resulting in an annual cyclic effect. Even though the ADFI response was not significant, it numerically set a trend observed in many other studies. Feed intake is generally expected to be higher in colder environments and lower in hot environments.

Fat addition resulted in significant effects on ADG, ADFI, and F/G. (Table 7; Figure 5, 6, and 7) The response was not different across seasons, although, the magnitude of response lessened going from hot to cold seasons. The ADG response peaked at 3.0% added fat, with no further benefit realized beyond this point. The lack of continued increases in ADG beyond the 3.0% fat level might have been the result of decreasing daily amino acid intake. The NRC lists the daily lysine requirement for finishing hogs as 17.1 grams lysine/day. At the 3.0% fat level, pigs were consuming 18.1 grams lysine/day, whereas pigs receiving the diet containing 5% added fat were consuming 16.4 grams lysine/day.

Average daily feed intake and F/G both showed linear responses. Average daily feed intake continued to decline across the entire range of fat addition, decreasing approximately 1% for each 1% of fat addition. Similarly, F/G continued to improve with each increase in fat level. Feed efficiency was improved roughly 2% for each 1% of fat addition.

The linear decrease in ADFI, noted in this study, is similar to that of other studies demonstrating an inverse relationship between ADFI and energy density of the diet. In this regard, the pig has been shown to regulate its intake to meet its energy needs.

The linear improvement in F/G as a result of fat addition has also been shown by other researchers. However, the response to fat addition in cold environments has been inconsistent. Many studies in which a response to fat addition was not noted were conducted in artificially controlled environmental chambers. It may be that natural seasonal conditions and fluctuations cannot be acurately reproduced by these chambers. Seasonal acclimation is also difficult to duplicate in an environmental chamber.

The results of this study indicate that thereponse of the finishing pig to dietary fat additions is essentially unaltered by season.

Table 1. Beginning and Ending Dates of Each Trial

Season	Date	
	Begin	End
Spring	4-17-86	7-10-86
Summer	7-10-86	9-22-86
Fall	9-25-86	12-23-86
Winter	12-30-86	3-30-87

Table 2. Composition of Experimental Diets

Ingredients lb/ton	Fat Addition, %					
	0	1.0	2.0	3.0	4.0	5.0
Ground milo	1587	1562	1537	1512	1487	1462
Soybean meal (44%)	365	365	365	365	365	365
Choice white grease (4-80)[a]	0	25	50	75	100	125
Dicalcium phosphate	20	20	20	20	20	20
Limestone	16	16	16	16	16	16
Salt	8	8	8	8	8	8
Trace mineral premix[b]	1	1	1	1	1	1
Vitamin premix[c]	3	3	3	3	3	3
Metabolizable Energy[d] kcal/lb	1422	1442	1473	1498	1523	1549

[a]Dried fat product containing 4% protein and 80% choice white grease.

[b]Containing 5.5% Mn, 10% Fe, 1.1% Cu, 20% Zn, 0.15% I, and 0.1% Co.

[c]Each lb of premix contains the following:vitamin A 400,000 IU, Vitamin D 30,000 IU, vitamin E 2,000 IU, riboflavin 450 mg d-pantothenic acid 1,200 mg, choline 40 g, niacin 2,500 mg B_{12} 2.2 mg, menadione dymethylpyrimidinol bisulfite 250 mg.

[d]Calculated value; ground milo 1470 kcal/lb., soybean meal (44%) 1400 kcal/lb., choice white grease 3500 kcal/lb.

Table 3. Average Daily Gain by Season and Level of Fat Addition

Season	Unit	Fat Addition, %					
		0	1.0	2.0	3.0	4.0	5.0
Spring	lb	1.63	1.77	1.84	1.86	1.80	1.77
Summer	lb	1.93	1.94	1.96	1.88	2.03	2.07
Fall	lb	1.65	1.76	1.70	1.84	1.71	1.74
Winter	lb	1.75	1.74	1.73	1.82	1.74	1.79

Table 4. Average Daily Feed Intake by Season and Level of Fat Addition

Season	Unit	Fat Addition, %					
		0	1.0	2.0	3.0	4.0	5.0
Spring	lb	5.43	5.48	5.83	5.72	5.48	5.08
Summer	lb	5.57	5.19	4.80	5.81	5.28	5.15
Fall	lb	5.30	5.47	5.61	5.65	4.99	5.32
Winter	lb	6.49	6.09	5.96	6.34	5.72	5.74

Table 5. Feed Efficiency by Season and Level of Fat Addition

Spring	Fat Addition, %					
	0	1.0	2.0	3.0	4.0	5.0
Spring	3.27	3.07	3.15	3.06	3.02	2.85
Summer	2.89	2.66	2.46	2.77	2.60	2.48
Fall	3.15	3.20	3.22	3.05	2.90	3.01
Winter	3.72	3.51	3.44	3.49	3.29	3.20

Table 6. Effect of Season on Gain, Feed Intake, and Feed/Gain.

Item	Units	Spring	Summer	Fall	Winter
ADG	lb	1.78	2.00	1.73	1.76
ADFI	lb	5.50	5.30	5.43	6.05
F/G[1]		3.07	2.65	3.09	3.44

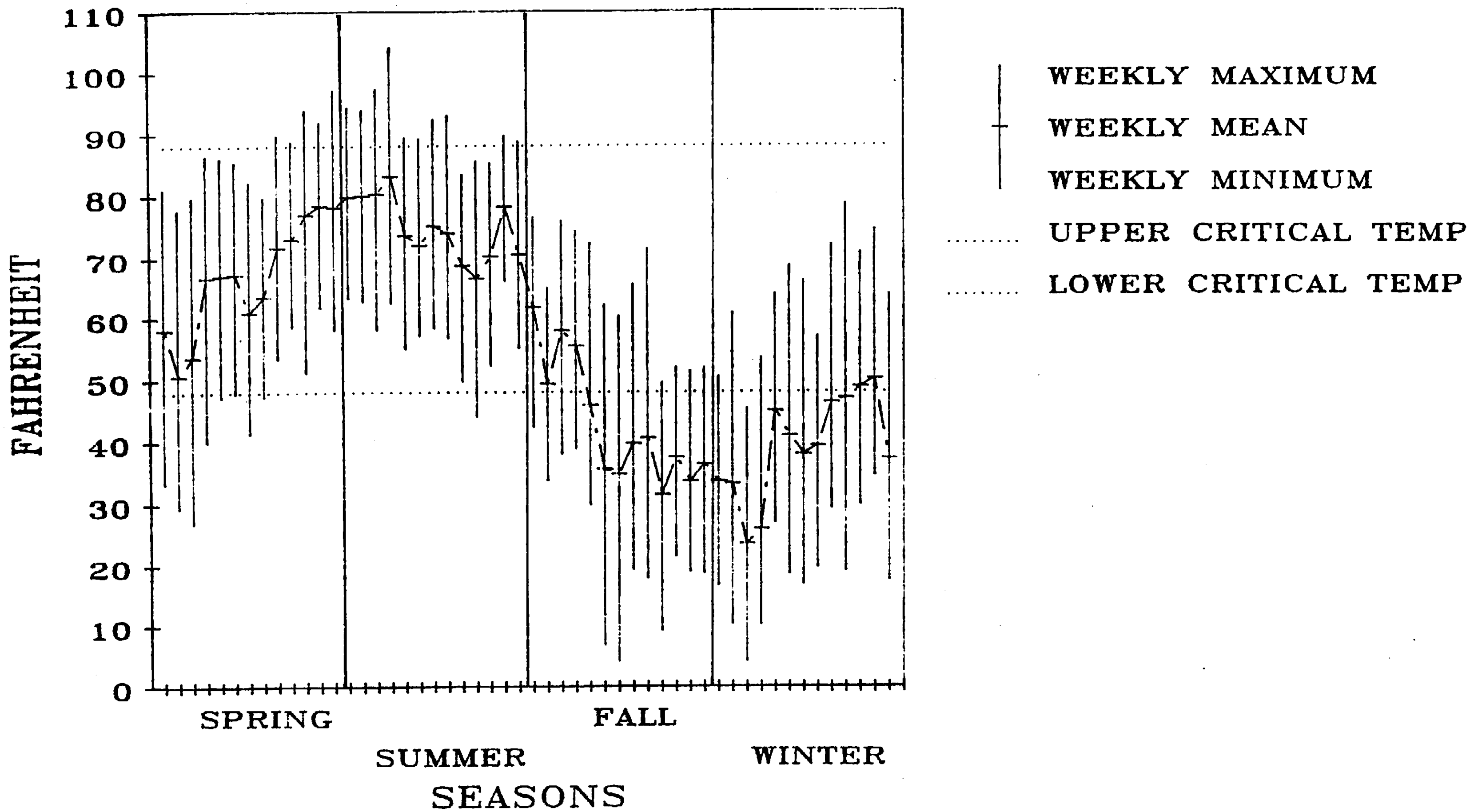
[1]Seasonal Effect P<.01.

Table 7. Effect of Fat Gain, Feed Intake, and Feed/Gain

Item	Units	% Fat Addition					
		0	1.0	2.0	3.0	4.0	5.0
ADG[1]	lb	1.74	1.80	1.81	1.90	1.82	1.84
ADFI[2]	lb	5.70	5.63	5.54	5.87	5.37	5.32
F/G[1]		3.25	3.11	3.07	3.09	2.95	2.89

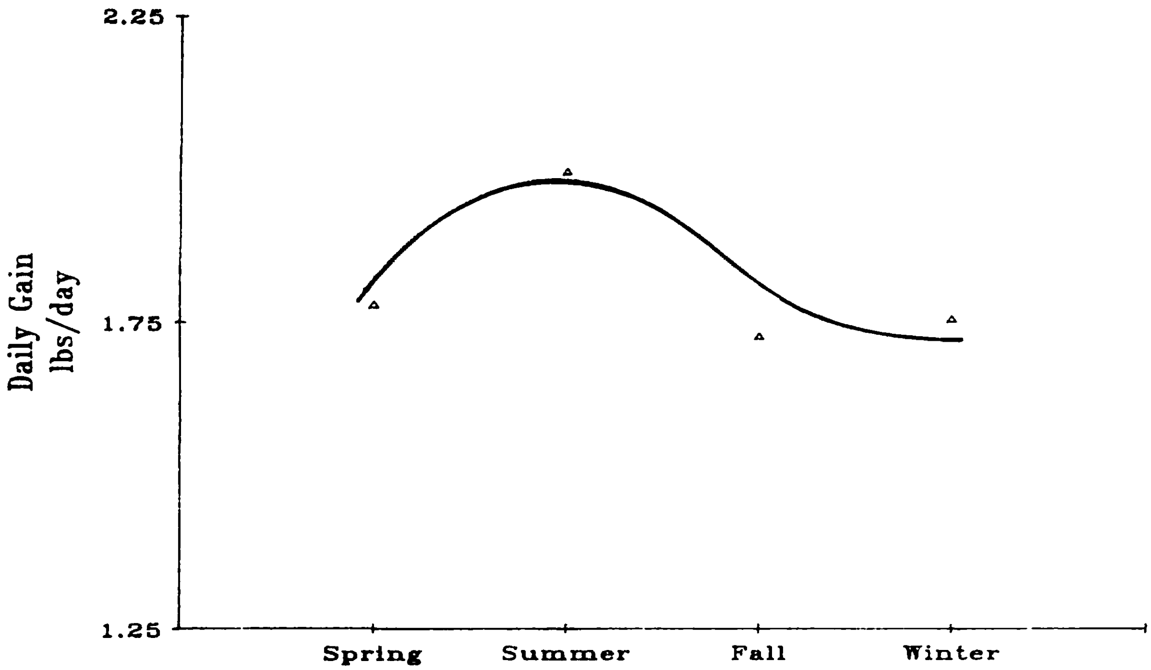
[1]Fat Effect P<.01.
[2]Fat Effect P=.02.

SEASONAL TEMPERATURE VARIATION
WEEKLY MAXIMUM, MINIMUM AND MEAN
Fig. 1

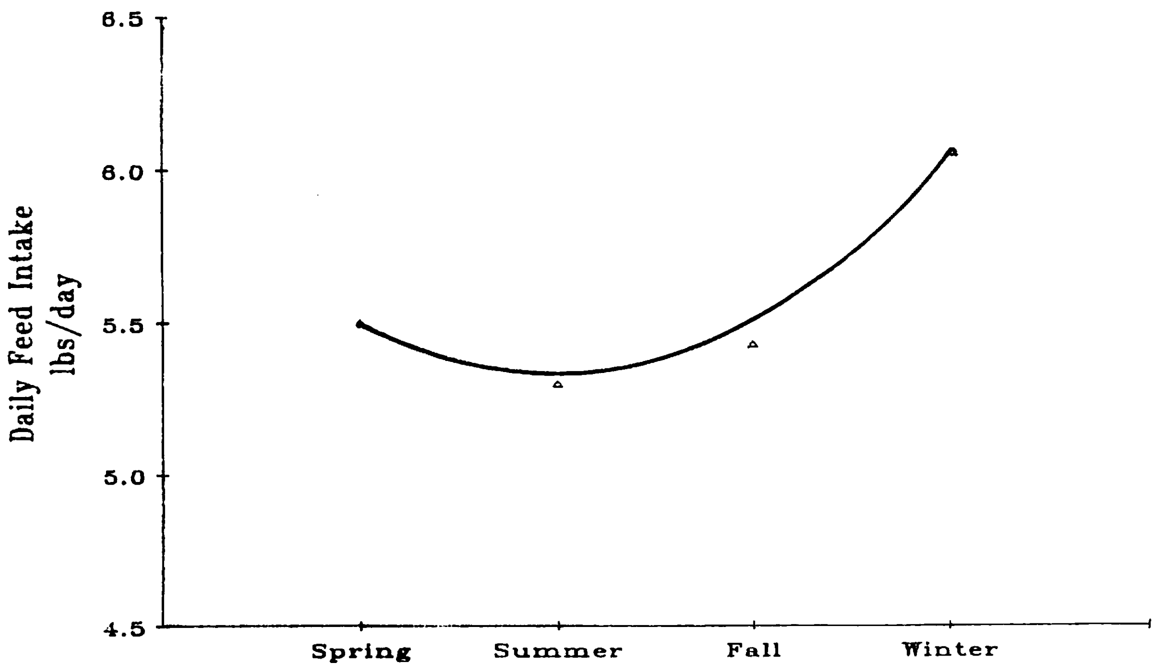


UPPER CRITICAL TEMP 88 F; LOWER CRITICAL TEMP 48 F

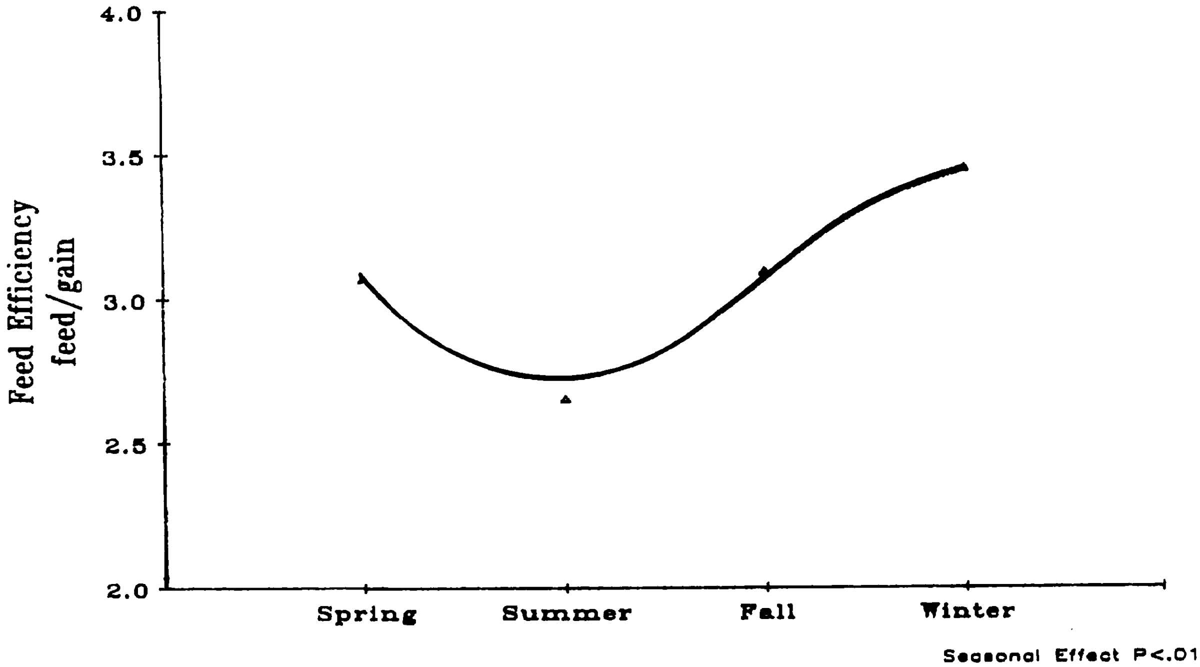
EFFECT OF SEASON ON
AVERAGE DAILY GAIN
Fig. 2



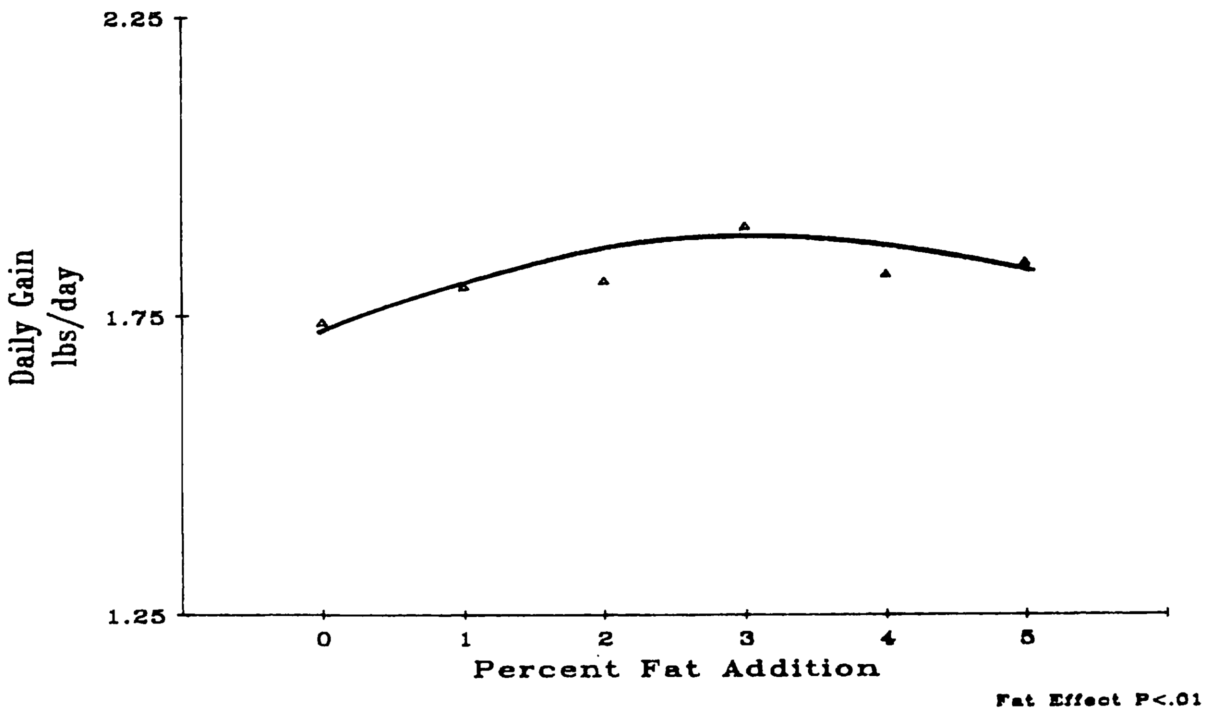
EFFECT OF SEASON ON
AVERAGE DAILY FEED INTAKE
Fig. 3



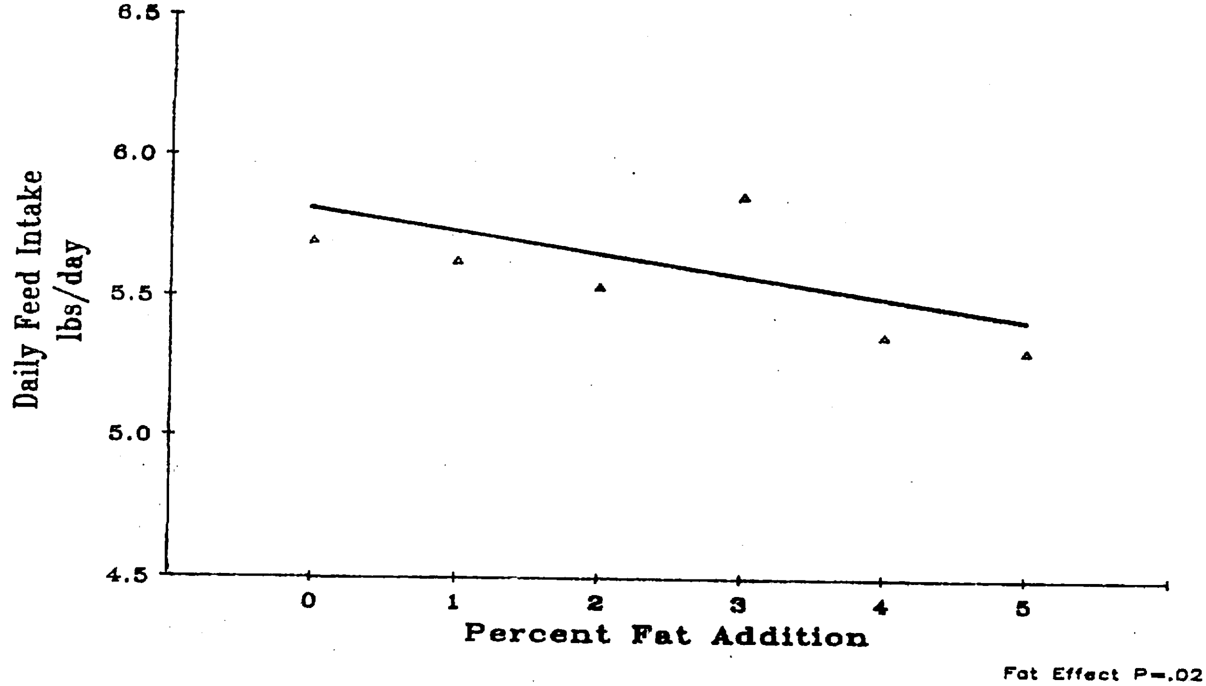
EFFECT OF SEASON ON FEED EFFICIENCY
Fig. 4



EFFECT OF FAT ON AVERAGE DAILY GAIN
Fig. 5



EFFECT OF FAT ON
AVERAGE DAILY FEED INTAKE
Fig. 6



EFFECT OF FAT ON
FEED EFFICIENCY
Fig. 7